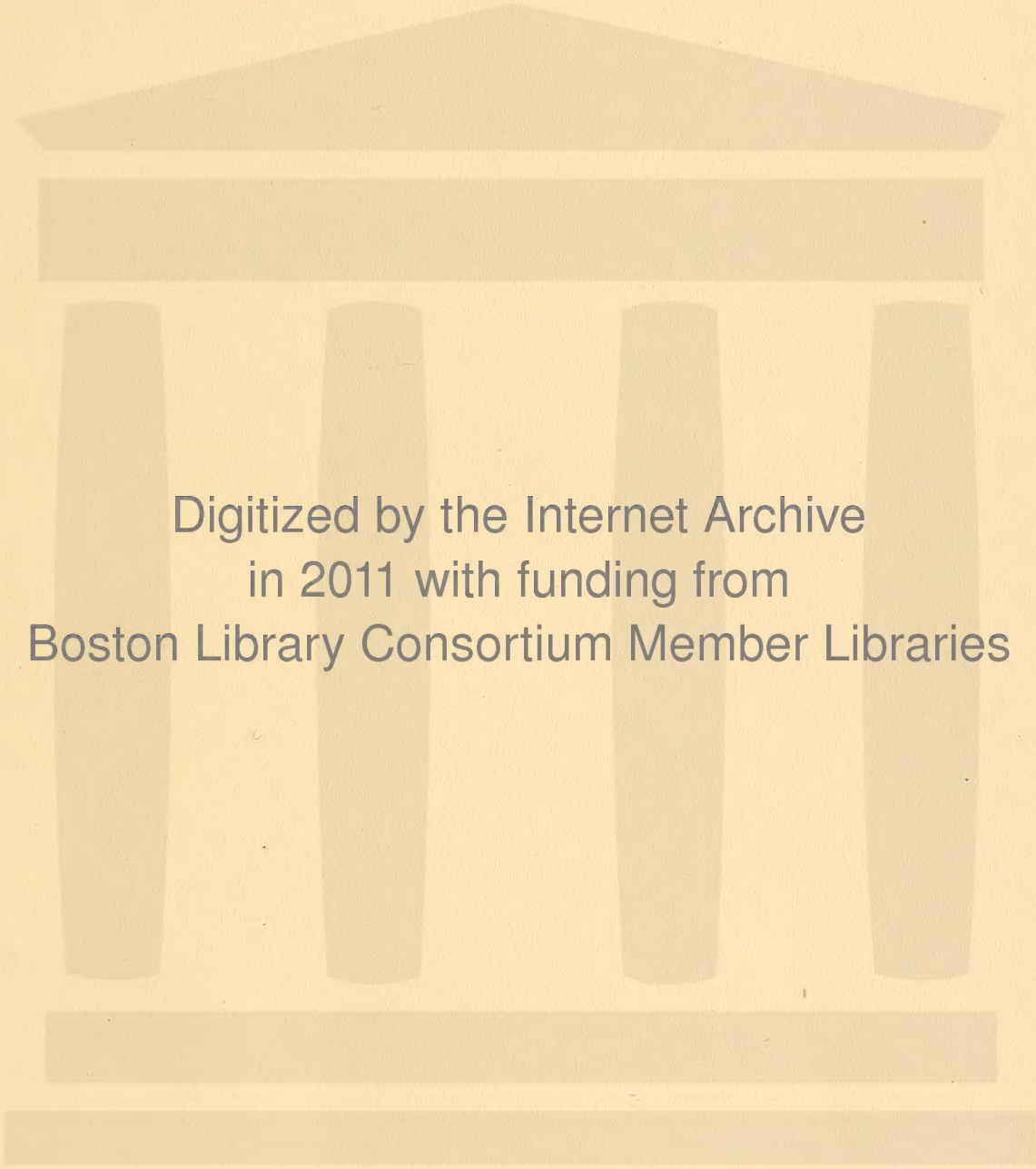


Digitized by the Internet Archive
in 2011 with funding from
Boston Library Consortium Member Libraries

http://www.archive.org/details/westernelectrici31chic

621.3
W52

WESTERN ELECTRICIAN

MASS. INSTITUTE OF TECHNOLOGY
JUL 17 1903
LIBRARY

EVERY SATURDAY.

VOLUME XXXI.

NUMBERS 1—26.

July 5—December 27, 1902.

ELECTRICIAN PUBLISHING COMPANY,
CHICAGO.

INDEX.

[In this Index subjects, titles and authors' names are all included, for convenience, in one alphabetically arranged list. Where necessary, articles are indexed under two or more headings. Often the Index is consulted by persons who have only a vague inkling of the title or nature of the article sought. In such case a search under every heading that might relate to the subject should be made.]

A

Abel, Sir Frederick, Death of 193
Abbott, W. L. (Coal Deposits of the United States). 280, 281
Acceleration Tests, Comparative, with Steam Locomotive and Electric Motor Cars. By B. J. Arnold and W. B. Potter. Illustrated. (American Institute of Electrical Engineers) 10, 11
Accuracy of the Zero in a Dynamophone 24
Advantages of Association for Small Electric-light Companies 70
Advertise, Trusts Must 351
Aeronaut Falls on a Trolley Wire 177
Africa, Exports to. (Editorial) 192
African Power Plant, Proposed 95
Agriculture, Electricity in 106, 282
Akouphone for Royalty 142
Alaska, Signal Corps' Operations in 352, 353
Alaska, Telegraphic Communication with 139
Alcohol Engine, Petrol or, Dynamo Set with. Illustrated 441
Allgemeine-Union Combination in Germany 470
Allis-Chalmers' Company's Boiler (Sederholm).. Illustrated 371
Allis Engines in Glasgow, Performance of the. (Editorial) 192
Alternating-current Circuits, Effect of Electrolytic Condensers in. By A. Trowbridge and E. R. Wolcott. (American Association for the Advancement of Science) 68
Alternating-current Lines, Transposition of 107
Alternating-current, Long-distance, and Hydrodynamic Phenomena Compared. By Henry T. Eddy, (American Association for the Advancement of Science) 25
Alternating-current Motor, Development of a Small. By H. I. Finch. Illustrated. (Chicago Electrical Association) 342, 343
Alternating-current Railway Systems. By Frank C. Perkins. Illustrated 208, 209, 232, 233, 250, 251
Alternating-current Railway System, Potter. Illustrated 344, 469
Alternating-current Railway, Washington, Baltimore and Annapolis. Illustrated 142, 143, 169
Alternating-current System, New Stanley-Kelly. Illustrated 345, 346
Alternating-current System of Distribution, Steinmetz. Illustrated 362
Alternating Current, The, for Heavy Railroad Work. 367
Alternators, Compounding, Steinmetz Method of. Illustrated 349
Alternators, Paralleling of, Requirements for the. By Henry E. Longwell. (Engine Builders' Association of the United States) 11, 12
American Association for the Advancement of Science. (Annual meeting in Pittsburg, June 27-July 3, 1902.) Illustrated 7, 21, 23, 24, 68, 152
American Association for the Advancement of Science. (Meeting in Washington, D. C., December 27, 1902, to January 3, 1903) 425, 461
American Electric Telephone Company's Traction or Mine Telephone. Illustrated 315
American Electrochemical Society. (Convention at Niagara Falls, September 15-18, 1902) 192, 193, 211, 213, 214, 325, 370, 371
American Electrotherapeutic Association. (Convention at Kaaterskill, N. Y., September 2-4, 1902) 174, 177
American Exhibition in London. (Editorial) 38
American Falls (Idaho) Power Plant 60
American Institute of Electrical Engineers. (Meetings and papers) 10, 11, 18, 19, 20, 44, 96, 110, 111, 235, 238, 239, 240, 255, 308, 312, 313, 330, 331, 371, 380, 381, 403, 404, 405, 406, 432, 433, 458, 463, 464, 465
American Institute of Electrical Engineers. (Editorial) 328, 384
American Institute of Electrical Engineers, Proposed Developments of the. By Charles F. Scott. (American Institute of Electrical Engineers) 330, 331
America, Municipal Trading in. By Robert P. Porter 61
American Pacific Cable Landed at San Francisco 447
American Roentgen Ray Society. (Annual meeting in Chicago, December 9-11, 1902) 425
American Physical Society 461
American Society of Mechanical Engineers. (Meeting in New York, December 2-4, 1902) 403, 420
American Street Railway Association. (Convention in Detroit, October 8-10, 1902.) Illustrated 119, 142, 194, 234, 235, 245, 246, 247, 248, 249, 250, 254, 257, 258, 259, 260, 261, 262, 273, 274, 278, 279, 281, 282, 309
American Telephone and Telegraph Company, Affairs of the 160
American Union Electric Company 111
Anæsthesia in Dental Surgery, Electrical. Illustrated 191
Andrews' "Handbook for Street-railway Engineers." (Book Table) 21
Animal Growth, Electricity and 447
Anthracite-coal Strike, Settlement of the. (Editorial) 274
Appleton, Wis., The Old and the New in 299
Applied Electricity, The Advance in 312
Arbitration of Street-railway Wage Questions in Chicago 79, 158, 169, 174, 216, 351
Arc Lamp, Enclosed, Globe Direct-current. Illustrated 468
Arc, Electric, Novel Use of the, in Prussia 60
Arc Electrodes, Improved Composite 161
Arc Lighting, Alternating-current Series. (Ohio Electric Light Association) 293, 294
Arc Regulator, G. I. Automatic. Illustrated 179
Arc, The Speaking, and Wireless Telephony. By Ernst Ruhmer. Illustrated. (Communication) 53
Arcophone, The, or Speaking Arc Lamp. By G. K. Smith and R. A. L. Snyder. Illustrated. (Engineer's Society of Western Pennsylvania) 208
Argentina, Engineering in 333, 334
Arizona Power Plant, Mrs. Tutt's Proposed 39
Arizona, Waterpower Possibilities in 39, 73
"Armature Windings of Direct-current Dynamos." By E. Arnold. (Book Table) 452
Armour Institute Evening Classes 197
Armour Institute, Machinery Hall of. Illustrated. 341, 342
Armstrong-Orling System of Wireless Telegraphy 79
Army and Navy Maneuvers 155, 194, 195
Arnold, B. J. (Comparative Acceleration Tests with Steam Locomotive and Electric Motor Cars. Illustrated 10, 11
Arnold, Bion J., Consulting Street-railway Engineer for City of Chicago. Portrait 271
Arnold's "Armature Windings of Direct-current Dynamos." (Book Table) 452
Arnold's Electro-pneumatic (Single-phase) Railway System 20, 234, 367
Association of Edison Illuminating Companies. (Annual meeting in the White Mountains, September 9-11, 1902) 60, 155, 176, 189, 190, 192, 197, 199, 200, 280, 281, 385, 386, 400, 401
Association of Railway Telegraph Superintendents. (Discussion on the Use of the Telephone in Operating Railroad Trains. Illustrated) 4, 5, 27, 28, 41, 42
Astor, Col. J. J., Gives His Marine Turbine Patents to the World 370
Asymmetrical-current Device for Telegraph Circuits, Pupin's. Illustrated 344, 345
Athens County's Record 396
Atkinson's Cable Code for General Public 316
Atlanta, Large Hydro-electric Development Near 365
Atlantic, Marconi Sends Messages Across the, Successfully 468
Atlantic, Telegraphing Through Space Across the 347
Atmospheric Products Company of Niagara Falls. Illustrated 252, 253
Auditorium Electric-lighting Plant, Development of the. Illustrated 51, 52, 56
August, 1902, Electrical Exports in 245
Aurora, Elgin and Chicago Electric Railway. Illustrated 106, 107, 142, 417, 418, 419
Automatic Central Exchange for Chicago 140, 178, 210
Automatic Circuit-interrupter on Overhead Wires. Illustrated 442
Automatic Exchange, Dayton's 396
Automatic Interrupter, Schneider's New. Illustrated 308
Automatic Photographic Detector for Passenger Cars. Illustrated 327
Automatic Rural Mail Carrier 20
Automatic Selective System for Space Telegraphy. Illustrated 123
Automatic Smokeless Stoker, Peerless. Illustrated 298
Automatic Telephone Patents, Bell Company's 236
Automatic Telephone System, Strowger. Illustrated. 156, 157
Automobile Equipments, Westinghouse Electric. Illustrated 12
Automobile, Electric, Brightening Prospects for the. (Editorial) 22
Automobile, Edison, to Be Tested 159
Automobile, Krieger Electric. Illustrated 173
Automobile Regulations in Chicago 11
Automobiles. (Notes) 48, 99, 130, 162, 203, 243, 285, 302, 455
Automobilism, Electricity as a Factor in 188

B

Baird Dry-battery Gauge. Illustrated 179
Baltimore and Ohio Tunnel, Storage Battery for Operation of 408
Baltimore and Ohio Tunnel, Third-rail System in the. Illustrated 139
Bandy, George N. Portrait 395
Barnard, B. S. Portrait 11
Barnes, Mr., of Rochester, and His Electrical Comforts 442
Battery Gauge, Baird. Illustrated 179
Battery Plates and Dinner Plates 299
Battery, The Coal. By Hugo Jone 324, 325
Bauer's "Magnetic Declination Tables." (Book Table) 470
Bay Counties Power Company, Progress of the 107, 240
Bechtel, E. J. (Methods of Increasing Central-station Business and Improving Load Curves) 294, 295
Belgian Blast Furnaces, Electrical Equipment in. By Frank C. Perkins. Illustrated 101, 102, 103
Belgium and England, Telephone Service Between 298
Bell and Independent Companies, Relation of the, Interstate Telephone Association's Action on the 426
Bell Company's Automatic Telephone Patents 236
Bell Telephone Output 41, 108, 213, 278, 351, 431
Bell's "Electric Power Transmission." (Book Table.) 73
Belted Motors, Independent, in Chicago Printing Plant. Illustrated 269, 270
Benefit Associations. (American Street Railway Association) 259
Bennett, Frank I. Portrait 271
Bennett, Frank I. (The Street-railway Problem in Chicago) 270, 271, 272
Berlin, Space Telegraphy Congress at 234, 311
Berlin, The Telephone System of 314
Berlin-Zossen High-speed Trials 106, 349
Besly Badger Grease Cup. Illustrated 42
Besly & Co.'s Motor-driven Grinder. Illustrated 334
Blackwell, F. O. (Continuous-current Motors for Machine Tools) 405, 406
Blast-furnace Gases for Factory Power Plant 200
Blast Furnaces, Belgian, Electrical Equipment in. By Frank C. Perkins. Illustrated 101, 102, 103
Blasting Accident, Remarkable, at Niagara Falls 331
Boiler Cleaner, Garrigus Mechanical. Illustrated 42
Boiler Explosion, Bad 407
Boiler, The Sederholm (Allis-Chalmers). Illustrated 371
Boilers, A "Scale Knocker" for. Illustrated 61
Boise-Payette Power Plant 73
Bolter's Sons', A., Iron-working Establishment, Induction Motors in. Illustrated 359, 360
Book Table 21, 73, 240, 336, 371, 386, 452, 470
Boone, Robert J. (Electric-light Apparatus Wanted in Marianna, Fla.) 215
Booster and Storage-battery Equipment of the Chicago City Railway. Illustrated 1
Boston Elevated Railway, Power Stations of the. Illustrated 105
Boston Traction Systems Inspected by Chicago Aldermen 87, 90
Bowie, A. J., Jr. (Proposed Electric Pumping for Stock Wells) 141
Boys, Electrical Books for. (Editorial) 274
Bradford, Admiral, on Space Telegraphy 195
Bradley and Lovejoy's Method of Fixing Atmospheric Nitrogen. Illustrated 252, 253
Brake Tests, Some, and Deductions Therefrom. By J. D. Keiley. Illustrated. With discussion. (American Institute of Electrical Engineers) 463, 464, 465
Braking and Traction Brakes. Illustrated. (Papers and discussion before the American Institute of Electrical Engineers) 463, 464, 465
Braking, Railroad Car. By R. A. Parke. Illustrated. With discussion. (American Institute of Electrical Engineers) 464, 465
Braun System of Space Telegraphy. By Emile Guarini. Illustrated 171, 172
Brazil, American Machinery in 325
Bremer Lamp, The. By Siegmund Saubermann. Illustrated. (Elektrotechnischer Verein of Vienna) 20, 21
Brett, Mrs. Annie McElroy, the Woman Telephone Operator of Texas 77
Bridge, Bascule, Over Chicago River, New Electrically Operated. Illustrated 187, 188, 189
Bridge, Electrically Operated, Out of Service 111
British Association, Annual Meeting of the, in Belfast 177, 193
British General Electric Company Manufacturing Carbons 126
British Government Telegraphs Inefficiently Administered. (Editorial) 90
British Government and the Electrical Engineers. (Editorial) 6
British Railway Switchboard, A Recent. Illustrated. 36
Brooks' Automatic Photographic Detector for Passenger Cars. Illustrated 327
Brooks, F. W. Portrait 225
Brooks, Howard. (Electrical Features of the Aurora, Elgin and Chicago Railway. Illustrated) 417, 418, 419
Brown, Boveri & Co.'s Electric Locomotive. Illustrated 54
Brown, Charles A., and George L. Cragg, Relations of 202, 215, 355
Buffalo Forge Company, Power Equipment of the 160
Buffalo Grain Elevator, New, Motor Equipment of a. Illustrated 67, 68
Buffalo, Independent Telephone Progress in 212
Buffalo, No Collect Messages in 237
Bullard and Rorty's Automatic Telephone Patents 236
Burdick, E. J. Portrait 225
Burnett, Douglass. (Distributed Lighting) 312
Business. (Notes) 15, 31, 49, 65, 83, 99, 115, 131, 147, 163, 185, 203, 204, 219, 244, 266, 285, 286, 303, 321, 339, 356, 375, 393, 413, 437, 455, 473
Busy-test System, Hulfish 332

C

Cable Code for General Public, Atkinson's 316
Cables Cut in Venezuelan and Haytian Waters 118
Cables, Submarine, The World's 158, 241
Caldwell, F. C. (A New Laboratory Switchboard Jack. Illustrated) 152
Caldwell's Laboratory Induction Coil. Illustrated 21
California, Another Great Power Project in 194
California Gas and Electric Corporation 240
California, Interesting Hydraulic Development in. 24
California, Northern, Consolidation of Lighting Interests in 240

Camlin, J. H. Portrait 397
Canada, Anti-American Tariff Agitation in. (Editorial) 310, 384
Canada Atlantic Railway Company's Telephone Line. 158
Canada, Municipal Street Railway in 433
Canadian Connection with Pacific Cable 73
Canadian Electrical Association. (Paper) 37
Canadian Imports. (Editorial) 384
Canadian Intelligence. (Correspondence) 13, 29, 46, 62, 80, 97, 112, 128, 144, 161, 217, 242, 282, 283, 336, 354, 410, 434, 471, 472
Canadian Niagara Power Plant, Progress on 123, 382, 383
Canadian Power Companies, Rival, at Niagara Falls. 20
Canadian Power Development at Niagara Falls. By Orrin E. Dunlap. Illustrated 382, 383
Canary Islands, Cable to the 440
C. & C. Shaft at Virginia City, Nev., Electrical Mine Equipment of the. By Leon M. Hall. Illustrated. 117, 118
Canfield, L. T. (Railroad Car Lighting) 95
Cape Breton, Marconi Towers at. Illustrated 67, 104
Cape Town, South Africa, Mountain Electric Railway at. Illustrated 346, 347
Carbons, British General Electric Company Manufacturing 126
Carey, Thomas. Portrait 271
Carhart, Henry S. (Revision of Physical Theory) 445, 446, 447
Carman Automatic Curtain Hoist. Illustrated 118
Carter, O. M. (Columbus, Buckeye Lake and Newark Electric Railway. Illustrated) 457, 458
Car Lighting, Railroad. By L. T. Canfield. (Master Car Builders' Association) 95
Car-lighting System, Combined Gas and Electric. Illustrated 53
Carlo Alberto, Space-telegraphic Experiments on the 39, 195, 245, 325, 347, 389
Carriage-call Annunciator, Edwards. Illustrated 180
Carriage Trade, Electric Railways Affect 169
Cars, Passenger, Automatic Photographic Detector for. Illustrated 327
Cascades at St. Louis Fair 346, 399
Castelli (Solari?) Receiver for Space Telephony. Illustrated 91
Ceco Electrical Machinery. Illustrated 262, 263, 264
Census Bulletin on Manufactures 401
Census Report on Electrical Apparatus and Supplies. 150, 151, 152
Central Association of Physics Teachers. (Meeting in Chicago, November 27-29, 1902) 403, 445, 446, 447
Central California Electric Company's Interesting Hydraulic Development 24
Central Electric Company's Catalogue 300
Central-service Plant for Dwelling Houses 241
Central-station Business, Methods of Increasing, and Improving Load Curves. By L. G. White, E. J. Bechtel and George Hayler, Jr. (Ohio Electric Light Association) 294, 295
Central-station Changes, Recent 95
Central-station Companies Should Join the National Electric Light Association. (Editorial) 210
Central-station Heating in Evanston 194, 216, 260
Central Station, Hot-water Heating from a. By E. H. McKnight. With discussion. (Ohio Electric Light Association) 318
Central-station Supply and Private Power, Relative Economy of. By M. B. R. 160
Central Telephone and Electric Company's Intercommunicating Telephones. Illustrated 297, 298
Charging Extra for Transformer When Wiring of Building Is by Another 7
Chattanooga Hustling for Street-railway Convention. 331
Chattahoochee River, Power Development on the 365
Checking Electrical Instruments. By Clayton H. Sharp. Illustrated. (Association of Edison Illuminating Companies) 298
Cheyenne, New Exchange for 298
Chicago, Arbitration of Street-railway Wage Questions in 79, 158, 169, 174, 216, 351
Chicago, Aurora and Elgin Electric Railway. Illustrated 106, 107, 142, 417, 418, 419
Chicago Automobile Regulations 11
Chicago, Automatic Central Exchange for 140, 178, 210
Chicago and Cincinnati, Boat and Electric-railway Connection Between 44
Chicago City Railway, Storage-battery and Booster Equipment of the. Illustrated 1
Chicago Conference of Independent Telephone Men 196
Chicago Edison Company Increases Capital Stock 421
Chicago Edison Company's Randolph Street Rotary Sub-station. Illustrated 377, 378, 379, 384
Chicago Electrical Association. (Meetings and papers) 255, 295, 316, 342, 343, 383, 417, 418, 419
Chicago, Electric-lighting Statistics of. (Editorial). 6
Chicago Elevated-railroad Improvements 61, 91, 361
Chicago Engineers' Club 403
Chicago, First Commercial Nernst Lamp Installation in 245
Chicago Flexible Shaft Company's Magnet-heating Furnace. Illustrated 408
Chicago, Independents Seek Toll-line Connection with 424, 430
Chicago Iron-working Establishment, Induction Motors in a. Illustrated 359, 360
Chicago, Local Organization of the Institute in 381, 403
Chicago, Municipal Ownership in, Aldermanic Argument for 450, 451, 470
Chicago, New Government Building in, Electrical Features of the 275, 346
Chicago, Overhead Wiring in 325
Chicago, Public Telephone Rate in, Reduced 93
Chicago Railroad Clearing Yards, Electrical Equipment of. Illustrated 133, 134, 135
Chicago River, New Electrically Operated Bascule Bridge over. Illustrated 187, 188, 189
Chicago Telephone Companies (Consolidating Companies) 197
Chicago, South Side Elevated of, Proposed Extensions of 61, 361
Chicago Street-railway Situation 12, 61, 74, 79, 87, 90, 270, 271, 272, 444, 450, 451
Chicago Telephone Company's Extensions 212, 350
Chicago, Telephone Tunnels in, Progress on the. Illustrated 205, 206, 207, 210, 315, 458, 459
Church Telephone Situation, The, at Washington, Ind. 77
Chicago, The Street-railway Problem in. By Frank I. Bennett. Portraits 270, 271, 272
Chicago Tribune Building, Electrical Equipment of 68
Chicago Typewriter Company's Telephone Holder. Illustrated 406
Chicago Union Traction Company's Annual Meeting. 61
Chicago, University of, Light, Heat and Power at the. Illustrated 33, 34, 35
Chicago, University of, Technology School for 470
Christensen Engineering Company Enters the Electrical Field. Illustrated 262, 263, 264
Cincinnati and Chicago, Boat and Electric-railway Connection Between 44
Cincinnati, Combination of Electric Railways Centering in 308
Cincinnati, Institute Branch in 458
Cincinnati-Toledo Electric Railway a Possibility 2
Circuit-breaker, Car, Westinghouse Automatic. Illustrated 126
Circuit-interrupter on Overhead Wires, Automatic. Illustrated 442
City Electricians Wanted, Two 461
Cleveland May Have Three-cent Fare 87, 121
Coal Battery, The. By Hugo Jone 324, 325
Coal Deposits of the United States. By W. L. Abbott. (Association of Edison Illuminating Companies) 280, 281
Coal Hoist Having Variable-speed Control, Electrically Operated. By P. O. Keilholtz. Illustrated. With discussion. (American Institute of Electrical Engineers) 381, 432, 433
Coal Mines, English, Electrical Apparatus in. Illustrated 291
Coal Strike, Settlement of the. (Editorial) 274
Coal, World's Production of, in 1901 334
Coho, H. B. (The Storage Battery as a Factor in Speed Control. Illustrated) 404, 405, 432, 433
Cole, H. K. Portrait 395
Coleman, E. M. Portrait 395
Collect Messages in Buffalo, No 237
Collins, A. Frederick, on Space Telegraphy. (New York Electrical Society) 468
Collins, A. Frederick. (The Seamy Side of Wireless Telegraphy) 94
Colorado and Wyoming, Telephone News from. (Correspondence) 315
Colorado, Independent Telephony in 256
Colorado River, Possible Power Developments on the 299
Colorado, Southern, Street-railway Consolidation Proposed 143
Columbus, Buckeye Lake and Newark Electric Railway. By O. M. Carter. Illustrated 457, 458
Compounding Alternators, Steinmetz Method of. Illustrated 349
Compound-wound Direct-current Generators, Steinmetz Method of Adjusting. Illustrated 362
Compressed-air Cars, Rome, May Be Abandoned in Favor of Electricity 52
Condensers, Electrolytic, in Alternating-current Circuits, Effect of. By A. Trowbridge and E. R. Wolcott. (American Association for the Advancement of Science) 68
Conductors and Motormen, Rules for 74
Conduits, Joint Use of. By Charles F. Hopewell. (International Association of Municipal Electricians) 277
Connector, Electric Train. Illustrated 214
Connery, Francis D. Portrait 271
Constancy of Magnets in Measuring Instruments. Illustrated 9
Continuous-current Motors for Machine Tools. By F. O. Blackwell. With discussion. (American Institute of Electrical Engineers) 405, 406, 432, 433
Contact, Third-rail, as Affected by Sleet and Ice. Illustrated 459
Cook Against Sterling Electric Company 389
Co-operation in Engineering. (Editorial) 444
Cooper's "Primary Batteries." (Book Table) 21
Copper Mining in Upper Michigan 416
Copper, Production of 160
Corbitt Printing Plant in Chicago, Independent Belted Motors in. Illustrated 269, 270
Coronation Illumination of English Fleet 121
Corporations, The Public and the 311
Correspondence Instruction. (Editorial) 56
Correspondence Schools in Electrical Education, Place of. By Harris C. Trow. With discussion. (Chicago Electrical Association) 316
Correspondence-school System for England 126
Corthell, E. L., on Engineering in Argentina 333, 334
Cost of Power, The. By M. J. Eichhorn. Illustrated. 69, 70, 88, 89
Cottage, The Electric. Illustrated 137
Cowles, Alfred H. (Units for Electrochemical Calculations) 325
Cragg, George L., and Charles A. Brown, Relations of 202, 215, 355
Crane, Jib, Large Electric 74
Crookes' World-starvation Theory Combated 179, 180
Cuba, European and American Trade Competition in. 407
Cuba, Electrical Trade with 241, 425
Cuba, Signal Corps' Operations in 353
Cuban Tariff, Amendments to 425
Curious Electrical Casualties 52
Curtain Hoist, Carman Automatic. Illustrated 118
Cuyahoga Telephone Company, Changes and Improvements in the 314

D

Daft and Williams' Marine Electric Signaling System 295
Dallas, Consolidation in 299
D. & W. 250-volt Plug Fuse. Illustrated 25
Davis, W. M., Telephone System of. Illustrated 466
Daylight, The Effect of, Upon the Propagation of Electromagnetic Impulses Over Long Distances. By G. Marconi. (Royal Society) 87
Day's Electrical Steering Gear. Illustrated 272
Dayton's Automatic Exchange 396
Deaf, Telephone Transmitter for the, Hutchinson. Illustrated 296
Decatur County, Ind., Farmers' Co-operative Telephone System in 298
De Courcy, A. (Metropolitan Railway System of Paris. Illustrated) 439, 440
De Courcy, A. (Milan-Gallarate Electric Railway. Illustrated) 323, 324, 325
De Forest, L. (Two Wireless-telegraph Messages Read Simultaneously) 111
De Forest-Smythe Wireless Telegraph. Illustrated. 39, 104, 111, 195, 468
Demand (Wright) and Electrolytic Meters, Improvements in. Illustrated 3
Dental Surgery, Electrical Anæsthesia in. Illustrated 191
Denver, Rate War in 38, 39
Depth of Submarine Cables 241
Des Moines City Railway, Power-plant Extensions for 126, 127
Des Moines Telephone Strike 26, 58, 109
Detroit, Electric Railways in and Around. Illustrated 221, 222, 223, 224, 225, 226, 227, 228
Detroit's Electric Railway System. (Editorial) 234
Detroit, Mich. (Correspondence) 319, 337, 355, 373, 391, 435, 453, 454, 471
Detroit, Possible Power Transmission from the "Soo" to 290
Detroit Telephone Situation 8, 109
Detroit United Railway. Illustrated 221, 222, 223, 224, 225, 226
Detroit United Railway, Interurban Lines of. Illustrated 226, 227
Detroit, Ypsilanti, Ann Arbor and Jackson Railway. Illustrated 227, 228
Dicke Lineman's Cart. Illustrated 180
Dickson, F. S. (Telephone Competition) 450
Direct-current Generators, Compound-wound, Steinmetz Method of Adjusting. Illustrated 362
Direct-current Instruments, New Weston. Illustrated 43
Direct-current Potential-changer, Thomson. Illustrated 349
Direct United States Cable Company's Report 123
Distributed Lighting. By Douglass Burnett. (American Institute of Electrical Engineers) 312
Distribution, Steinmetz Alternating-current System of. Illustrated 362
Distribution System of Steinmetz, Synchronous-motor. Illustrated 326, 327
Distribution System, Steinmetz Rotary-converter. Illustrated 290, 291
Divers' Operations, Electric Lights and Telephones for 211
Dortmund, Germany, Three-phase Pumping Installation at. By Frank C. Perkins. Illustrated 305, 306, 307
Drainage Canal, Waterpower Development on, below Joliet. Illustrated 43, 57, 72, 75, 85, 86, 87, 107, 123, 299, 353, 431
Dresser Night Light, Roche's. Illustrated 409
Drysdale, C. V. (Testing the Magnetic Qualities of Materials in Bulk. Illustrated) 190, 191
Ducretet Loud-speaking Telephone. Illustrated 449
Dunlap, Orrin E. (Canadian Power Development at Niagara Falls. Illustrated) 382, 383
Dunlap, Orrin E. (Progress on Power Plant No. 2 at Niagara Falls, N. Y. Illustrated) 149, 150, 151
Durability Tests of Storage Batteries 200
Düsseldorf Industrial and Trades Exposition. By Frank C. Perkins. Illustrated 17, 18
Duty of Electrical Companies in the Matter of Insulating High-potential Conductors. (Editorial). 22
Dwelling Houses, Central-service Plant for 241
Dynamophone, Accuracy of the Zero in a 24
Dynamo Set with Petrol or Alcohol Engine. Illustrated 441

E

Economical Turn-down Lamp. Illustrated 216
Edison Electric Meter. Illustrated 2
Edison Storage Battery 36, 159, 318
Eddy, H. C. (Length of the Heating Season) 91
Eddy, Henry T. (Long-distance Alternating-current and Hydrodynamic Phenomena Compared) 25
Edwards Carriage-call Annunciator. Illustrated 180
Edwardsville, Ill., Electric-light Affairs in 119
Ehret's Automatic Selective System for Space Telegraphy. Illustrated 123
Eichhorn, M. J. (The Cost of Power.) Illustrated. 69, 70, 88, 89
Eidmann, Henry F. Portrait 271
Electric Automobile, Brightening Prospects of the. (Editorial) 22
Electric and Gas Car-lighting System, Combined. Illustrated 53
Electric and Gas Lamp Renewals Compared 135
Electric Cottage, The. Illustrated 137
Electric Express and Package Delivery. By George W. Parker. Illustrated. (American Street Railway Association) 273
Electric Fire Pump in Rouen. Illustrated 363
Electric Furnaces, New. Illustrated. 103, 287, 288, 308, 424
Electric Goad for Cattle 75
"Electric" Headache Cure. (Editorial) 38
Electric Lighting. (Notes) 14, 30, 47, 48, 63, 64, 82, 98, 114, 130, 146, 162, 184, 202, 218, 243, 266, 284, 302, 320, 338, 355, 356, 374, 392, 412, 435, 436, 455, 472
Electric-lighting Statistics of Chicago. (Editorial). 6
Electric Lights and Telephones for Divers' Operations 211
Electric Lighting, Spectacular 365
Electric Motor Cars and Steam Locomotive, Comparative Acceleration Tests with. By B. J. Arnold and W. B. Potter. Illustrated. (American Institute of Electrical Engineers) 10, 11
Electric Motor, Effect of the Introduction of the, on Domestic Industries. (Editorial) 310
Electric Mountain Locomotive. Illustrated 54
Electric Persuader in Georgia, The 276, 277
Electric Power in Rolling Mills 307
"Electric Power Transmission." By Louis Bell. (Book Table) 73
Electric Pumping for Stock Wells, Proposed. By A. J. Bowie, Jr. (Pacific Coast Electric Transmission Association) 141
Electric Railways. (Notes) 14, 15, 30, 48, 64, 82, 98, 99, 114, 130, 146, 162, 184, 202, 203, 219, 243, 266, 284 285, 302, 320, 338, 356, 374, 392, 412, 436, 455, 472
Electric Railways Affect Carriage Trade 169
Electric Railways and Macadam Roads, Relation of. 228
Electric Railways, Freight Traffic on 180
Electric Railways in and Around Detroit. Illustrated 221, 222, 223, 224, 225, 226, 227, 228
Electric Railways, The Field for 336
Electric-railway Project, Big, Swedish Government Considering 334
Electric-railway Service, Sleeping Cars for 294
Electric-railway System, Sperry. Illustrated 469
Electric Space Telegraphy, The Progress of. By G. Marconi. Illustrated. (Royal Institution) 24, 25, 35, 36, 59, 60
Electric Specialty Company's Train Connector. Illustrated 214
Electric Storage Battery Company's Convention in Philadelphia, October 13-15, 1902 299
Electric Storage Battery Company 74
Electric Stove, Traveler's (Simplex). Illustrated 42
Electric Traction, Single-phase 179
Electric Variable Speed Control. Illustrated. (Papers and discussions before the American Institute of Electrical Engineers) 380, 381, 404, 405, 406, 432, 433
Electric-vehicle Equipments, Westinghouse. Illustrated 12
Electrical Anæsthesia in Dental Surgery. Illustrated 191
Electrical Apparatus and Supplies, Census Report on 150, 151, 152
Electrical Apparatus, Home-made. By D. E. Mann. (Communication.) 193
Electrical Casualties, Curious 52
"Electrical Catechism." (Book Table) 240
Electrical Education, Place of Correspondence Schools in. By Harris C. Trow. With discussion. (Chicago Electrical Association) 316
Electrical Engineering in Great Britain. (Editorial). 6
"Electrical Engineering Testing." By G. D. Aspinall Parr. (Book Table) 73
Electrical Engineering Course, The Ideal. By Charles P. Steinmetz. (American Institute of Electrical Engineers) 44
Electrical Equipment in Belgian Blast Furnaces. By Frank C. Perkins. Illustrated 101, 102, 103
Electrical Equipment of Chicago Railroad Clearing Yards. Illustrated 133, 134, 135
Electrical Features of the Aurora, Elgin and Chicago Railway. By Howard Brooks. Illustrated. (Chicago Electrical Association) 417, 418, 419
Electrical Instruments, Checking. By Clayton H. Sharp. Illustrated. (Association of Edison Illuminating Companies) 197
Electrical Manila. By R. G. Mayse. Illustrated 309
Electrical Manufacturing Companies, Possible Combinations of 74
Electrical Patents Granted by the United States. A Survey of. By Story B. Ladd. (Census Bulletin). 181, 182, 198, 214, 215
Electrical Plants, Gas-power Development for 367
Electrical Protection for Government Vaults 442

59011

Electrical Rhetoric in Nevada 409
Electrical Securities. (Notes) 48, 82, 114, 162
Electrical Workers' Strikes 155, 176
Electrically Operated Bascule Bridge Over Chicago River, New. Illustrated 187, 188, 189
Electrician Killed, but the Plant Continued to Operate 109
Electricity, Applied, The Advance in 312
Electricity and Animal Growth 447
"Electricity and Its Similitudes." By Charles H. Tyndall. (Book Table) 386
Electricity as a Factor in Automobilism 188
Electricity Building at St. Louis Exposition. Illustrated 290, 382, 399
Electricity Displacing Gas as an Illuminating Agent. (Editorial) 210
Electricity, Seeing at a Distance by 364, 442
Electricity, Sheep Shearing by 235
Electricity, Steel Smelting by 79
Electrochemical Calculations. Units for. By Alfred H. Cowles. (American Electrochemical Society) 325
Electrochemical Paradox, An Apparent. By Carl Hering. (American Electrochemical Society) 211
Electrochemistry at the World's Fair, St. Louis. By W. E. Goldsborough. (American Electrochemical Society) 213, 214
Electrodes, Arc, Improved Composite 161
Electrolytic Condensers in Alternating-current Circuits, Effect of. By A. Trowbridge and E. R. Wolcott. (American Association for the Advancement of Science) 68
Electrolytic Meters, Wright Demand and, Improvements in. Illustrated 3
Electromagnetic Impulses Over Long Distances, The Effect of Daylight Upon the Propagation of. By G. Marconi. (Royal Society) 87
Electrometallurgy of Iron and Steel, Developments in. By Marcus Ruthenberg. (American Electrochemical Society) 370, 371
Electrostatic Wattmeter in Commercial Measurements. By Miles Walker. Illustrated. (American Institute of Electrical Engineers) 18, 19, 20
Electrotechnical Industry in Russia. By Thomas E. Heenan. (U. S. Consular Report) 159
Elektrotechnischer Verein of Vienna. (Paper) 20, 21
Electrotherapeutics at the St. Louis Exposition 174
"Elements of Electrical Engineering." By Tyson Sewell. (Book Table) 386
Elevated-railroad Improvements, Chicago 61, 91, 361
Elevated Railway, Boston, Power Stations of the. Illustrated 105
Elevated Railway, Liverpool, Improvements on 18
Elevator, Electric, of Great Magnitude Proposed 299
Elevator, Grain, New Buffalo, Motor Equipment of a. Illustrated 67, 68
Elevators, Electric. By Charles R. Pratt. (New York Electrical Society) 312
Energy Loss in Commercial Insulating Materials When Subjected to High-potential Stress. By Charles Edward Skinner. Illustrated. (American Institute of Electrical Engineers) 96, 110, 111
Engine Builders' Association of the United States. (Paper) 11, 12
Engine Builders' Association of the United States. (Annual meeting in New York on December 1 and 2, 1902) 425
Engine, Haberkorn Double-piston-valve. Illustrated. 215
Engine, Large, for London Metropolitan Railway 103
Engineering Building, New, at University of Michigan. Illustrated 168, 169
Engineer of the Twentieth Century, The. By Charles F. Scott. (Engineers' Club of Philadelphia) 451, 452
Engineers' Club of Philadelphia. (Paper) 451, 452
Engineers' Society of Western Pennsylvania. (Paper) 208
England and Belgium, Telephone Service Between 298
England, Correspondence-school System for 126
England, Electric Parcel Delivery in 318
England, Municipal Telephone Control in 256, 384, 408
English Coal Mines, Electrical Apparatus in. Illustrated 291
English Steam Roads to Be Electrically Operated 360
Erie Telephone System, Old, Broker's Estimate of the. 212
Etiquette, Professional, for Electrical Engineers. (Editorial) 348
Europe, Edison's New Storage Battery in 318
Evanston, Central-station Heating in 194, 216, 260
Evanston Electric Illuminating Company Purchased by Samuel Insull 95
Evansville, Ind., Evolution of Street Cars in. Illustrated 443
Evansville, Ind., Telephone Situation 124, 388, 399, 448, 466
Everett, Henry A. Portrait 225, 314, 355
Exports, A Year's Electrical 91
Exports and Imports. (Editorial) 72, 154, 192, 254, 328
Exports, Electrical 2, 91, 154, 155, 245, 254, 328, 329, 403
Exporters to Siam, Hints to 255
Exposition for the Far East, A Floating 173
Express and Package Delivery, Electric. By George W. Parker. Illustrated. (American Street Railway Association) 273
Express and Package Delivery in England 318

F

Fall Business Prospects 174, 175, 176
Fans, Electric Ceiling, Lubricated Bearing for, Weston Patent for, Sustained 42
Fare, Three-cent, Cleveland May Have 87, 121
Farmer, Thomas. Portrait 225
Farmers' Telephone System, Co-operative, in Indiana. 298
Far West, High-tension Work in the. By George H. Lukes. (Association of Edison Illuminating Companies) 199, 200
Far West, Telephone Progress in the. (Correspondence) 109, 140
Fast Run on Lake Shore Electric Railway 363
Fedden, S. E. (Steam Turbines) 125, 126
Federal Telephone Company, Affairs of the 314, 350
Fellow Servants, The Doctrine of. (Editorial) 106
Ferguson, L. A., A Well-deserved Compliment to. (Editorial) 192
Ferraris Monument and Award 54
Fessenden System of Space Telegraphy. Illustrated. 109, 120, 121, 420
Field (Marshall) & Co., Power, Lighting and Telephones for. Illustrated 165, 166, 167, 168
Filaments, Incandescent-lamp, Manufacture of, from Paper 161
Finch, H. L. (Development of a Small Alternating-current Motor. Illustrated) 342, 343
"Fireflies" on the Stage 17
Fire Pump in Rouen, Electric. Illustrated 363
Fish, President, F. P., Talks 93
Fish Story, An Electrical. (Editorial) 310
Flasher, Electric, in Interior Lighting 452
Floating Exposition for the Far East, A 173
Flour Mills, Magnetic Separators in 370
Foreman, Milton J. Portrait 271
"Forest Reserves," Government Report on. (Book Table) 336
Fort Wayne Electrostatic Ground-detector. Illustrated 280
Fort Wayne Men in Conference 95
Fort Worth Telephone Enterprise 236
Foster, W. E. (Signal Circuits) 369, 370
Fowler, George W. (A Series-parallel System of Speed Control. Illustrated) 404, 432, 433
France, Long-distance Electric-railway Project in 465
France, Mountain Streams in, Electric Power Possibilities of 334
Franklin Institute. (Paper) 197
Frazee, L. A. Portrait 395
Freight Handlers' Strike. (Editorial) 38
Freight Traffic on Electric Railways 180
French Smoke-preventing Device, Novel 12, 13
Frontage Consents for Street Railways. (Editorial). 384
Frontier Telephone Company of Buffalo, Work of the 212
Fry, John H. Portrait 235
Fuel Briquettes. (Editorial) 122
Fuel, Oil as, Government Report on 421
Fullerton, Irwin. Portrait 225
Furnaces, New Electric. Illustrated 103, 287, 288, 308, 424
Furnace, Stewart Magnet-heating. Illustrated 408
Fuse, Plug, D. & W. 250-volt. Illustrated 25

G

Galveston, Large Power Station in 367
Garrigus Mechanical Boiler Cleaner. Illustrated. 42
Gas and Electric Car-lighting System, Combined. Illustrated 53
Gas and Electric Lamp Renewals Compared 135
Gas Engines for the St. Louis Exposition, Large 425
Gas Engines Used for Electric Driving, Regulation of 292
Gas Engines. (Editorial) 154
Gas Explosions in Manholes. (Editorial) 407
Gas-engine Generating Set, Walrath. Illustrated 192
Gas Mains, Leakage from. (Editorial) 241
Gas, Natural 367
Gas-power Development for Electrical Plants. Illustrated 452
Gases, Ionization of. By George F. Stradling. (Franklin Institute) 334
Gear Wheels, Paper 442
Geary Street-railway Proposition in San Francisco. 2, 397
Geer, Henry Burus. (Queer Quirks of the Quad) 372
General Electric Company 61, 74
Generators, Ceco. Illustrated 262, 263, 264
Generators, Compound-wound Direct-current, Steinmetz Method of Adjusting. Illustrated 362
German Electrical Manufacturers. By Frank H. Mason. (United States Consular Report) 155
German Pherophon System. Illustrated 421
German War Maneuvers, Space Telegraphy at the 195
Germany, Allgemeine-Union Combination in 470
Germany at the St. Louis Exposition 192
Germany, The Situation in. (Editorial) 154, 402
Germany's Alarm at the Extension of American Trade. (Editorial) 122, 402
Germany's Electrical Trade with Russia 233
G. I. Automatic Arc Regulator. Illustrated 179
Gibboney, Robert H. Portrait 397
Girls as Telegraph Messengers 142, 173, 174, 241
Glass Factory to Be Electrically Equipped 79
Glasgow, Performance of the Allis Engines in. (Editorial) 192
Glidden, Mr., Telegraphs Around the World 349
Globe Direct-current Enclosed Arc Lamp. Illustrated 468
Goad, Electric, for Cattle 75
Goldsborough's, Prof., Work for the St. Louis Exposition. (Editorial) 174
Goldsborough, W. E. (Extent of the Universal Exposition of St. Louis in 1904. Illustrated) 382
Goldsborough, W. E. (Electrochemistry at the World's Fair) 213, 214
Government Building in Chicago, New, Electrical Features of the 275, 346
Government Vaults, Electrical Protection for 442
Government Telegraphs of Great Britain, Inefficient Operation of the. (Editorial) 90
Governor, New Replogle Waterwheel. Illustrated 60
Grade Crossings, Interlocking Switches at. (Editorial) 90
Grain Elevator, New Buffalo, Motor Equipment of a. Illustrated 67, 68
Grand Rapids, Grand Haven and Muskegon Railway. Illustrated 460, 461
Grease Cup, Besly Badger. Illustrated 42
Great Lakes, Wireless Telegraphy for the 54
Great Northern Underground Railroad in London 86
Greely, Gen., Annual Report of, as Chief Signal Officer of the United States Army 348, 352, 353, 366, 367, 387
Grinder, Gardner, Motor-driven (Besley & Co.). Illustrated 334
Ground-detector, Fort Wayne Electrostatic. Illustrated 280
Guarini, Emile. (Progress in Space Telegraphy. Illustrated) 170, 171, 172, 251
Gullot System of Train Lighting. Illustrated 362
Guayaquil, Bids for Lighting 443

H

Haberkorn Double-piston-valve Engine. Illustrated. 215
Haggin's Stock Farm in Kentucky, Elaborate Isolated Plant on 7
Hall, Leon M. (Electrical Mine Equipment of the C. & C. Shaft at Virginia City, Nev. Illustrated). 117, 118
Hamlin & Russel Lamp Guard. Illustrated 276
Hammer, Jackson Portable Electric. Illustrated 198, 199
"Handbook for Street-railway Engineers." By H. B. Andrews. (Book Table) 21
Harper, J. C. Portrait 395
Hawaii, Hydro-electric Irrigation in 149
Hawaii, Space Telegraphy to, Proposed. (Editorial) 22
Hawaiian Cable Shipped from London 216
Hayler, George, Jr. (Methods of Increasing Central-station Business and Improving Load Curves) 295
Haytian Cable, United States Navy to Protect 111, 118
Headlights, Electric 173
Heating, Central-station, in Evanston 194, 216, 260
Heating, Electrical, in the House of Mr. Barnes of Rochester 442
Heating, Hot-water, from a Central Station. By E. H. McKnight. With discussion. (Ohio Electric Light Association) 318
Heating Season, Length of the. By H. C. Eddy. (Communication) 91
Hedley, Frank, Appointed General Superintendent of New York Interborough Company. Portrait 465
Heenan, Thomas E. (Electrotechnical Industry in Russia) 159
Heinze's Magnetic Wheel for Railways. Illustrated. 255
Heraeus Electric Furnace. Illustrated 308
Hering, Carl. (An Apparent Electrochemical Paradox) 211
Herr, Henry S. (The Sliding Scale of Rates for the Telephone Company) 448
High-potential Power-transmission Circuits, Remarkable Accident Involving Telephone and 264
High-potential Stress, Energy Loss in Commercial Insulating Materials, When Subjected to. By Charles Edward Skinner. Illustrated. (American Institute of Electrical Engineers) 96, 110, 111
High-speed Electric Mail Delivery 200, 399
High-Speed Electric Railroading. (Editorial) 106
High-tension Circuits, Static Interrupter for. Illustrated 37
High-tension Work in the Far West. By George H. Lukes. (Association of Edison Illuminating Companies) 199, 200
Hoist, Coal, Having Variable-speed Control, Electrically Operated. By P. O. Keilholtz. Illustrated. With discussion. (American Institute of Electrical Engineers) 381, 432, 433
Holborn Electric Furnace. Illustrated 308
Homan's "Self-propelled Vehicles." (Book Table) 386
Home-made Electrical Apparatus. By D. E. Mann. (Communication) 193
Hook-switch, Stromberg-Carlson. Illustrated 449
Hopewell, Charles F. (Joint Use of Conduits) 277
Hoskins, William. (Large Electric Furnaces Near Penn Yan, N. Y. Illustrated) 287, 288
Hotel, San Francisco, Electric Equipment of a 443
Hot-water Heating from a Central Station. By E. H. McKnight. With discussion. (Ohio Electric Light Association) 318
Houses, Dwelling, Central-service Plant for 241
Howell's Composite Telephone and Telegraph System. Illustrated 108
How to Use the Telephone. Illustrated 314
Hudson River Road, Receiver for 275
Hudson River Valley, Power Transmission in the 79
Hudson Valley Railway Company's Strike 197, 216, 233, 324
Hulfish's Telephone Patents. Illustrated 332
Hull's Radiometric Receiver for Electric Waves 21
Hull, Charles E. Portraits 395, 422
Hutchins, J. C. Portrait 225
Hutchins, Jere C., President American Street Railway Association. Portrait 245
Hutchison's Akouphone in England 142
Hutchinson, A. L. Portrait 395
Hutchinson Telephone Transmitter for the Deaf. Illustrated 296
Hydro-electric Development, Central California Electric Company's 24
Hydrodynamic Phenomena and Long-distance Alternating-current Phenomena Compared. By Henry T. Eddy. (American Association for the Advancement of Science) 25
Hylo Lamp with Pendant Switch. Illustrated 407

I

Illinois Central Telephone Line. Illustrated 4, 5, 27, 76
Illinois Glass Company, Electrical Equipment of the 79
Illinois, Northern, Interurban Roads in 440
Illinois Telephone and Telegraph Company's Operations. Illustrated 140, 178, 205, 206, 207, 315
Illumination of English Fleet During Royal Review. 121
Illumination, Street, in San Francisco. Illustrated. 136
Incandescent Lamp Trade in the Netherlands 193
Incandescent-lamp Filaments, Manufacture of, from Paper 161
Incandescent Lamp as a Pyrometer, Use of 365
Independent Belted Motors in Chicago Printing Plant. Illustrated 269, 270
Independent Telephone Association of the United States. (Papers) 8, 77
Independent Telephone Men in Conference 196
Independent Telephone Movement in Ohio and Surrounding States 124
Independent Telephony, Needed Improvements in. By L. W. Stanton. (Independent Telephone Association of the United States) 8
Independents Seek Toll-line Connection with Chicago 424, 430
Indiana and Ohio, Railway Combinations in 308
Indiana Electrical Association. (First regular meeting in Indianapolis, September 17 and 18, 1902) 195, 207, 208
Indiana, Interurban Electric Railways in. With map 231, 232, 233
Indiana, Information from. (Correspondence) 14, 29, 47, 63, 81, 98, 113, 128, 129, 145, 161, 183, 201, 217, 218, 242, 265, 283, 301, 320, 337, 354, 373, 391, 410, 411, 435, 454, 471
Indiana Mutual Telephone Association. (Annual meeting in Indianapolis, October 14, 1902) 236, 296
Indiana, Southern, Telephone Situation in 448, 466
Indiana Telephone Toll-line Valuations 178
Indiana, Telephone Profits in 76
Indiana Telephone Items. (Correspondence) 9, 26, 40, 58, 77, 93, 109, 124, 140, 157, 158, 178, 196, 213, 237, 256, 278, 297, 315, 333, 351, 368, 431, 449, 466, 467
Indianapolis Interurban Terminal Question 111
Individual Electric Motors, The Operation of Machine Shops by. By R. T. E. Lozier. Illustrated. With discussion. (American Institute of Electrical Engineers) 380, 381
Induction Coil, A New Laboratory. Illustrated 21
Induction Motors in a Chicago Iron-working Establishment. Illustrated 359, 360
Induction Motors in a Wood-working Establishment. 409
Induction Motors, Steinmetz Starting Device for. Illustrated 421
Induction Regulator, Steinmetz Polyphase. Illustrated 326
Injudicious Superlative, The. (Editorial) 22
Injudicious Superlative, The. By T. J. Johnston. (Communication) 53
Institute, Proposed Developments of the. By Charles F. Scott. (American Institute of Electrical Engineers) 330, 331
Instruments, Electrical, Checking. By Clayton H. Sharp. Illustrated. (Association of Edison Illuminating Companies) 197
Instruments, Measuring, Magnets in. A Consideration of the Constancy of. Illustrated 9
Instruments, New Weston Direct-current. Illustrated 43
Insull, Samuel, Makes Central-station Purchases 95
Insulation, Clothed with, as with a Garment. (Editorial) 254
Insulating Materials, Commercial, Energy Loss in, When Subjected to High-potential Stress. By Charles Edward Skinner. Illustrated. (American Institute of Electrical Engineers) 96, 110, 111
Insulator, Third-rail, Manhattan. Illustrated 194
Interior Lighting, Electric Flasher in 452
Interlake Regatta, Mr. Warren's Wemco Wins. Illustrated 75
International Association of Municipal Electricians. (Convention in Richmond, Va., October 7-9, 1902) 176, 253, 276, 277
International Electrical Congress at St. Louis in 1904 Proposed. (Editorial) 444
International Telephone Company 237, 314
International Telephone Manufacturing Company's Apparatus at Saratoga, N. Y. Illustrated 5
International Tramways Congress and Exhibition in London 57
Interrupter, Circuit, Automatic, on Overhead Wires. Illustrated 442
Interurban Electric Railways in Ohio, Indiana and Michigan. With maps 228, 229, 230, 231, 232, 233
Interurban Electric Railways. (Editorial) 234
Interurban Road, Steamboat Connection with 317
Interurban System, Extensive, Proposed in Texas 299
Interurban Terminal Question, Indianapolis 111

Interrupter, Static, for High-tension Circuits. Illustrated 37
Interrupter, Schneider's New Automatic. Illustrated 308
Interstate Independent Telephone Association. (Convention in Chicago, December 9, 10 and 11, 1902.) Illustrated 196, 332, 388, 395, 396, 402, 422, 423, 424, 426, 427, 428, 429, 430, 448
Intramural Railway for St. Louis World's Fair, Electric 195, 211, 272
Ionization of Gases. By George F. Stradling. (Franklin Institute) 334
Iowa, Independent Telephone Consolidation Proposed in 109
Iron and Steel, Electrometallurgy of, Developments in. By Marcus Ruthenberg. (American Electrochemical Society) 370, 371
Iron-working Establishment, Chicago, Induction Motors in a. Illustrated 359, 360
Isolated Plant, Elaborate, on a Kentucky Farm 7
Italian Scheme for High-speed Mail Delivery 200, 399
Italy, Milan-Gallarate Electric Railway in. By A. De Courcy. Illustrated 323, 324, 325
Italy, Space Telegraphy in. By Emile Guarini 171, 172

J

Jack, Switchboard, A New Laboratory. By F. C. Caldwell. Illustrated. (American Association for the Advancement of Science) 152
Jackson, George W., on the Telephone Tunnels in Chicago. Illustrated 205, 206, 207, 458, 459
Jackson, William S. Portrait 271
Jamestown, N. Y., A Railway Franchise in 336
Jamestown, N. Y., Bell Telephone Extensions in and Near 296
Jamestown, N. Y., Independent Telephony in and Near 212
Jamestown, N. Y., Pole Question in. By T. S. Lane. (Communication) 40
Japan, Telegraph and Telephone Advancement in 314
Jenkins, Edward H., Death of 2
Jib Crane, Large Electric 74
"Jim Crow" Street-car Law in New Orleans. (Editorial) 348
Johnny's Poem on the Lightning 79
Johnston, T. J. (The Injudicious Superlative) 53
Joint Use of Conduits. By Charles F. Honewell. (International Association of Municipal Electricians) 277
Joliet, Drainage Canal Below, Waterpower Development on. Illustrated 43, 57, 72, 75, 85, 86, 87, 107, 123, 299, 353, 431
Jones, Fred A. (Selection of Street-railway Motor Equipment 45
Jone, Hugo. (The Coal Battery) 324, 325
Joplin, Mo., Telephone Matters in 157
July, 1902, Electrical Exports in 155
Juniper for Poles, Use of 264
Jury Regulations for St. Louis World's Fair 209

K

Kansas City, City Electrician Wanted in 461
Kansas City, Electrical Parade in 272
Kansas City Home Telephone Company 278
Kansas Independent Telephone Association. (Convention in Kansas City, September 11 and 12, 1902) 196
Kaiser, The, and Electric Cars. (Editorial) 174
Keiley, J. D. (Some Brake Tests and Deductions Therefrom. Illustrated) 463, 464, 465
Keilholtz, P. O. (Electrically Operated Coal Hoist Having Variable-speed Control. Illustrated) 381, 432, 433
Keller Electric Furnace. (Editorial) 424
Kelly-Stanley Alternating-current System, New. Illustrated 345, 346
Kelvin's, Lord, Opinion of Space Telegraphy 91
Kentucky and Other States, Telephone Statistics of. (Editorial) 348
Kentucky Farm, Elaborate Isolated Plant on a 7
Kentucky Telephone Association. (Annual Meeting in Louisville, October 28 and 29, 1902) 256, 333, 350
Kewanee, Ill., to Have Central-energy Telephone System 351
Krieger Electric Automobile. Illustrated 173

L

Laboratory Induction Coil, A New. Illustrated 21
Laboratory Switchboard Jack, A New. By F. C. Caldwell. Illustrated. (American Association for the Advancement of Science) 152
Ladd, Story B. (A Survey of Electrical Patents Granted by the United States) 181, 182, 198, 214, 215
Lake Shore Electric Railway, Fast Run on 363
Lamme, B. G. (Washington, Baltimore and Annapolis Single-phase Railway. Illustrated) 238, 239, 240
Lamp, Economical Turn-down. Illustrated 216
Lamp Guard, Hamlin & Russel. Illustrated 276
Lamp, Osmium, More About the 334
Lamp, Potter Mercury-vapor. Illustrated 153
Lamp Renewals, Gas and Electric, Compared 135
Lamp, Sterling Spiral-filament. Illustrated 127
Lamp, The Bremer. By Siegmund Saubermann. Illustrated. (Elektrotechnischer Verein of Vienna) 20, 21
Lamp with Pendant Switch, Hylo. Illustrated 407
Land Anchor, Miller. Illustrated 407
Lane, T. S. (Pole Question in Jamestown, N. Y.) 40
Langdon, W. (A Remarkable Lightning Flash. Illustrated) 70
Large Cars in City Streets. (Editorial) 56
Layne, John W. Portrait 395
League of American Municipalities, National Electric Light Association and the 216
Legal Contest over Permanency of Electric-power Supply 365
Legal Status of Submarine Cables. (Editorial) 210
Leonard, H. Ward. (Multiple-unit Voltage Speed Control for Trunk-line Service. Illustrated) 405, 432, 433
Light Distribution, A Portable Photometer for Measuring 21
Light, Heat and Power at the University of Chicago. Illustrated 33, 34, 35
Light, Railway and Power Plant, An Interesting Swiss. Illustrated 415, 416
Light, Waves of, An Instrument Wanted to Transmit the Impulses of. (Editorial) 364
Lighting and Power for Marshall Field & Co. Illustrated 165, 166, 167, 168
Lighting, Distributed. By Douglass Burnett. (American Institute of Electrical Engineers) 312
Lighting, Interior, Electric Flasher in 452
Lighting Effects at St. Louis Exposition 382, 399
Lighting, Railroad Car. By L. T. Canfield. (Master Car Builders' Association) 95
Lighting, Spectacular Electric 365
Lightning Flash, A Remarkable. By W. Langdon. Illustrated 70
Lightning, Johnny's Poem on the 79
Lightning Phenomena, Remarkable 142
Lightning Takes an Unexpected Path 52
Lineman's Cart, Dicke. Illustrated 180
Lion, Why the, Roared. (Editorial) 384
Liverpool Elevated Railway, Improvements on 18
Load Curves, Improving, Methods of Increasing Central-station Business and. By L. G. White, E. J. Bechtel and George Hayler, Jr. (Ohio Electric Light Association) 294, 295
Locomotive, Electric Mountain. Illustrated 54
Locomotive, Steam, and Electric Motor Cars, Comparative Acceleration Tests with. By B. J. Arnold and W. B. Potter. Illustrated. (American Institute of Electrical Engineers) 10, 11
Locomotives, Electric Mining 172
London, Great Northern Underground Railroad in 86
London, International Tramways Congress and Exhibition in 57
London Metropolitan Railway Power Plant 103, 142
London Underground Roads, Power Plant for 353
London, Yerkes-Morgan Railway Contest in 55, 95, 160, 327, 443
Long-distance Alternating-current and Hydrodynamic Phenomena Compared. By Henry T. Eddy. (American Association for the Advancement of Science) 25
Long-distance Telephone Business, Is the, Unprofitable? (Editorial) 138
Long-distance Telephony, Improvements in. Illustrated 92
Long-distance Power Transmission, Success in. By F. A. C. Perrine. (Society of Arts) 78, 79
Long-distance Telephone Reporting 406
Long-distance Transmission for Montreal 421
Long-distance Wireless Tests Over Land by Marconi 39, 122, 195, 311
Long Telephone Spans 212
Longwell, Henry E. (Requirements for the Paralleling of Alternators) 11, 12
Los Angeles, Bell Activity in 448
Loud-speaking Telephone, Ducretet. Illustrated 449
Lovejoy and Bradley's Method of Fixing Atmospheric Nitrogen. Illustrated 252, 253
Lozier, R. T. E. (The Operation of Machine Shops by Individual Electric Motors. Illustrated) 380, 381, 432, 433
Lukes, George H. (High-tension Work in the Far West) 199, 200
Lumpkin, I. A. Portrait 395

M

McConnell, E. P., Death of 93
McCue's Apparatus for Electrical Anæsthesia in Dental Surgery. Illustrated 191
McKnight, E. H. (Hot-water Heating from a Central Station) 318
Macadam Roads and Electric Railways, Relation of. 228
Mackay, John W., Death of. Portrait 53
Mackay, John W., In Memory of 71
Machine Shops, The Operation of, by Individual Electric Motors. By R. T. E. Lozier. Illustrated. With discussion. (American Institute of Electrical Engineers) 380, 381, 432, 433
Machine Tools, Continuous-current Motors for. By F. O. Blackwell. With discussion. (American Institute of Electrical Engineers) 405, 406, 432, 433
Machinery Hall of Armour Institute. Illustrated. 341, 342
Madeiras, A Telephone System Needed in the 256
Magnets in Measuring Instruments, A Consideration of the Constancy of. Illustrated 9
"Magnetic Declination Tables." By L. A. Bauer. (Book Table) 470
Magnetic Experiments on Metals 89
Magnetic Qualities of Materials in Bulk, Testing the. By C. V. Drysdale. Illustrated 190, 191
Magnetic Separators in Flour Mills 370
Magnetic Wheel for Railways. Illustrated 255
Magnetism as an Aid to Traction 447
Mail Carrier, Rural, Automatic 20
Mail Delivery, High-speed Electric 200, 399
Mailloux Gift to the Institute 235
Maine, Electric Railways in 408
Mann, D. E. (Home-made Electrical Apparatus) 193
Manhattan Railway Company of New York, Power House of the. Illustrated 400, 401
Manila, Electrical. By R. G. Mayse. Illustrated 309
Manufactures in the United States, Statistics of. (Census Bulletin) 401
Marconi and His Affairs 245, 311, 325, 347, 389, 441
Marconi and Solari 73
Marconi, (Editorial) 72
Marconi, G. (The Effect of Daylight Upon the Propagation of Electromagnetic Impulses Over Long Distances) 87
Marconi, G. (The Progress of Electric Space Telegraphy. Illustrated) 24, 25, 35, 36, 59, 60
Marconi in Nova Scotia 325, 347, 441
Marconi Invention, A New, Reported 441
Marconi, Long-distance Wireless Tests Over Land by 39, 122, 195, 311
Marconi-Postal Telegraph Arrangement 82, 104, 142
Marconi Sends Messages Across the Atlantic Successfully 468
Marconi System of Space Telegraphy. By Emile Guarini. Illustrated 170, 171
Marconi Towers at Cape Breton. Illustrated. 67, 104, 441
Marine Electric Signaling System. Daft and Williams' 295
Marianna, Fla., Electric-light Apparatus Wanted in. By Robert J. Boone. (Communication) 215
Marinette Iron Works' Gas-engine Generating Set. Illustrated 407
Marshall Field & Co., Power, Lighting and Telephones for. Illustrated 165, 166, 167, 168
Massena (N. Y.) Power Plant 17, 22, 53
Master Car Builders' Association. (Paper) 95
Mason, Frank H. (German Electrical Manufacturers) 155
Master Mechanics of Street-railway Companies to Organize 260
Matthews & Bro.'s "Scale Knocker" for Boilers. Illustrated 61
Matthews, Charles P. (An Integrating Photometer for Glow Lamps and Sources of Like Intensity. Illustrated) 313
Mayor, William. Portrait 271
May, 1902, Electrical Exports for 2
Mayse, R. G. (Electrical Manila. Illustrated) 309
Maypole, William T. Portrait 271
Meadowcroft, William H. Portrait 335
Measuring Instruments, Magnets in, A Consideration of the Constancy of. Illustrated 9
Mechanical Draft in an Electric-railway Power Plant 60
Mercury-vapor Lamp, Potter. Illustrated 153
Messengers' Strike in Chicago, Telegraph 68, 142, 173, 174, 241
Meston Patent for Lubricated Bearing for Electric Ceiling Fans Sustained 42
Metals, Magnetic Experiments on 89
Meter, Edison Electric. Illustrated 2
Meters. (Ohio Electric Light Association) 293
Meters, Wright Demand and Electrolytic, Improvements in. Illustrated 3
Metric System, Elihu Thomson on the 91
Metropolitan Elevated Terminal in Chicago 361
Metropolitan Street Railway Company of New York, Power Houses of the. Illustrated 400, 401
Metropolitan Railway System of Paris. By A. De Courcy. Illustrated 439, 440
Metropolitan Railway Power Plant in London 103, 142
Mexico. (Correspondence) 129, 242, 283, 284, 319, 354, 355, 454
Mexico, Telephone Opposition in 448
Mica. (Editorial) 38
Michigan, Electric-railway Consolidation Proposed in 121, 195
Michigan, Interurban Electric Railways in. With maps 230, 231, 232
Michigan Railway to be Equipped with Arnold Electro-pneumatic Railway System 20
Michigan Telephone Company Defaults Interest on Bonds 26, 58, 76, 108, 314, 333
Michigan, Telephone News from. (Correspondence.) 351, 406, 467
Michigan, University of, New Engineering Building at. Illustrated 168, 169
Milan-Gallarate Electric Railway. By A. De Courcy. Illustrated 323, 324, 325
Miller Land Anchor. Illustrated 407
Miller's Portable Photometer for Measuring Light Distribution 21
Mine Equipment, Electrical, of the C. & C. Shaft at Virginia City, Nev. By Leon M. Hall. Illustrated 117, 118
Mines, English Coal, Electrical Apparatus in. Illustrated 291
Mineral Products of the United States 123
Mining Locomotives, Electric 172
Minneapolis and St. Paul, New Power Plant of Twin City Rapid Transit Company in. Illustrated 288, 289, 290
Minwegen, John. Portrait 271
Miscellaneous Notes 15, 31, 48, 49, 64, 83, 99, 114, 130, 147, 163, 184, 203, 219, 285, 303, 321, 339, 356, 375, 412, 436, 472, 473
Missouri, Important Telephone Deal in 157
Mock, J. C. (Signal Circuits) 369, 370
Molecular Attraction and the Electron Theory. (Editorial) 462
Montreal, Long-distance Transmission for 421
Montreal, Steam-turbine Plant for 74
Moore, E. W. Portrait 225
Morgan-Yerkes Railway Contest in London 55, 95, 160, 327, 443
Morgenstern, G. H., on Pay-station Service 351
Motor Equipment of a New Buffalo Grain Elevator. Illustrated 67, 68
Motor Equipment, Street-railway, Selection of. By Fred A. Jones. (Southwestern Gas, Electric and Street Railway Association) 45
Motor, Small Alternating-current, Development of a. By H. I. Finch. Illustrated. (Chicago Electrical Association) 342, 343
Motor, Synchronous, Distribution System of Steinmetz. Illustrated 326, 327
Motor, Wagner Single-phase, Upheld in Patent Suit. 280
Motor Work, Variable-speed, Three-wire System for. By N. W. Storer. Illustrated. With discussion. (American Institute of Electrical Engineers) 381, 432, 433
Motors, Ceco. Illustrated 262, 263, 264
Motors, 133-cycle Single-phase, Use of, on 60 Cycles. 346
Motors, Electric, Individual, The Operation of Machine Shops by. By R. T. E. Lozier. Illustrated. With discussion. (American Institute of Electrical Engineers) 380, 381, 432, 433
Motors, Independent Belted, in Chicago Printing Plant. Illustrated 269, 270
Motors, Induction, in a Chicago Iron-working Establishment. Illustrated 359, 360
Motors, Induction, Steinmetz Starting Device for. Illustrated 421
Motors, Induction, in a Wood-working Establishment 409
Motors for Machine Tools. Continuous-current. By F. O. Blackwell. With discussion. (American Institute of Electrical Engineers) 405, 406, 432, 433
Motorman, The 282
Motormen and Conductors, Rules for 74
Mountain Electric Railway at the Cape. Illustrated. 346, 347
Mountain Locomotive, Electric. Illustrated 54
Multiple-unit Voltage Speed Control for Trunk-line Service. By H. Ward Leonard. Illustrated. With discussion. (American Institute of Electrical Engineers) 405, 432, 433
Multiplex Telegraphy, Pupin Awarded Priority in 89
Municipal Electrical Association of England. (Paper) 125, 126
Municipal Ownership in Chicago, Aldermanic Argument for 450, 451, 470
Municipal Ownership in Newton, Iowa 240
Municipal-ownership Agitation in Chicago. (Editorial) 444
Municipal-ownership Agitation, How to Oppose 318
Municipal-ownership Challenge, That 216
Municipal Street Railway in Canada 433
Municipal Telephone Control in England 256, 384, 408
Municipal Telephone Experiment at Tunbridge Wells. 384, 408
Municipal Trading in America. By Robert P. Porter 61
Muskegon, Grand Haven and Grand Rapids Railway. Illustrated 460, 461

N

National Association of Stationary Engineers. (Convention in Boston, September 2-5, 1902) 177
National Bureau of Standards 420
National Electrical Contractors' Association. (Convention at Philadelphia, July 16, 1902) 52
National Electric Light Association 9, 70, 210, 216, 308, 425
Natural Food Company's Plant, Unusual Features of the. By Frank C. Perkins. Illustrated 54, 55
Natural Gas 241
Navies, Modern, Submarine Boats in 349, 365
Navy and Army Maneuvers 155, 194, 195
Navy, Electrical Appliances in the 440
Naval Tests of Space Telegraphy 195, 363, 441
Nebraska Independent Telephone Association. (Annual Convention in Lincoln, December 19 and 20, 1902) 466
New Britain, Conn., Stringent Wiring Regulations in, Modified 160
Newcastle, England, Suburban Steam Lines in, Electrical Operation for 161
New England News. (Correspondence) 13, 28, 29, 46, 62, 80, 97, 112, 128, 144, 182, 201, 217, 264, 265, 282, 300, 319, 336, 353, 354, 372, 373, 390, 409, 410, 434, 453, 470
Nernst Lamp Installation in Chicago, First Commercial 245
Nernst Lamps Used for Decorative Street Lighting. 91
Netherlands, Incandescent-lamp Trade in the 193
Nevada, Electrical Rhetoric in 409
Newman's Telephone Attachment. Illustrated 332
New Orleans, "Jim Crow" Street-car Law in. (Editorial) 348
News Service by Space Telegraphy, Parisian 90, 311
New South Wales, Electrical Association of 2
Newton, Iowa, Municipal Ownership in 240
New York Edison Company, Waterside Station of the. Illustrated 400, 401
New York Electrical Society. (Meetings and papers) 312, 468
New York Notes. (Correspondence) 13, 28, 45, 46, 62, 80, 97, 112, 127, 128, 144, 161, 182, 201, 217, 241, 242, 264, 282, 300, 319, 336, 353, 372, 390, 409, 434, 453, 470

New York-Philadelphia Electric Railway..... 126
New York Rapid Transit Subway System, Power House and Cars of. Illustrated.....176, 400, 401
New York State Electrical Laboratory..... 361
New York State Independent Telephone Association. 76
New York State, Long-distance Telephone Connections in 397
New York Street Railway Association. (Annual Meeting in Caldwell, N. Y., September 9-11, 1902). 194
New York, The Pennsylvania Railroad in. With map 253
New York Power Stations, Five. By W. F. Wells. Illustrated. (Association of Edison Illuminating Companies) 400, 401
New York Traction Systems Inspected by Chicago Aldermen 74, 87, 90
New Zealand, Telegraphy and Telephony in..... 125
New Zealand, Single-phase Power Transmission in. Illustrated 152, 153
Niagara Falls as a Center of Interest to Electricians. (Editorial)..... 154
Niagara Falls, Canadian Power Development at. By Orrin E. Dunlap. Illustrated 382, 383
Niagara Falls. (Correspondence).....46, 410
Niagara Falls, Manufacture of Nitrogen Compounds at. Illustrated 252, 253
Niagara Falls, Natural Food Company's Plant at, Unusual Features of the. By Frank C. Perkins. Illustrated 54, 55
Niagara Falls, N. Y., Progress on Power Plant No. 2 at. By Orrin E. Dunlap. Illustrated..... .....149, 150, 151, 383
Niagara Falls, Remarkable Blasting Accident at.... 331
Niagara Falls, Rival Canadian Power Companies at. 20
Niagara Power Developments, Magnitude of..... 329
Niagara Power Plant, Canadian, Progress on..... ..... 123, 382, 383
Nitrogen Compounds, Manufacture of, at Niagara Falls. Illustrated 252, 253
Northern California Power Company's Project..194, 409
Northeastern Iowa Independent Telephone Association 430
North Jersey Traction Deal.....250, 312
Northwestern Notations. (Correspondence)..... .....14, 29, 47, 63, 81, 98, 113, 129, 145, 161, 162, 183, 202, 218, 242, 284, 301, 320, 337, 355, 373, 374, 411, 435, 454, 471
Northwest, Telephone News from the. (Correspondence) 9, 26, 40, 58, 76, 93, 108, 124, 140, 157, 178, 196, 213, 237, 256, 278, 297, 315, 332, 350, 368, 388, 406, 431, 449, 466
Nova Scotia, Marconi in.....325, 347

O

October, 1902, Electrical Exports for 403
O'Connell's Receiving Device for Wireless-signal Systems. Illustrated 397
O'Neil, Admiral, on Submarine Boats..... 119
Oerlikon Company's Single-phase Railway Experiments 179
Ohio and Indiana, Railway Combinations in..... 308
Ohio Electric Light Association. (Convention in Columbus, October 14-16, 1902)..... .....255, 292, 293, 294, 295, 318
Ohio, Franchise Question in. (Editorial) 192
Ohio, Interurban Electric Railways in. With map.. .....228, 229, 230, 231
Ohio, News from. (Correspondence) 13, 14, 29, 46, 47, 62, 63, 80, 81, 97, 98, 112, 113, 182, 183, 201, 217, 242, 265, 283, 300, 301, 319, 337, 354, 373, 391, 410, 434, 435, 453, 471
Ohio Telephone Notes. (Correspondence) 9, 40, 58, 76, 93, 108, 178, 196, 256, 278, 297, 315, 332, 333, 351, 368, 388, 406, 431, 449, 466
Ohio and Surrounding States, Growth of Independent Telephone Companies in 124
Ohm-sifter Needed, An. (Editorial)..... 328
Oil as Fuel, Government Report on..... 421
Oil Pump, Sterrett. Illustrated 276
Old Time Telegraphers. (Reunion in Salt Lake City, September 10-12, 1902).....152, 188
Oral Agreement in Relation to Patent Ownership.... 389
Orling-Armstrong System of Wireless Telegraphy.. 79
Osmium Lamp, More About the..... 334
Oudin's "Standard Polyphase Apparatus and Systems." (Book Table) 371
Overhead Trolley in Paris 272
Overhead Wires, Automatic Circuit-interrupter on. Illustrated 442
Overhead Wiring in Chicago..... 325
Ozone, Recent Uses of. (Editorial)..... 292

P

Pacific Cable, British...73, 153, 329, 349, 364, 366, 379
Pacific Cable, British, Completion of the.....329, 379
Pacific Cable, United States..... .....20, 55, 107, 216, 366, 379, 402, 447
Pacific Coast Electric Transmission Association. (Paper) 141
Pacific Slope, On the. (Correspondence)..... .....14, 30, 47, 81, 113, 129, 130, 145, 183, 184, 218, 265, 266, 301, 337, 374, 411, 454
Pacific, Space Telegraphy on the 347
Pacific States Telephone Company's Extensions.... 431
Palmer, G. W., Jr. (Signals for Urban and Interurban Railways) 257
Palmer Process of Reproducing Pictures at a Distance. Illustrated 363
Paper Gear Wheels 442
Paper Manufacture of Incandescent-lamp Filaments from 161
Paralleling of Alternators, Requirements for the. By Henry E. Longwell. (Engine Builders' Association of the United States).....11, 12
Parcel Delivery in England, Electric 318
Paris, Lighting System for, American Capitalists Plan 467
Paris, Metropolitan Railway System of. By A. De Courcy. Illustrated 439, 440
Paris Metropolitan Underground Railway..257, 439, 440
Paris, Overhead Trolley in 272
Parisian News Service by Space Telegraphy....90, 311
Parke, R. A. (Railroad Car Braking. Illustrated).. ..... 464, 465
Parker, George W. (Electric Express and Package Delivery. Illustrated) 273
Parker, George W. Portrait 273
Parr's "Electrical Engineering Testing." (Book Table) 73
Party Lines, Selective Telephone Switch for. Illustrated 398
Party-line System, A New Selective..... 76
Patent Commissioner Allen, Report of..... 279
Patents, Electrical, Granted by the United States, A Survey of. By Story B. Ladd. (Census Bulletin) 181, 182, 198, 214, 215
Patent Ownership, Oral Agreement in Relation to.. 389
Patent Record, Electrical. Illustrated 16, 31, 32, 49, 50, 65, 66, 83, 84, 99, 100, 115, 116, 131, 132, 148, 163, 164, 185, 186, 204, 219, 220, 244, 267, 268, 286, 303, 304, 321, 322, 339, 340, 356, 357, 358, 375, 376, 393, 394, 413, 414, 437, 438, 455, 456, 473, 474
Patents, Electrical and Otherwise. (Editorial)... 254
Patent Suit, Wagner Single-phase Motor Upheld in. 280
Patents Upheld, Weston Instrument..... 467
Payette-Boise Power Plant..... 73
Pay-station Service 351
Penington, T. C. Portrait 235
Pennsylvania Railroad in New York. With map.... 253
Pennsylvania Railroad and the Telegraph Companies 1
Pennsylvania, Southeastern, Electrical Development in 311
Pennsylvania Street Railway Association. (Convention at York, Pa., September 10, 1902)..... 194
Pensions for Street-railway Employes. (American Street Railway Association) 259
Penn Yan, N. Y., Large Electric Furnaces Near. By William Hoskins Illustrated.....287, 288
Perkins, Frank C. (Alternating-current Railway Systems. Illustrated) 208, 209, 232, 233
Perkins, Frank C. (Düsseldorf Industrial and Trades Exposition. Illustrated) 17, 18
Perkins, Frank C. (Electrical Equipment in Belgian Blast Furnaces. Illustrated) 101, 102, 103
Perkins, Frank C. (Three-phase Pumping Installation at Dortmund, Germany. Illustrated)..... .....305, 306, 307
Perkins, Frank C. (Unusual Features of the Natural Food Company's Plant. Illustrated) 54, 55
Perrine, F. A. C. (Success in Long-distance Power Transmission) 78, 79
Perrine on the Transposition of Alternating-current Lines 107
Personal-injury Claims, X-ray in 309
Personal. (Notes) 14, 30, 47, 63, 81, 82, 98, 114, 130, 145, 146, 162, 184, 202, 218, 242, 243, 266, 284, 302, 320, 338, 355, 374, 392, 411, 412, 435, 454, 472
Peruvian Development 21
Peters, A. E. Portrait 225
Petrol or Alcohol Engine, Dynamo Set with. Illustrated 441
Phelps Company's Hylo Lamp with Pendant Switch. Illustrated 407
Pherophon, The. Illustrated 421
Philadelphia-New York Electric Railway..... 126
Philippine Islands, Signal Corps Operations in.... 366
Photographic Detector, for Passenger Cars, Automatic. Illustrated 327
Photometer, A Portable, for Measuring Light Distribution 21
Photometer, An Integrating, for Glow Lamps and Sources of Like Intensity. By Charles P. Matthews. Illustrated. (American Institute of Electrical Engineers) 313
Physical Theory, Revision of. By Henry S. Carhart. (Central Association of Physics Teachers)..... .....445, 446, 447
Pickard Wireless-telegraph Apparatus. Illustrated. 169
Pickard's Experiments in Space Telephony..... 195
Pictures, Reproducing at a Distance, Palmer Process of. Illustrated 363
Pike's Peak Power Company's Transmission System. Illustrated 71
Pile Driver, Electrically Operated. Illustrated.... 420
Pino's Submarine Inventions 425
Pipe Covering, Steam, and Its Relation to Station Economy. By H. G. Stott. Illustrated. (Association of Edison Illuminating Companies) ..385, 386
Pittsburg, Bell Rates in, Competition Forces Reductions in 125
Pittsburg, Institute Meetings in.....308, 386
Pittsfield Accident, Responsibility for..... 288
Pitt River, in California, Great Project for Power Development on the 194
Poles, Use of Juniper for 264
Polyphase Induction Regulator, Steinmetz. Illustrated 326
Portland, Ore., Electrical Development at 43
Porter, Robert P. (Municipal Trading in America) 61
Postal Telegraph-cable Company, Affairs of the.... .....1, 82, 104, 142, 160, 194
Postal Telegraph Company's Arrangement with Marconi 82, 104, 142
Potential-changer, Thomson Direct-current. Illustrated 349
Potter Alternating-current Railway System. Illustrated 344, 469
Potter Mercury-vapor Lamp. Illustrated 153
Potter, W. B. (Comparative Acceleration Tests with Steam Locomotive and Electric Motor Cars. Illustrated) 10, 11
Power Distribution Scheme for Scotland, Large. With map 416
Power and Lighting for Marshall Field & Co. Illustrated 165, 166, 167, 168
Power Plant No. 2 at Niagara Falls, N. Y., Progress on. By Orrin E. Dunlap. Illustrated..149, 150, 151
Power Plant, St. Louis Exposition 440
Power Possibilities, Electric, of Mountain Streams in France 197
Power Supply, Electric, Permanency of, Legal Contest over 365
Power, The Cost of. By M. J. Eichhorn. Illustrated 69, 70, 88, 89
Power-transmission and Telephone Circuits, Remarkable Accident Involving 264
Power Transmission, Electric, in the Far West. By Geo. H. Lukes. (Association of Edison Illuminating Companies) 199, 200
Power Transmission in the Hudson River Valley... 79
Power Transmission in New Zealand, Single-phase. Illustrated 152, 153
Power Transmission, Long-distance, Success in. By F. A. C. Perrine. (Society of Arts).....78, 79
Power Transmission. (Notes) 15, 48, 64, 82, 146, 184, 243, 285, 302, 320, 321, 338, 356, 472
Power Transmission, Possible, from the "Soo" to Detroit 290
Power Transmission System of the Pike's Peak Company. Illustrated 71
Power Transmission, Wireless, Wanted for St. Louis Exposition 38, 42, 111, 141
Pratt, Charles R. (Electric Elevators) 312
Preece, Sir William, on "The Science of Business." (Editorial) 424
"Primary Batteries." By W. R. Cooper. (Book Table) 21
Printing Plant, Chicago, Independent Belted Motors in. Illustrated 269, 270
Private Power, Central-station Supply and, Relative Economy of. By M. B. R. 160
Professional Etiquette for Electrical Engineers. (Editorial) 348
Proposed Developments of the Institute. By Charles F. Scott. (American Institute of Electrical Engineers) 330, 331
Prussia, Novel Use of the Electric Arc in..... 60
Publications. (Notes) 15, 30, 31, 48, 64, 82, 99, 114, 130, 147, 162, 163, 184, 203, 219, 243, 266, 285, 302, 303, 321, 338, 339, 356, 374, 392, 412, 436, 455, 472
Public Ownership. (Editorial) 254, 444
Public Telephone Rate in Chicago Reduced..... 93
Pump, Electric Fire, in Rouen. Illustrated..... 363
Pumping for Stock Wells, Proposed Electric. By A. J. Bowie, Jr. (Pacific Coast Electric Transmission Association) 141
Pumping Installation, Three-phase, at Dortmund, Germany. By Frank C. Perkins. Illustrated.. .....305, 306, 307
Pupin Awarded Priority in Multiplex Telegraphy.. 89
Pupin's Asymmetrical-current Device for Telegraph Circuits. Illustrated 344, 345
Pyrometer, Use of Incandescent Lamp as a..... 365

Q

Quad, Queer Quirks of the. By Henry Burns Geer. 372
Quarantine, Rough-and-Ready. (Editorial) 90

R

Radiometric Receiver for Electric Waves..... 21
Radion, A New Element 35
Railroad Car Lighting. By L. T. Canfield. (Master Car Builders' Association)..... 95
Railroad Clearing Yards, Chicago, Electrical Equipment of. Illustrated 133, 134, 135
Railroad Elevator of Great Magnitude Proposed.... 299
Railroad Telephone Line in Canada..... 158
Railroad Telephone, The 237
Railroad Trains, Use of the Telephone in Operating. Illustrated. (Association of Railway Telegraph Superintendents).....4, 5, 6, 27, 28, 41, 42
Railroad Work, Heavy, Storage Battery for..... 408
Railroad Work, Heavy, The Alternating Current for. 367
Railway Combinations in Ohio and Indiana..... 308
Railway, Electric Intramural, for St. Louis World's Fair 195, 211, 272
Railway, Light and Power Plant, An Interesting Swiss. Illustrated 415, 416
Railway Power House, Largest, South of the Equator (Sydney, Australia) 245
Railway Signaling Club. (Paper).....369, 370
Railways, Magnetic Wheel for. Illustrated..... 255
Railway Trials, Berlin-Zossen High-speed.....106, 349
Railways, Urban and Interurban, Signals for. By G. W. Palmer, Jr. (American Street Railway Association) 257
Railway Switchboard, A Recent British. Illustrated. 36
Railway Systems, Alternating-current. By Frank C. Perkins. Illustrated....208, 209, 232, 233, 250, 251
Railway System, Potter Alternating-current. Illustrated 344
Randolph Street Rotary Sub-station in Chicago. Illustrated 377, 378, 379, 384
Raney, H. C., Address of, as President of the Interstate Independent Telephone Association.....422, 423
Raney, H. C. Portrait 395
Rapid Railway System of Detroit and Port Huron. Illustrated 226, 227
Rapid Transit Subway System in New York, Power House and Cars of. Illustrated.....176, 400, 401
Rates (Space-telegraph) Low but Not Available.... 216
Rates, The Sliding Scale of, for the Telephone Company. By Henry S. Herr. (Interstate Independent Telephone Association) 448
Raymer, Walter J. Portrait..... 271
Receiver, Fessenden Electromagnetic. Illustrated.. 420
Receiving Device for Wireless-signal Systems. Illustrated 397
Rectifier System, Steinmetz Improved. Illustrated. 104, 105
Regulation of Gas Engines Used for Electric Driving. Illustrated 452
Regulator, Steinmetz Polyphase Induction. Illustrated 326
Relative Economy of Central-station Supply and Private Power. By M. B. R..... 160
Remarkable Accident Involving High-potential Power--transmission and Telephone Circuits..... 264
Replogle Waterwheel Governor. Illustrated..... 60
Resistance of Certain Insulators..... 234
Revision of Physical Theory. By Henry S. Carhart. (Central Association of Physics Teachers)..... .....445, 446, 447
Ringer, New Telephone. Illustrated..... 467
Rival Telephone Conventions. (Editorial)..... 72
Roadmasters, Electric-railway 235
Robinson, Elisha, The Sad Plight of..... 158
Robinson, H. H. (Toll Rates)..... 430
Roche's Dresser Light. Illustrated..... 409
Rochester, Mr. Barnes of, and His Electrical Comforts 442
Rochester, Rival State Telephone Associations Formed at 76
Rockford Home Telephone System. Illustrated..396, 397
Rockford, Ill., Electric Railways..... 440
Rockies, Among the. (Correspondence).....29, 30, 81, 129, 145, 183, 284, 301, 320, 337, 355, 411, 454
Rocky Mountain Region, Telephone News from the. (Correspondence) 333
Rolling Mills, Electric Power in..... 307
Rome Compressed-air Cars May Be Abandoned in Favor of Electricity 52
Rood's Measurements of Resistances..... 234
Rooney-Westbury Electric Lamp Company. Portraits 335
Roosevelt, President, Accident to.....174, 210, 288
Roosevelt's Message, President. (Editorial)..... 402
Rorty and Bullard's Automatic Telephone Patents.. 236
Ross, Walter. Portrait 225
Rotary-converter Distribution System, Steinmetz. Illustrated 290, 291
Rotary Sub-station in Chicago, Randolph Street. Illustrated 377, 378, 379, 384
Rouen, Electric Fire Pump in. Illustrated..... 363
Rowland, The Late Professor 44
Royal Institution of London. (Paper)..... .....24, 25, 35, 36, 59, 60
Royal Society of London. (Paper)..... 87
Ruhmer, Ernst. (The Speaking Arc and Wireless Telephony. Illustrated) 53
Ruhmer's Improvement in the Speaking Arc. Illustrated 398, 399
Ruhmer Wireless Telephony, Experiments with..... 124
Rules for Motormen and Conductors..... 74
Rural Mail Carrier, Automatic 20
Russia, Electrotechnical Industry in. By Thomas E. Heenan. (United States Consular Report)..... 159
Russia, Germany's Electrical Trade with..... 233
Ruthenberg, Marcus. (Developments in Electrometallurgy of Iron and Steel).....370, 371

S

Sabin's John I., House Burned by Remarkable Accident 264
St. Joseph River Power Development 407
St. Lawrence Power Company's Plant at Massena, N. Y. 17, 22, 53
St. Louis, Elevated Roads Proposed in 182
St. Louis, Universal Exposition of, in 1904, Extent of the. By W. E. Goldsborough. Illustrated.... 382
St. Louis World's Fair, Electrochemistry at the. By W. E. Goldsborough. (American Electrochemical Society) 213, 214
St. Louis World's Fair, Preparations for the. Illustrated 38, 42, 111, 141, 174, 192, 195, 209, 211, 213, 214, 259, 272, 290, 346, 382, 399, 419, 425, 426, 440, 444, 468
St. Paul and Minneapolis, New Power Plant of Twin City Rapid Transit Company in. Illustrated..... .....288, 289, 290
St. Petersburg, Large Exchange in, American Plant for 350, 466
St. Thomas (Ont.) Municipal Street Railway..... 433
Salt Lake City, Telephone Improvements in..... 351
Salt Lake, Suburban Electric Road at..... 211
San Diego, Improvements in..... 12
San Francisco, American Pacific Cable Landed at.. 447
San Francisco, Geary Street-railway Proposition in. 2, 397
San Francisco Hotel, Electric Equipment of a.... 443
San Francisco, Street Illumination in. Illustrated. 136
San Francisco, Telephone Application in 298
San Antonio, Improvements in 365

Saratoga, N. Y., New Telephone Exchange at. Illustrated 5
Saubermann, Siegmund. (The Bremer Lamp. Illustrated) 20, 21
Sault Ste. Marie Waterpower Development 107, 290, 311, 452
"Scale Knocker" for Boilers, A. Illustrated 61
Scheefer Meter and Tesla Motor Patents in Litigation. Illustrated 360, 361
Schneider's New Automatic Interrupter. Illustrated. 308
Scotland. Large Power Distribution Scheme for. With map 416
Scott, Charles F. (The Engineer of the Twentieth Century) 451, 452
Scott, Charles F., on Electric Variable-speed Control. (American Institute of Electrical Engineers) 380
Scott, Charles F. (Proposed Developments of the Institute) 330, 331
Scribner, C. E., Telephone Signal System of. Illustrated 466
Searchlights in Mimic Warfare 194
Seattle, Poor Bell Telephone Service in 212
Seattle-Tacoma Interurban Electric Railway. Illustrated 136, 317
Seeing at a Distance by Electricity 364, 442
Selective Party-line System, A New 76
Selective System for Space Telegraphy, Automatic. Illustrated 123
Selective Telephone Switch for Party Lines. Illustrated 398
Selection of Street railway Motor Equipment. By Fred A. Jones. (Southwestern Gas, Electric and Street Railway Association) 45
Self-contained Engine-dynamo Plants for English Railway Cars. (Editorial) 444
"Self-propelled Vehicles." By James E. Homans. (Book Table) 386
September, 1902, Electrical Exports for 329
Series-parallel System of Speed Control, A. By George W. Fowler. Illustrated. With discussion. (American Institute of Electrical Engineers) 404, 432, 433
Sewell's "Elements of Electrical Engineering." (Book Table) 386
Sharp, Clayton H. (Checking Electrical Instruments. Illustrated) 197
Shawinigan Falls, Long-distance Transmission from. 421
Sheep Shearing by Electricity 235
Short, Sidney H., Death of. Portrait 288, 307
Siam, Exporters to, Hints to 255
Signal Circuits. By J. C. Mock and W. E. Foster. (Railway Signaling Club) 369, 370
Signal Corps. Work of the 195, 348, 352, 353, 366, 367, 387
Signaling, Electric-railway. (Editorial) 310
Signaling System, Marine Electric, Daft and Williams 295
Signals for Urban and Interurban Railways. By G. W. Palmer, Jr. (American Street Railway Association) 257
Simplex Company's Electric Stove for Travelers. Illustrated 42
Single-phase Electric Traction (Oerlikon System) .. 179
Single-phase Motors on 60 Cycles, Use of 133-cycle. 346
Single-phase Motor, Wagner, Upheld in Patent Suit 280
Single-phase Power Transmission in New Zealand. Illustrated 152, 153
Single-phase Railway Operation. (Editorial) 234
Single-phase Railway System, Arnold's 20, 234, 364
Single-phase Railway, Washington, Baltimore and Annapolis. Illustrated 142, 143, 169, 234, 238, 239, 240, 367
Skinner, Charles Edward. (Energy Loss in Commercial Insulating Materials When Subjected to High-potenital Stress. Illustrated) 96, 110, 111
Sleeping Cars for Electric-railway Service 294
Sliding Scale of Rates, The, for the Telephone Company. By Henry S. Herr. (Interstate Independent Telephone Association) 448
Small Electric Furnaces. Illustrated 308
Smelting Steel by Electricity 79
Smith, G. K. (The Arcophone or Speaking Arc Lamp. Illustrated) 208
Smith Storage Battery Company's Apparatus 390
Smoke-preventing Device, Novel French 12, 13
Sniffin, Edward H. (The Steam Turbine—Its Commercial Aspect. Illustrated) 248, 249, 250, 260, 274, 279
Snoqualmie Falls Company, White River Development by 329
Snyder, R. A. L. (The Arcophone or Speaking Arc Lamp. Illustrated) 208
Societies and Schools. (Notes) 15, 48, 64, 99, 114, 147, 184, 203, 243, 321, 338, 374, 412, 472
Society for the Promotion of Engineering Education. (Annual Meeting in Pittsburg, June 27 and 28, 1902) 7
Society of Arts. (Paper) 78, 79
Solari and Marconi 73
Solari or Castelli Receiver for Space Telephony. Illustrated 91
Soporific, Electricity as a. (Editorial) 138
South, Extensions in the, Western Union to Make .. 215
South Side Elevated, Proposed Extensions of 61, 361
South Side Telephone Exchanges in Chicago, New .. 212
Southeastern Iowa Telephone Association. (Annual meeting in Oskaloosa, October 14 and 15, 1902) .. 29
Southern Developments. (Correspondence) 13, 28, 46, 62, 80, 97, 128, 144, 145, 182, 201, 217, 242, 264, 301, 319, 336, 337, 354, 372, 390, 391, 410, 434, 453, 470, 471
Southern Indiana Telephone Association. (Annual meeting in Louisville, October 28 and 29, 1902) 333, 350
Southern Telephone Developments. (Correspondence) .. 9, 26, 40, 58, 76, 77, 93, 108, 109, 124, 140, 178, 213, 256, 297, 333, 350, 351, 368, 388, 431, 449, 467
Southwestern Gas, Electric and Street Railway Association. (Paper) 45
Space-telegraph Inventors, Troubles of. (Editorial). 90
Space-telegraph Patents, Stone 468
Space-telegraph Rates Low but Not Available 216
Space-telegraph Station at Cape Breton, Marconi. Illustrated 67, 104, 441
Space Telegraphy, Automatic Selective System for. Illustrated 123
Space-telegraphy Congress at Berlin 234, 311
Space Telegraphy, Electric, The Progress of. By G. Marconi. Illustrated. (Royal Institution) ... 24, 25, 35, 36, 59, 60
Space Telegraphy, Dessenden System of. Illustrated 109, 120, 121, 420
Space Telegraphy in Warfare. (Editorial) 138
Space Telegraphy, Lord Kelvin's Opinion of 91
Space Telegraphy. (Notes) 15, 48, 64, 82, 163, 219, 243, 302, 321, 371, 375, 412, 436
Space Telegraphy, Parisian News Service by 90, 311
Space Telegraphy, Progress in. By Emile Guarini. Illustrated 170, 171, 172, 250
Space Telegraphy to Hawaii Promised. (Editorial). 22
Space Telegraphy, The Effect of Daylight Upon. By G. Marconi. (Royal Society) 87
Space Telegraphy, Various Tests of 59, 60, 104, 111, 121, 122, 195, 311, 325, 347, 363, 389, 411, 468
Space Telegraphy. (See also Marconi and Wireless Telegraphy.)
Space Telegraphy, Castelli (Solari?) Receiver for. Illustrated 91
Space Telephony, Pickard's Experiments in 195
Spanish Electric railway Project 60
Spain, Long Telephone 212
Speaking Arc and Wireless Telephony, The. By Ernst Ruhmer. Illustrated. (Communication) .. 53
Speaking Arc, Improvement in the. Illustrated. 398, 399
Speaking Arc Lamp, The Arcophone or. By G. K. Smith and R. A. L. Snyder. Illustrated. (Engineers' Society of Western Pennsylvania) 208
Spectacular Electric Lighting 365
Speed Control, Variable, Electric. Illustrated. (Papers and discussions before the American Institute of Electrical Engineers) 380, 381, 404, 405, 406, 432, 433
Speed-regulating Device. White. Illustrated 127
Speed of Electric Cars, Regulating the. (Editorial). 210
Sperry, Elmer A., Electric-railway System of. Illustrated 469
Stage Lighting Effects 17
Standard Pole and Tie Company 264
"Standard Polyphase Apparatus and Systems." By Maurice A. Oudin. (Book Table) 371
Standards, Street-railway. (American Street Railway Association) 281, 282
Standard Vitrified Conduit Company's Third-rail Insulator. Illustrated 194
Stanley, Albert H. Portrait 225
Stanley Electric Manufacturing Company .. 42, 74, 390
Stanley-Kelly Alternating-current System, New. Illustrated 345, 346
Stanton, L. W. (Needed Improvements in Independent Telephony) 8
Starting Device for Induction Motors, Steinmetz. Illustrated 421
Static Interrupter for High-tension Circuits. Illustrated 37
Steamboat Connection with Interurban Road 317
Steam Locomotive and Electric Motor Cars, Comparative Accelerating Tests with. By B. J. Arnold and W. B. Potter. Illustrated. (American Institute of Electrical Engineers) 10, 11
Steam Pipe Covering and Its Relation to Station Economy. By H. G. Stott. Illustrated. (Association of Edison Illuminating Companies) ... 385, 386
Steam Roads, English, to Be Electrically Operated .. 360
Steam Turbines. By S. E. Fedden. (Municipal Electrical Association of England) 125, 126
Steam Turbines. (Editorial) 122, 154
Steam-turbine Plant for Montreal 74
Steam Turbines in Europe 327
Steam Turbine Patents, Col. J. J. Astor Gives His, to the World 370
Steam Turbine, The. By Edward H. Sniffin. Illustrated. With discussion. (American Street Railway Association) 248, 249, 250, 260, 274, 279
Sleet and Ice, Third-rail Contact as Affected by. Illustrated 459
Steel Smelting by Electricity 79
Steering Gear, Day's Electrical. Illustrated 272
Steinmetz, Charles P., Recent Inventions of. Illustrated 104, 105, 290, 291, 326, 327, 349, 362, 421
Steinmetz, Charles P. (The Ideal Electrical Engineering Course) 44
Steinmetz Receives an Honorary Degree 22
Sterling Electric Company, Cook Against 389
Sterling Spiral filament Lamp. Illustrated 127
Sterrett Oil Pump. Illustrated 276
Stieringer's Work, Luther 443
Stocks, Electric, Said to be a Good Purchase 160
Stock Wells, Proposed Electric Pumping for. By A. J. Bowie, Jr. (Pacific Coast Electric Transmission Association) 141
Stockyards Wiring 111
Stoker, Peerless Automatic Smokeless. Illustrated. 298
Stone Space-telegraph Patents 468
Storage Batteries, Durability Tests of 200
Storage-battery and Booster Equipment of the Chicago City Railway. Illustrated 1
Storage-battery, Edison 36, 159, 318
Storage Battery for Heavy Railroad Work 408
Storage Battery, The, as a Factor in Speed Control. By H. B. Coho. Illustrated. With discussion. (American Institute of Electrical Engineers) 404, 405, 432, 433
Storage-battery Trade Aboard 300
Storage Battery Without Jars, A 390
Storer, N. W. (Three-wire System for Variable-speed Motor Work. Illustrated) 381, 432, 433
Stove, Electric, Traveler's (Simplex). Illustrated .. 42
Stott, H. G. (Steam Pipe Covering and Its Relation to Station Economy. Illustrated) 385, 386
Stradling, George F. (Ionization of Gases) 334
Street Cars in Evansville, Ind., Evolution of. Illustrated 443
Street Illumination in San Francisco. Illustrated ... 136, 137
Street Railway Accountants' Association. (Convention in Detroit, October 8-10, 1902) 269
Street Railways, Frontage Consents for. (Editorial) 384
Street-railway Master Mechanics to Organize 260
Street-railway Motor Equipment, Selection of. By Fred A. Jones. (Southwestern Gas, Electric and Street Railway Association) 45
Street-railway Problem in Chicago, The. By Frank I. Bennett. Portraits 270, 271, 272
Street-railway Standards. (American Street Railway Association) 281, 282
Street-railway Wage Questions in Chicago, Arbitration of 79, 158, 169, 174, 216, 351
Stromberg-Carlson Central-energy Telephones for Mines and Interurban Railways Illustrated 407
Stromberg-Carlson Farewell Party 298
Stromberg Carlson Hook switch. Illustrated 449
Stromberg-Carlson Telephone Ringer. Illustrated ... 467
Strowger Automatic Telephone System. Illustrated 156, 157
Sturtevant Company, B. F., at Hyde Park, Mass., New Works of the. Illustrated 317
Submarine Boats, Admiral O'Neil on 119
Submarine Boats (Editorial) 328
Submarine Cables, Legal Status of the. (Editorial) 210
Submarine Cables, The World's 158, 241
Submarine Inventions. Pino's New 425
Submarine Boats in Modern Navies 349, 365
Susquehanna River Power Plants, Proposed 52, 311, 386
Swedish-American Gravity Telephone Hook. Illustrated 406
Swedish Government Considering Big Electric-railway Project 334
Swiss Light, Railway and Power Plant. An Interesting. Illustrated 415, 416
Switchboard Apparatus for Telephone-exchange Circuits, Hulush. Illustrated 332
Switchboard Jack, A New Laboratory. By F. C. Caldwell. Illustrated. (American Association for the Advancement of Science) 152
Switchboard, Railway, A Recent British. Illustrated 36
Switzerland, Three-phase Electric Railway in 123
Sydney, Australia, Railway Power House in 245
Synchronous-motor Distribution System of Steinmetz. Illustrated 326, 327

T

Tacoma-Seattle Interurban Electric Railway. Illustrated 136, 317
Taylor's Electric Furnace. Illustrated 163, 287, 288
Technical Education. (Editorial) 364
Technolexicon, The 335, 336
Technology School for University of Chicago 470
Telegraph and Telephone System, Composite. Illustrated 108
Telegraph Circuits, Pupin's Asymmetrical-current Device for. Illustrated 344, 345
Telegraph Companies' Competition 1
Telegraph. (Notes) 15, 48, 64, 82, 99, 130, 162, 203, 219, 285, 303, 338, 375, 412
Telegraphic Communication with Alaska 139
Telegraphing Around the World 349, 364
Telegraphy, Multiplex, Pupin Awarded Priority in .. 89
Telephone and High-potential Power-transmission Circuits, Remarkable Accident Involving 264
Telpherage, Applications of. Illustrated 143
Telephone and Telegraph System, Composite. Illustrated 108
Telephone Companies, New. (Notes) 77, 125, 212, 314, 388, 467
Telephone Company, The Sliding Scale of Rates for the. By Henry S. Herr. (Interstate Independent Telephone Association) 448
Telephone Competition Advantageous 92
Telephone Competition. By F. S. Dickson 450
Telephone Contracts. (Editorial) 22
Telephone Control, Municipal, in England. 256, 384, 408
Telephone, Ducretet Loud-speaking. Illustrated 449
Telephone Exchange, Private, for Marshall Field & Co. Illustrated 167, 168
Telephone Extensions and Improvements. (Notes) 125, 212, 430
"Telephone Green Book." (Book Table) 386
Telephone Holder, Chicago. Illustrated 406
Telephone Hook, Gravity (Swedish-American). Illustrated 406
Telephone, How to Use the. Illustrated 314
Telephone in Operating Railroad Trains, Use of the. Illustrated. (Association of Railway Telegraph Superintendents) 4, 5, 6, 27, 28, 41, 42
Telephone Line, Railroad, in Canada 158
Telephone Manufacturers and Dealers. (Notes) 26, 41, 58, 77, 109, 125, 158, 196, 213, 237, 257, 278, 368, 389, 449, 467
Telephone Men. (Notes) 26, 41, 77, 140, 158, 196, 212, 257, 278, 296, 368, 406, 449, 467
Telephone News, General. (Notes) 8, 26, 41, 58, 77, 93, 109, 125, 140, 158, 178, 213, 237, 257, 278, 333, 368, 389, 406, 431, 449, 467
Telephone Operator, A Woman, in Texas 77
Telephone Patents, Bell Company's Automatic 236
Telephone-patent Suits. Recent 40
Telephone Patents, New. Illustrated 92, 108, 236, 296, 332, 466
Telephone Profits in Indiana 76
Telephone Rate in Chicago, Public, Reduced 93
Telephone Rates. (Editorial) 56
Telephone Reporting, Long-distance 406
Telephone Ringer, New. Illustrated 467
Telephone Situation, The Church, at Washington, Ind. 77
Telephone Spans, Long 212
Telephone Switch for Party Lines, Selective. Illustrated 398
Telephone System, Strowger Automatic. Illustrated 156, 157
Telephone System, The 58
Telephone, The Railroad 237
Telephone Toll-line Valuations, Indiana 178
Telephone, Traction or Mine. (American Electric Telephone Company). Illustrated 315
Telephone Transmitter for the Deaf, Hutchinson. Illustrated 296
Telephone Transmitters, Disinfection of. (Editorial) 292
Telephone Tunnels in Chicago, Progress on the. Illustrated 205, 206, 207, 210, 315, 458, 459
Telephones and Electric Lights for Divers' Operations 211
Telephones, Central-energy, for Mines and Interurban Railways (Stromberg-Carlson). Illustrated .. 407
Telephones, Central Telephone and Electric Company's Intercommunicating. Illustrated 297, 298
Telephony, Independent, Needed Improvements in. By L. W. Stanton. (Independent Telephone Association of the United States) 8
Telephony, Long-distance, Improvements in. Illustrated 92
Telluride Power Transmission Company Engaged in Important Litigation 365
Tesla Motor Patents in Litigation. Illustrated .. 360, 361
Testing the Magnetic Qualities of Materials in Bulk. By C. V. Drysdale. Illustrated 190, 191
Texas. (Correspondence) 129, 319, 354, 355, 454
Texas, Extensive Interurban System Proposed in .. 299
Third-rail Contact as Affected by Sleet and Ice. Illustrated 459
Third-rail Insulator, Manhattan. Illustrated 194
Third-rail Roads, Operation of, in Sleet Storms. (Editorial) 462
Third-rail System in the Baltimore and Ohio Tunnel. Illustrated 139
Thomas' Static Interrupter for High-tension Circuits. Illustrated 37
Thomson Direct-current Potential-changer. Illustrated 349
Thomson, Elihu, on the Metric System 91
Three-cent Fare, Cleveland May Have 87, 121
Three-phase Electric Railway in Switzerland 123
Three-phase Pumping Installation at Dortmund, Germany. By Frank C. Perkins. Illustrated ... 305, 306, 307
Three-wire System for Variable Speed Motor Work. By N. W. Storer, Illustrated. With discussion. (American Institute of Electrical Engineers) 381, 432, 433
Thunderstorms, What Causes 13
Toledo-Cincinnati Electric Railway a Possibility 2
Toll-line Connection with Chicago, Independents Seek 424, 430
Toll Lines, Signal System for, Scribner's. Illustrated 466
Toll Rates. By H. H. Robinson. (Interstate Independent Telephone Association) 430
Toronto, City Electrician Wanted in 461
Traction Brakes, Braking and. Illustrated. (Papers and discussion before the American Institute of Electrical Engineers) 463, 464, 465
Traction, Magnetism as an Aid to 447
Trade News. (Notes) 15, 31, 49, 64, 65, 83, 99, 114, 115, 130, 131, 147, 163, 184, 185, 203, 219, 243, 244, 266, 285, 303, 321, 339, 356, 375, 392, 412, 413, 436, 437, 455, 473
Trade Unionism Gone Mad. (Editorial) 138
Trafford City, Pa., New Westinghouse Industries at. 240
Train Connector, Electric. Illustrated 214
Train, Fast Express, Wireless Telegraphy on .. 408, 409
Train Lighting by Electricity. Illustrated 53, 72, 95, 174, 362
Train-lighting System, Novel. Illustrated 362
Tramways Congress and Exhibition in London, International 57
Transatlantic Space Telegraphy 389, 462
Transfers, Street-railway, Registration of. (American Street Railway Association) 259
Transformer, Charging Extra for, When Wiring of Building is by Another 7
Transformers, Stanley Company's, Non-infringing ... 390
Transportation Building at St. Louis Exposition 468
Transposition of Alternating-current Lines 107

Traveler's Electric Stove (Simplex). Illustrated.. 42
Trolley-car Journey, Misleading Account of. (Editorial) 348
Trolley, Overhead, in Paris..... 272
Trolley Wire, Aeronaut Falls on a..... 177
Trowbridge, A. (Effect of Electrolytic Condensers in Alternating-current Circuits) 68
Trow, Harris C. (Place of Correspondence Schools in Electrical Education) 316
Trusts Must Advertise 351
Tunbridge Wells, Municipal Telephone Experiment at 384, 408
Tunnel, Niagara Falls Power, Tested to Full Capacity 383
Turn-down Lamp, Economical. Illustrated..... 216
Tutt's, Mrs., Proposed Arizona Power Plant..... 39
Twentieth Century, The Engineer of the. By Charles F. Scott. (Engineers' Club of Philadelphia).451, 452
Twin City Rapid Transit Company, New Power Plant of. Illustrated 288, 289, 290
"Two-telephone Nuisance," The. (Editorial)..... 138
Two Wireless-telegraph Messages Read Simultaneously. By L. De Forest. (Communication).... 111
Tyndall's "Electricity and Its Similitudes." (Book Table).... 386

U

Underground Railroad in London, Great Northern... 86
Underground Roads, London, Power Plant for..... 353
Underwriters' Electrical Committee Meeting..... 447
Union-Allgemeine Combination in Germany..... 470
United Gas and Electric Company..... 95
United States, Coal Deposits of the. By W. L. Abbott. (Association of Edison Illuminating Companies) 280, 281
United States, Electrical Patents Granted by the, A Survey of. By Story B. Ladd. (Census Bulletin) 181, 182, 198, 214, 215
United States, Mineral Products of the..... 123
United States Mining and Trading Company's Automatic Smokeless Stoker. Illustrated..... 298
United States Navy to Protect Haytian Cable..111, 118
United States Patent Office, Report of the, for the Year Ended June 30, 1902..... 279
United Telpherage Company, Appliances of the. Illustrated 143
University of Chicago, Light, Heat and Power at the. Illustrated 33, 34, 35
University of Chicago, Technology School of..... 470
University of Illinois, Branch Meeting of the Institute at the 403
University of Michigan, New Engineering Building at. Illustrated 168, 169
Units for Electrochemical Calculations. By Alfred H. Cowles. (American Electrochemical Society).. 325
Universal Exposition of St. Louis in 1904, Extent of the. By W. E. Goldsborough. Illustrated.... 382
Unusual Features of the Natural Food Company's Plant. By Frank C. Perkins. Illustrated.....54, 55
Utah, Telephone Opposition Assured in..... 388

V

Vanderbilt's, Alfred, Electric Plant..... 318
Van Horne, John, Death of. Portrait..... 442
Variable Speed Control, Electric. Illustrated. (Papers and discussions before the American Institute of Electrical Engineers)..... .....380, 381, 404, 405, 406, 432, 433
Vaults, Government, Electrical Protection for..... 442
Venezuelan and Haytian Waters, Cables Cut in.... 118
Virginia City, Nev., C. & C. Shaft at, Electrical Mine Equipment of the. By Leon M. Hall. Illustrated 117, 118
Vreeland, H. H., Address of, as President of the American Street Railway Association..... .....246, 247, 258, 259, 274
Vreeland, H. H. Portrait 235

W

Wagner Single-phase Motor Upheld in Patent Suit.. 280
Walker, Miles. (The Electrostatic Wattmeter in Commercial Measurements. Illustrated)..18, 19, 20
Ware, J. B. Portrait 395
Warren's, Mr., Wemco Wins Interlake Regatta. Illustrated 75
Washington, Baltimore and Annapolis Electric Railway. Illustrated 142, 143, 169, 234, 238, 239, 240, 367
Washington, Ind., The Church Telephone Situation at 77
Waterpower Development on Drainage Canal Below Joliet. Illustrated 43, 57, 72, 75, 85, 86, 87, 107, 123, 299, 353, 431
Waterpower Development, Sault Ste. Marie.107, 290, 311
Waterpower Possibilities in Arizona.....39, 73
Water Supply, Purification of, by Ozone. (Editorial) 292
Waterwheel Governor, New Replogle. Illustrated.. 60
Wattmeter, The Electrostatic, in Commercial Measurements. By Miles Walker. Illustrated. (American Institute of Electrical Engineers)....18, 19, 20
Waves, Electric, A Radiometric Receiver for..... 21
Webb on the Accuracy of the Zero in a Dynamophone. 24
Wells, W. F. (Five New York Power Stations. Illustrated) 400, 401
Wemco, Mr. Warren's, Wins Interlake Regatta. Illustrated 75
Werno, Charles. Portrait 271
Westbury, Harry. Portrait 335
Western Electrical Supply Company's Portable Electric Hammer. Illustrated 198, 199
Western Electrician, Annual Fall Trade Number of the. (Editorial) 174
Western Electrician's Estimates of Electrical Manufactures Compared with Census Report. (Editorial) 154
Western Telephone and Telegraph Company..... 212
Western Union's Annual Report 275
Western Union Telegraph Company, Affairs of the.. .....1, 135, 160, 194, 215, 275, 447
ments in. Illustrated 3
Westinghouse Automatic Car Circuit-breaker. Illustrated 126
Westinghouse Electric-vehicle Equipments. Illustrated 12
Westinghouse Industries at Trafford City, Pa., New. 240
Weston Direct-current Instruments, New. Illustrated 43
Weston Instrument Patents Upheld..... 467
White, L. G. (Methods of Increasing Central-station Business and Improving Load Curves) 294
White River Development by Snoqualmie Falls Company 329
White Speed-regulating Device. Illustrated..... 127
Wiley, H. W., Combats Crooke's World-starvation Theory 179, 180
Wilcox on Gas and Electric Lamp Renewals..... 135
Wilmington's Claim to Distinction 388
Wireless Power Transmission Wanted for St. Louis Exposition 38, 42, 111, 141
Wireless-signal Systems, Receiving Device for. Illustrated 397
Wireless-telegraph Apparatus, Pickard. Illustrated. 169
Wireless Telegraph, De Forest-Smythe. Illustrated. 39, 104, 111, 195, 468
Wireless-telegraph Messages, Two, Read Simultaneously. By L. De Forest. (Communication). 111
Wireless Telegraphy, Armstrong-Orling System of.. 79
Wireless Telegraphy for the Great Lakes..... 54
Wireless Telegraphy on Fast Express Train....408, 409
Wireless Telegraphy, The Seamy Side of. By A. Frederick Collins 94, 95
Wireless Telegraphy. (See also Marconi and Space Telegraphy.)
Wireless Telephony, Ruhmer, Experiments with.... 124
Wireless Telephony, The Speaking Arc and. By Ernst Ruhmer. Illustrated. (Communication).. 53
Wireless Tests Over Land, Long-distance, by Marconi 39, 122, 195, 311
Wires, Electrical, Used in Railway Signaling, Average Life of. (Editorial) 348
Wiring of Building Is by Another, Charging Extra for Transformer when 7
Wiring, Overhead, in Chicago 325
Wiring Regulations, Stringent, in New Britain, Conn., Modified 160
Wisconsin Traction, Light, Heat and Power Company's Plant in Appleton, Wis. 299
Wolcott, E. R. (Effect of Electrolytic Condensers in Alternating-current Circuits) 68
Woman Telephone Operator in Texas, A..... 77
Woodbury, C. J. H., on the Telephone System..... 58
Wood-working Establishment, Induction Motors in a. 409
World's Submarine Cables, The 158
Wright Demand and Electrolytic Meters, Improve-

X

X-ray, Curious Use of the, Proposed for Japan. (Editorial) 444
X-ray in Personal-injury Claims..... 309
X-ray Work, New Development in..... 300

Y

Yerkes, An Interview with..... 443
Yerkes-Morgan Railway Contest in London..... .....55, 95, 160, 327, 443
York, Pa., The Lighting Situation in..... 362

Z

Zambesi River Power Plant, Proposed 95
Zero in a Dynamophone, Accuracy of the..... 24
Zinc, Production of 75
Zossen-Berlin High-speed Trials.....106, 349

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, JULY 5, 1902. No. 1

Storage-battery and Booster Equipment of the Chicago City Railway.

The downtown portion of the electric-railway system of the Chicago City Railway Company became so heavily taxed during last year that it became necessary to raise the voltage on the feeders in that section. This has now been accomplished by a booster and storage-battery plant which was installed in the company's cable-power plant at Twenty-first and State Streets. The plant takes the peak of the load in the business district and is charged from the line at 450 to 500 volts. The specifications of the storage battery designate that it is to be operated as a line battery, to be charged from the line when the voltage is at least 450 and discharged on morning and evening peaks, the voltage to be increased at these times as high as 500, to throw the load on the battery. The plant was placed in operation early in the present year and has served its purpose very satisfactorily. As a rule, the battery is charged from 1 a. m. to 3:30 a. m., discharged from 7 to 8 a. m., charged again from 10 to 12 a. m., and discharged from 5 to 6:30 p. m.

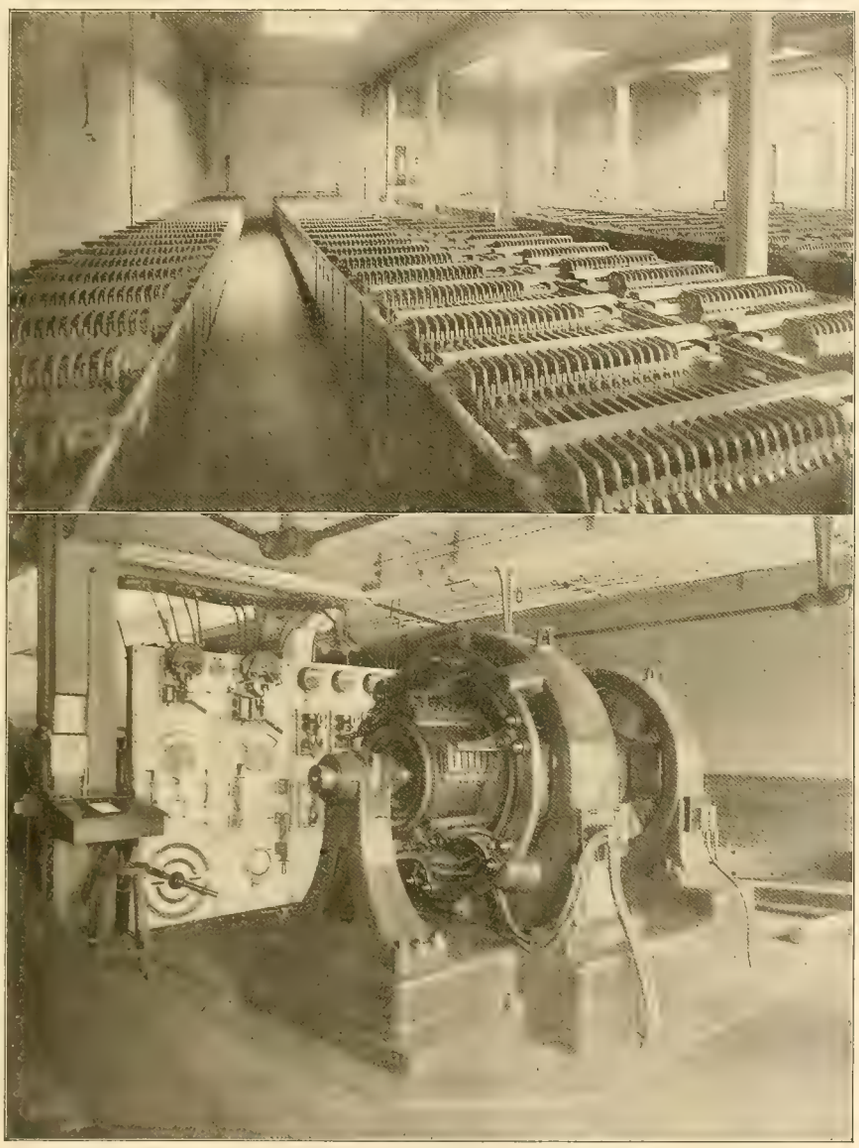
The storage battery, shown in the upper illustration, is located on the second floor of the building and consists of 250 type-G39 Chloride cells, installed by the Electric Storage Battery Company. It has a capacity of 1,520 amperes on a discharge of one hour, or nearly 800 kilowatts. Each cell has room for 51 plates, so the battery's capacity can be increased to 2,000 ampere-hours. The maximum voltage of the battery is 625 volts.

The booster and switchboard for regulating the equipment are located on the ground floor, as shown in the lower picture. The former is of the Western Electric Company's make and consists of a 170-horsepower, shunt-wound motor, mechanically connected on the same shaft to the generator, which has a differentially wound field and is so arranged that the current through it may be reversed. The motor is fed from the line at 500 to 625 volts and has a capacity of 290 amperes. It draws its current from either or both of the company's two electric generating stations located at Forty-ninth Street and Oakley Avenue and Fifty-second Street and Wabash Avenue. When it is desired to draw particularly from one of these stations, that plant's outgoing voltage is raised above that of the other station.

The generator end of the booster is wound for a current of 1,333 amperes at from 75 to 175 volts, the unit revolving at 600 revolutions a minute. The booster adds its voltage to that of the line or battery. In discharging the battery the actual amount of current discharged can be regulated exactly by means of the booster, and by means of a special rheostat the battery can be used to help out only the peaks of the load or to take care of the peaks and also part of the regular load. Usually the battery is discharged on a two-hour run at about 1,000 amperes.

The switchboard comprises a motor panel, a generator panel and three feeder panels, all built of white marble. The motor panel contains a 500-ampere General Electric circuit-breaker, a Weston 750-volt illuminated-dial voltmeter, a three-pole starting switch, a field switch, a two-pole switch for throwing the motor on either the battery or line and a controlling handle for the rheostat. At the top of the generator panel is a 2,500-ampere circuit-breaker, mechanically connected to the circuit-breaker on the motor panel, so that the machines can be cut out simultaneously. This panel also contains a 2,000-ampere switch for throwing the booster on the line, and a two-pole switch of the same capacity for connecting the battery either to the line or generator end of the booster. A recording voltmeter is also provided.

There are three feeder panels and each is provided with an ammeter, circuit-breaker and switch. These panels are connected to taps brought in from three feeder sections, and are so arranged that the discharge of the booster may be thrown on any one or any combination of those feeders, as the load demands. The sections mentioned supply the Clark Street, Archer Avenue and Wentworth Avenue lines.



STORAGE-BATTERY AND BOOSTER EQUIPMENT OF THE CHICAGO CITY RAILWAY.

Before the battery plant was placed in operation the voltage of the Clark Street end of the company's system would frequently be as low as 300 or 250 volts. While this has been bettered to some extent, the principal advantage of the new plant has been in making it possible to handle on the Wentworth Avenue line 125 new large double-truck cars, that could not have been operated by the old system. These cars are each equipped with four 35-horsepower, GE67 motors and measure 47 feet over the bumpers. Each car weighs 48,000 pounds when empty and will seat 52 people. The smaller single-truck cars that were replaced have been transferred to other lines of the company's extensive system.

In a way this storage-battery-booster installation is of a temporary nature, in its present location. When the new alternating-current generating station is built, which the company now has under consideration, rotary-converter sub-stations will be used to distribute the direct current, and this booster outfit will be used as it is now to help out the peak in some section, and will be located directly at a sub-station.

As a further help to take care of the increasing load in the downtown district, the company is planning to install additional generating capacity at Twenty-first and State Streets this fall. The machinery will consist of two Wheelock-Corliss engines, direct-connected to 650-kilowatt General Electric railway generators. These units will be placed in the machine shop, which is to be vacated as soon as the new shops are completed at Seventy-seventh Street. These changes are being made under the general direction of General Manager Robert McCulloch and the more immediate supervision of Richard McCulloch, assistant general manager of the company.

Telegraph Companies' Competition.

Official announcement has been made of the agreement between the Postal Telegraph-cable Company and the Pennsylvania railroad, by which the Postal company acquires the exclusive right to transact commercial telegraph business on the lines belonging to the railroad system east of Pittsburg and Erie, Pa., and to string wires on the railroad company's poles and rights-of-way. The agreement was expected to take effect July 1st, and transfer of offices to the Postal system will be made as rapidly as possible after that date. It is understood that similar agreements covering the remainder of the railroad company's system will be put in force as soon as the existing contracts with the Western Union company expire.

The agreement just consummated will take away from the Western Union system and add to the Postal system all offices and the telegraph lines on 4,745 miles of railroad in a populous and important section of the country.

This is certainly a serious blow to the Western Union company, and the allied Postal Telegraph and Commercial Cable companies have been active in other directions also. One great stroke is the laying of a Pacific cable, which now seems assured, by the cable company. The Postal company has within the last two years made substantial gains in various other directions, notably in the acquiring of branch offices in all the principal hotels of the country. It has also won numerous condemnation suits in various states, thus establishing its right to construct its lines upon railroad rights-of-way. It is said to be expending over $1,000,000 a year in the extension of its lines in all directions.

It is understood that the Pennsylvania Railroad Company has made an offer to purchase the existing pole lines belonging to the Western Union Telegraph Company occupying its territory. The poles are valued by the Western Union at $300 a mile and the wire at $50 a mile for copper and $30 a mile for iron. The upset figure offered by the Pennsylvania company, it is said, is $50 a mile for poles and $10 a mile for wire. Claim is made that as both poles and wire are old they are of considerably less value than actual construction prices. There is hint of litigation before the matter is finally settled.

There is some newspaper gossip of the possibility of a consolidation of the two great telegraph companies, but the report is probably pure conjecture.

Benson, Minn., has decided in favor of municipal ownership of the electric-light plant.

Edison Electric Meter.

On October 23, 1900, Thomas A. Edison was granted a patent for an electric meter in which there is employed a constant-speed motor, which drives a register at a speed substantially proportional to the current consumed. Certain improvements in the meter are covered by a patent issued to Mr. Edison last week, the object of these improvements being to simplify the construction and increase the efficiency of a meter of this type.

Fig. 1 is a front elevation, partly in section, showing the operative parts of the improved meter; Fig. 2 is a diagram of the motor circuits. (1) represents an electric motor of any suitable type, the armature (2) of which is mounted on a vertical shaft (3). This shaft is stepped on a block (4) of phosphor-bronze, or other hard material, which is received in a vertically adjustable cup for holding oil, so as to lubricate the shaft.

The register (25) and the elements carried thereby are preferably counterbalanced by counterbalance weights (34). Connected to the scale beam at one end by means of a knife-edge connection (35) is a core (36) of an ampere indicator, the core being made, preferably, of the purest Norway iron. In order that this core may be made as light as possible, it is preferably hollow, as indicated, and may

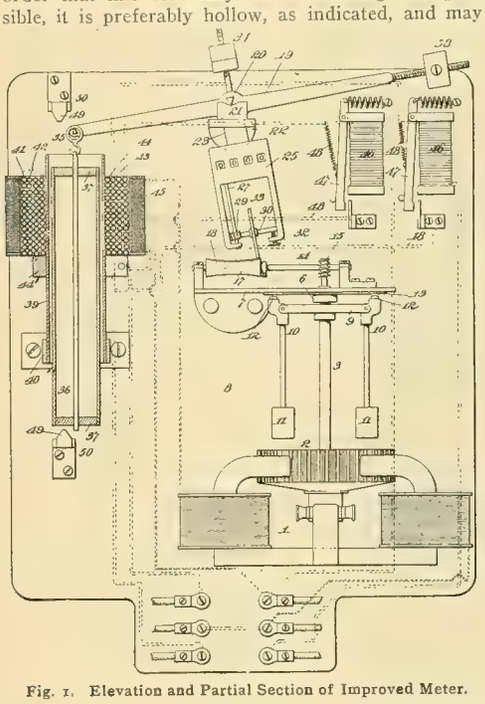


Fig. 1. Elevation and Partial Section of Improved Meter.

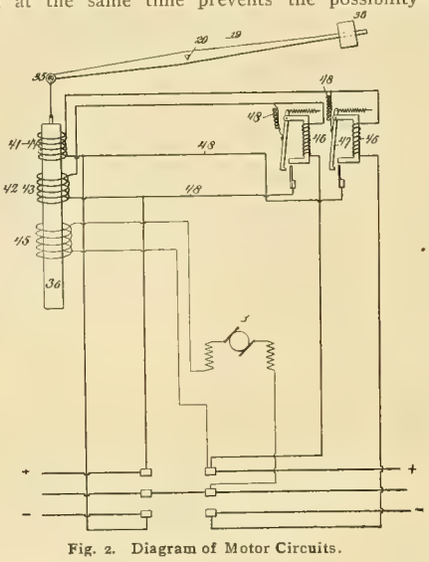


Fig. 2. Diagram of Motor Circuits.

EDISON ELECTRIC METER.

be provided at its ends with plugs (37). At the opposite end of the scale beam is an adjusting weight (38), which sufficiently counteracts the weight of the core (36) as will permit the latter to be moved to extents proportional to the current consumed when the coils are energized by such current. The ampere-indicator coils are wound, preferably, on a copper tube (39), which is suitably carried by a support (40), secured to the plate (8). The meter illustrated is intended specifically for use on a three-wire system, in which case each of the outside wires (see Fig. 2) is in series with one set of solenoid coils, which are wound on the tube (39). Preferably with the three-wire meter, these coils are arranged in the four sets (41), (42), (43) and (44), as shown in Fig. 1, each set being formed of a single layer of comparatively coarse insulated wire helically wound in position. The outside coil (41) is connected with the inside coil (44), as shown, and the coils are arranged in series, for example, with the negative main, as shown, while the inner coils (42) and (43) are connected together and are arranged in series with the other main. By this arrangement the combined magnetic effect on the core (36) of the coils (41) and (44) is substantially equal to the combined magnetic effect thereon of the coils (42) and (43), whereby corresponding movements of the core (36) will be produced by a corresponding current in either the positive or negative main.

The operation of the meter is as follows: Normally the friction wheel (33) will be almost in engagement with the narrow end of the cam (18). When the meter is properly connected up for use with the motor in multiple, the latter will commence to operate until its speed reaches the desired point, whereupon such speed will be maintained constant by the centrifugal-speed governor (10). The slight current which traverses the motor also influences the corrective coil (45) to overcome the magnetic inertia of the core (36), so that when any current influences the ampere coils on either or both the outside mains the core (36) will be attracted to the proper proportionate extent, swinging the scale beam (19) on its pivot and causing the friction wheel (33) to be engaged by the proper part of the cam (18), as to give the desired rate of registration. This movement of the scale beam (19) under the influence of the current to be measured can take place without resistance during that portion of the rotation of the shaft (14) when the cam is withdrawn from engagement with the friction wheel. At this time the ampere indicator will be free to adjust itself to the current to be measured absolutely independent of any friction other than the negligible friction imposed by the knife-edge pivots (20).

At each rotation of the shaft (14), therefore, the cam (18) will engage the friction wheel (33) to move the same in a smaller or larger arc, according to the current to be measured, and in this engagement between the cam and the friction wheel the latter will be slightly elevated to lift the free end of the shaft (30) from the adjusting screw (32), the shaft falling back upon such adjusting screw after the cam has ceased to engage the friction wheel. By thus regulating the adjusting screw (32) so that the lower edge of the friction wheel will be slightly below the plane of the cam (18), whereby the latter will slightly elevate the friction wheel at each engagement therewith, Mr. Edison does away with the necessity of securing a constant and delicate adjustment between the cam and friction wheel and at the same time prevents the possibility of any lost motion due to ordinary wear of either of the elements.

By winding the solenoid coils upon a copper tube he dampens or makes sluggish the movements of the core (36), (without, however, affecting the accuracy of the indicator), owing to the generation of Foucault currents in the tube, due to variations in the strength of the coils produced by changes in the current to be measured. When a destructive current traverses the circuit, as may occur in the case of a short-circuit beyond the meter, the magnetic cut-out or cut-outs (46) will close one or both of the shunts (48) to short-circuit the ampere coils.

Geary Street-railway Proposition in San Francisco.

City Engineer Grunsky of San Francisco has completed his estimate of the cost of reconstructing and maintaining the Geary Street railway under municipal ownership. The project is explained as follows: Main line, electric conduit system, 4.9 miles long from the ferry to the junction of Market and Geary Streets, thence along the present route to Fulton Street and Tenth Avenue; an extension to the ocean, overhead trolley, 2.35 miles long on C Street, from Tenth Avenue to Great Highway; extension on Nineteenth Avenue, overhead trolley, three miles long, from C Street across Golden Gate Park, to Ocean Avenue; crosstown line, overhead trolley, 5.8 miles long, on Chestnut Street, from the Presidio to a terminus at Illinois Street. The Second Street branch is not included in the present report, it being assumed that transfer arrangements can be made with other roads. The total cost is estimated at $2,250,000. Eliminating the lines from C Street to the ocean and from Nineteenth Avenue to the Sunset District, the cost would amount to $1,836,000. An estimate of the cost of operation and maintenance of the line proposed from the park direct to the ferries, without laterals is as follows: Operation per annum, $144,290; maintenance and deterioration account, $33,000; interest, $29,750; total, $207,040.

Cincinnati-Toledo Electric Railway a Possibility.

Writing from Columbus, under date of June 28th, the Ohio correspondent of the Western Electrician says: "According to an interview with H. C. Lang, a member of the Mandelbaum-Pomeroy syndicate of Cleveland, great things are contemplated for this summer and next spring in the way of long-distance electric-railway service. It was hinted in this correspondence some time ago that there was possibly a plan on foot to connect Cincinnati and Toledo by means of the Cincinnati, Dayton and Toledo Traction Company's lines and the Western Ohio Traction Company's system, and now, according to this interview, this report is confirmed. The Southern Ohio lines extend from Cincinnati to Dayton. From the latter city to Piqua, the Clegg-Winters people own the line, and from Piqua to Findlay, a distance of 80 miles, the Western Ohio Traction Company controls a road, the part from Wapakoneta being already in operation. From Findlay to Toledo the Toledo, Bowling Green and Southern Company operates a line. Hence, the only building now required is between Piqua and Wapakoneta. According to Mr. Lang, all the roads mentioned will be used, and an electric express will be put on to make the distance between Cincinnati and Toledo in eight hours. Sleeping cars, buffet and parlor cars will be put on, and a freight business will also be done. It is said that the Western Ohio company will have its line in operation within 60 days, and that the entire line will be running late this fall or early next spring. The Mandelbaum-Pomeroy syndicate now controls 140 miles of this line, which will be 204 miles long. The Western Ohio Traction Company, at a meeting of the stockholders a few days ago, made arrangements to dispose of $500,000 worth of securities, and this money will be used in completing the system."

Death of Edward H. Jenkins.

Edward H. Jenkins of San Antonio, Texas, the president of the Southwestern Gas, Electric and Street Railway Association and of the San Antonio Gas and Electric Company and the San Antonio Traction Company, died recently. Mr. Jenkins was prominent and energetic in promoting the interests of the Southwestern Association. H. A. Evans, secretary of the association, says of him: "He was recognized as possessed of exceptional executive talent, and was thoroughly conversant with all minor details of the trade. His wide acquaintance throughout the country has greatly extended his beneficent influence, for he held to a marked degree the confidence of those he became associated with. His thoughtful consideration of the necessities of the employes of the companies under his management and his careful attention to matters involving their comfort, welfare and happiness won for him their lasting affection."

Electrical Exports in May.

Electrical exports from the United States in May, 1902, were valued at $907,727, of which $443,345 represents electrical machinery and $464,382 electrical appliances, including telegraph and telephone instruments. This is a decrease in the exportation of electrical machinery of $46,849, as compared with the corresponding month in 1901. Classified by destination, the principal exports of electrical machinery for May, 1902, were as follows: United Kingdom, $260,475; British North America, $90,078; countries of Europe not elsewhere mentioned, $24,383; Mexico, $17,024; Central American states and British Honduras, $11,271; Germany, $10,160; British Australasia, $9,550; Brazil, $7,989; Cuba, $2,855; France, $2,153; Japan, $1,820; Africa, $1,742; Colombia, $1,359.

Electrical Association of New South Wales.

The 1902 session of the Electrical Association of New South Wales was held at Vickery's Chambers, Sydney, in the early part of April. Officers for the ensuing year were elected as follows: President, J. R. Bainton; vice-presidents, J. H. D. Brearley and J. R. W. Gardan; counsel, A. C. F. Webb, O. W. Brain, F. E. Bradford, E. C. Daubeny, A. A. Dircks, O. Haes and E. Noyes; treasurer, G. R. Hodson; secretary, E. F. Moates. J. R. Bainton, president of the association, delivered the annual address, reviewing the work undertaken by the association. He showed that the inauguration of the federal tariff, if left without any further alteration, would seriously hamper the progress of the electrical industry, by reason of its high duties on electrical material and machinery generally.

Improvements in Wright Demand and Electrolytic Meters.

Extensive improvements have been brought out by Arthur Wright of Brighton, England, in his well-known type of maximum-demand meters and also in the integrating electric meters of the electrolytic mercury type. It is claimed that meters of the latter type have hitherto been unsuccessful in practice, but good results have been obtained by means of Mr. Wright's improvements.

Fig. 1 illustrates a form of electrolytic mercury meter which is said to have given excellent results in practice. In this form (1) is the main chamber of the meter, hermetically closed at all points except at the point (2) where it is closed by the ground-glass stopper (3); (4) is the electrolyte, which may consist of a solution of mercurous nitrate or other suitable solution; (5) the anode chamber containing

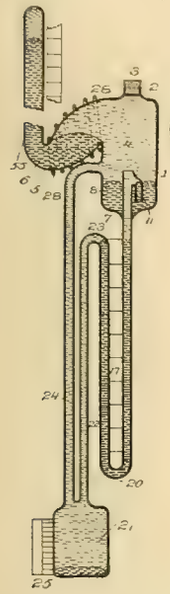


Fig. 1. Electrolytic Mercury Meter.

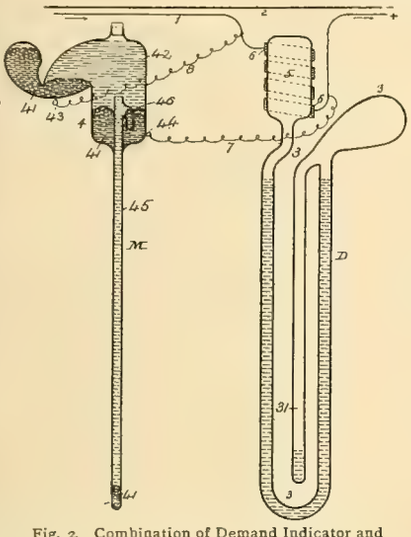


Fig. 2. Combination of Demand Indicator and Electrolytic Meter.

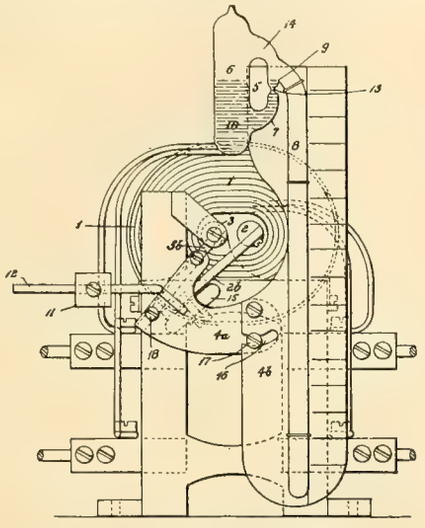


Fig. 3. Automatic Maximum-demand Meter.

IMPROVEMENTS IN WRIGHT DEMAND AND ELECTROLYTIC METERS.

the mercury anode (6), (7) the cathode chamber containing the mercury cathode (8), (11) the intermediate chamber, (20) the U-shaped tube constituting the equivalent of the first dial of a clock-train meter and measuring in units; (17) the scale for showing the reading of the first dial; (21) the receptacle constituting the equivalent of the second dial and measuring in tens or hundreds; (22) the tube connecting the receptacle with the upper part (23) of the second limb of the U-tube; (24) the tube connecting the receptacle with the main chamber (1); (25) the scale for reading off the level of the collected mercury in the receptacle; (28) the heating wire for setting up convection currents to lessen the chance of crystallization at the anode; (55) the anode feeder, consisting in this case of a long tube, which tube may be graduated, and serves as a check upon the reading obtained in tube (20), or in tube (20) and receptacle (21). Such check is not necessary, but is sometimes expedient to adopt for the purpose of convincing consumers of the accuracy of the registration.

The action of the meter is as follows, the instrument being usually arranged in shunt: When current passes, the volume of mercury constituting the anode decreases, while the volume of mercury constituting the cathode increases, the increase of the cathode being a measure of the electricity passed. The mercury overflows through the intermediate chamber (11), which allows the mercury to go through in very minute quantities, into the measuring tube (20). This tube or chamber is constructed so as to empty its entire contents into the receptacle (21) at a single operation. Instead of employing a mercury cathode, a platinum one may be used, or it may be made of a platinum-iridium alloy or carbon. The instrument is adapted for resetting by turning upside down.

In the metering of electricity it is now a common practice to employ not only an electricity meter as usually understood—such, for example, as a current or energy meter—but also in order that the charges may be determined in a more equitable manner another instrument—such, for example, as a demand indicator. A disadvantage which results from this practice is that as each instrument entails a drop in volts a double drop is thus involved. By means of another of Mr. Wright's inventions, however, he says he is able to employ both instruments with no further loss than is entailed by a single instrument.

Fig. 2 illustrates the application of the invention to the case in which both a Wright demand indicator and a Wright meter of the mercury electrolytic type are employed. In the drawing (D) represents a suitable type of a demand indicator—that is to say, an indicator for recording an extreme limit or range of a variable characteristic of an electric current within a certain period of time, or, more specifically stated, an indicator which will record the maximum or minimum current which has passed during any given period of time. This indicator is now in common use.

The heating strip (6) of the demand indicator is wrapped around the bulb (5) in any well-known manner. The passage of the current through the heating resistance causes expansion of the gas in the chamber (5), and thus forces the liquid in the U-tube (3) to the top of the limb of the tube removed from the chamber (5) and causes its overflow into the receptacle (31), which may be calibrated. It is evident that the amount of liquid in the receptacle (31) may be taken to measure the maximum amount of current which has passed through the heating coil (6), since the instrument has been reset and the receptacle (31) has been emptied.

The electricity meter (M) is of the mercury electrolytic type. As shown, it consists of a glass receptacle closed at all points and filled in part with a mass of mercury (41) and in part with an electrolyte (42). The anode (43) and the cathode (44) communicate with the masses of mercury, as shown.

The manner of connecting the demand meter (D) and the electricity meter (M) to the mains is shown in the drawing. The supply leads are numbered (1) and (2), and the heating coil (6) of the demand indicator is placed in circuit therewith. The electricity meter (M) is connected by the wires (7) and (8) in shunt to the demand indicator. As shown, it is connected in shunt to the heating resistances of this demand indicator.

As a means of automatically metering the current which passes through an electrolytic mercury meter, Mr. Wright has devised several appliances. These automatically indicate the decrease of weight of the mercury anode or the increase in weight of the mercury cathode, or, in still another method, register the movement of that part of the instrument which contains the two electrodes and the electrolyte. Such an instrument is shown in Fig. 3, in which (1) is the vessel containing the electrolyte (2), the anode (3), and the cathode (4), the anode having an anode feeder (20). The vessel (1) is held by a clip (21) pivoted at the point (22); (23) is a cord passing from a clip (24) attached to the lower part of the vessel (1) and passing over pulley (25) to a spiral spring (26), whose other end is attached to the fixed support (27). To pulley (25) is attached an index finger (28), adapted to traverse the scale (29); (30), (31) are platinum terminals connected with the anode and cathode, respectively.

When current is passed through the instrument, some of the mercury of the anode is dissolved in the electrolyte, which also deposits mercury on the cathode. The consequence is that the mercury of the anode decreases and that of the cathode increases in the well-known manner. As this takes place angular movement of the vessel (1) takes place in the direction shown by the arrow. This causes a slackening of cord (23), which is taken up by spring (26), and the index finger is moved along the scale from left to right. The greater the current which has passed within a given time, the greater the transfer of mercury, the greater the angular movement, and the further to the right is the position taken up by the index finger. The position, therefore, of the index finger on the scale gives a reading of the current which has passed.

An ingenious form of maximum-demand indicator invented by Mr. Wright is illustrated in Fig. 4. The indicator consists of a vessel of such form that liquid is cut off from one part, known as the reservoir, and is transferred by decantation to another part, known as the receiver, in proportion to the angular movement or tilting of the vessel. The instrument is shown in front elevation in the diagram.

The liquid container (5) when the instrument is first put in position has no liquid in the receiver (8), but only in the reservoir (6), and in the feed pipe (7), such liquid extending up to the level of the lip. When a current is passed through the coil (1) angular movement of a free armature core (3) takes place, (2) being a fixed armature core, and the container (5) is tilted to such an angle that some of the liquid flows over the lip and into the receiver (8), and the amount of liquid so transferred to the receiver is a measure of the current passed through the coil. If the current is cut off, the parts will be returned to their normal position by virtue of the weight (11), whose position is adjustable upon the bent rod (12) attached to the frame, but the liquid in the receiver will remain there.

If now the current be switched on again and be a smaller current than that previously passed, tilting will again take place, but no more liquid will pass from the reservoir (6), as the angular movement will not be so great as on the previous passage of the current. If, however, a current be passed through the coil greater than that previously passed, a greater amount of tilting or of angular movement will take place than was formerly the case, and more liquid will be transferred to the receiver. Hence the amount of liquid found in the receiver after a definite period of time will give an indication of the maximum current which has passed through the coil during that period.

To enable the liquid to be returned to the reservoir and feed pipe after the maximum current—at the quarterly reading of the meter—has been taken, the upper part of the receiver may be connected to the upper part of the reservoir by a tube (14), termed the "replacing tube," so that on turning the container upside down the liquid will flow from the receiver into the reservoir. The strength of the field and the repulsion between the armature cores will vary with the ampere-turns, so that the field may have two windings and may be adapted for a three or more wire circuit.

Mr. Wright has also devised a direct-current electrolytic meter, by means of which the drawbacks arising from polarization or back electromotive force are obviated, and has constructed accurate and reliable meters through which only a fraction of the total current need be passed. The invention consists of a battery, a thermal couple, or the like, arranged to counterbalance or compensate for the back electromotive force of the electrolytic cell. Improvements in maximum and minimum recording meters have also been devised by Mr. Wright, comprising various types of expansion bulbs, index tubes, etc. All these inventions enumerated are covered by a series of seven United States patents, numbered 702,844 to 702,850, consecutively, granted on June 17th. The patents are all assigned to the Mutual Electric Trust of Brighton, England.

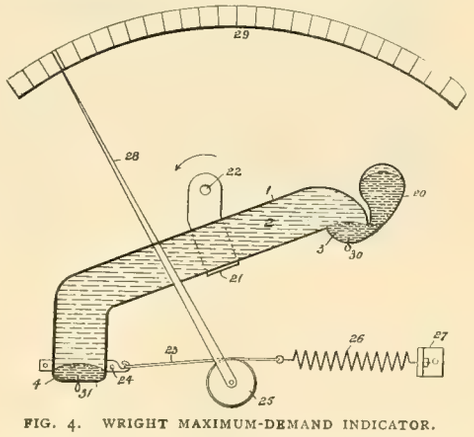


FIG. 4. WRIGHT MAXIMUM-DEMAND INDICATOR.

The county commissioners at Logan, Utah, have granted the Telluride Light and Power Company a franchise for a single-track electric railroad. The franchise covers the principal thoroughfares from Logan to Hyrum and from Wellsville to Mendon.

Use of the Telephone in Operating Railroad Trains.

PART I.

One of the most interesting topics considered at the convention of the Association of Railway Telegraph Superintendents held in Chicago on June 18th-20th last was the use of the telephone in railroad service. Following is given an abstract of this important discussion, starting with a description by U. J. Fry, superintendent of telegraph of the Chicago, Milwaukee and St. Paul Railroad Company of Milwaukee, of an apparatus used for operating a duplex circuit in connection with a quadruplex circuit:

Mr. Fry: We have found that it is a very useful accomplishment to be able to work a wire from Chicago to Milwaukee quadruplex and a wire from Milwaukee to Minneapolis, 350 miles, single with 17 offices with which Chicago alone works locally. From investigation we found that 50 per cent. of the messages handled between Chicago and those offices were with the Minneapolis office. It occurred to us that if we could increase the capacity of that single wire during the time Chicago was working we would decrease the working hours of the wire 25 per cent. In connection with the duplex wire now handling it we found it practical to drop one or two of the local offices at the distant end and relay the messages at the Minneapolis office, thus increasing the capacity of the wire, that was previously worked single, 30 or 40 per cent.

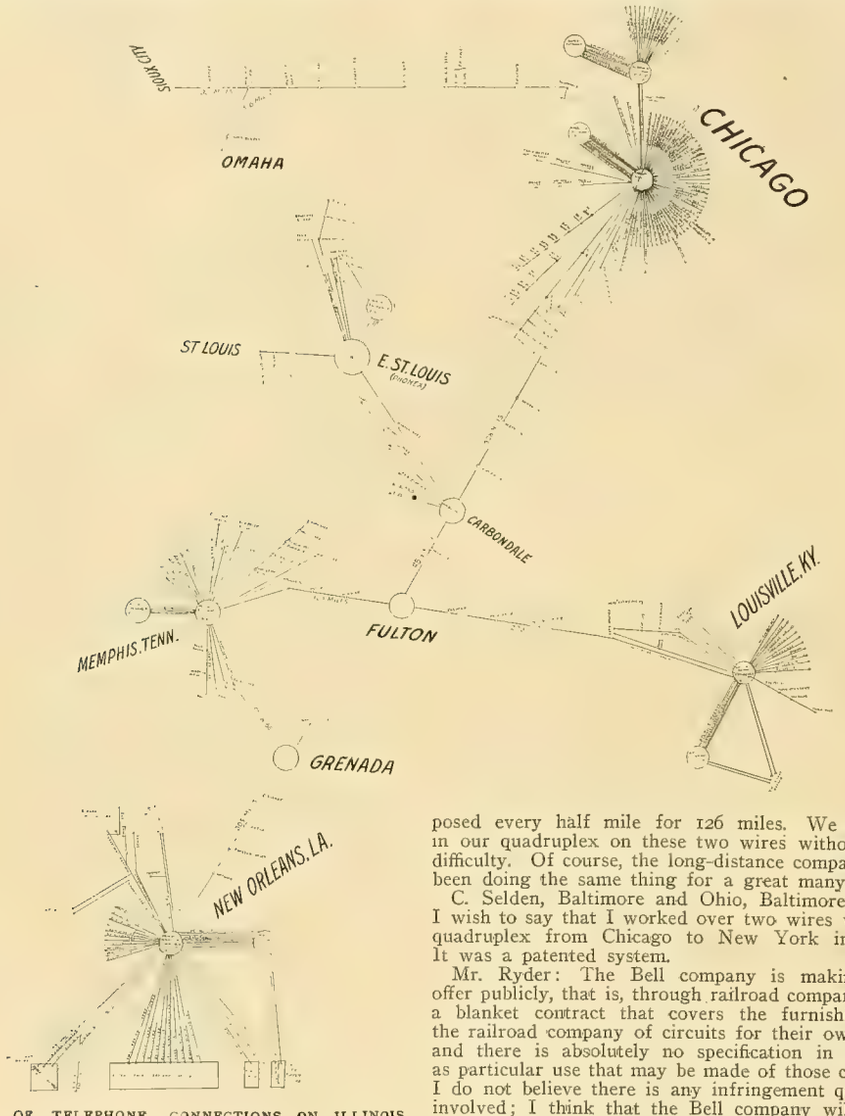


DIAGRAM OF TELEPHONE CONNECTIONS ON ILLINOIS CENTRAL RAILROAD.

While we were considering the matter of duplexing this single wire with 17 offices with 150-ohm relays a great many of our friends were inclined to be sceptical. We installed the apparatus and started out with a resistance in our rheostat of 10,800 ohms, that being our balance, as we were using a dynamo current, which, of course, included the resistance behind the machines at each end. During clear weather we balanced at 10,800 ohms; in rainy weather we would get a resistance down as low as 6,500 ohms, and it worked all right. As to the static, we have used only a portion of one condenser. The wire works perfectly. It works so well that our chief operator in Chicago sent a message shortly after we had introduced the service asking me if it would not be advisable to remove some of the local offices and relay the work at Minneapolis; he said at the same time that the No. 134 (what is known as our single wire when duplexed) worked better than any other wire out of Chicago.

It has been generally understood by us, and no doubt perhaps by a great many others, that it was impossible to work quadruplex or duplex over a Morse relay. Why it should be considered so, I am unable to say. Duplexing of a single wire over Morse relays is an easy matter. If you have a single circuit on which most of the business, or as much as 50 per cent., is handled between terminals, you might as well duplex it and work double between terminals, and locally when they are clear.

W. W. Ryder, Chicago, Burlington and Quincy, Chicago: In this connection, it may be of interest that the idea that originally prevailed that a composite telephone and telegraph system could not be worked as a part of a quadruplex circuit is a fallacy; there is an idea prevailing that an impedance coil, which is necessary to confine a telephone current within certain limits, would act as a bar to the successful working of a quadruplex, particularly the common side; but experiment has proven that that is not the case; and for some time I have been using a composite circuit as part of a quadruplex circuit with perfectly satisfactory results.

H. V. Miller, Chicago and Alton, Bloomington, Ill.: We are using two telephone wires that have been put up for telephone purposes, only they are transposed every half mile for 126 miles. We couple in our quadruplex on these two wires without any difficulty. Of course, the long-distance company has been doing the same thing for a great many years.

C. Selden, Baltimore and Ohio, Baltimore, Md.: I wish to say that I worked over two wires worked quadruplex from Chicago to New York in 1886. It was a patented system.

Mr. Ryder: The Bell company is making the offer publicly, that is, through railroad companies, of a blanket contract that covers the furnishing by the railroad company of circuits for their own use; and there is absolutely no specification in so far as particular use that may be made of those circuits. I do not believe there is any infringement question involved; I think that the Bell company will meet us more than half way on that question.

President J. H. Jacoby, Lehigh Valley, South Bethlehem, Pa.: I would ask Mr. Ryder what the resistance of the impedance coils is that he uses with the quadruplex?

Mr. Ryder: We use 500 ohms, fixed magnets.

Mr. Miller: We find that this hardly can be called an impedance coil in the sense of the diagrams or prints that we got up. We use no bar magnets across the top of the coils at all; they are simply a helix of wire with a certain amount of resistance in each one. It works better that way than it does with bars across the top or across the top and bottom both. It works perfectly quiet at all times except when one of the telephone wires should happen to have a bad connection or a little more resistance for any cause that may come on on the other side. You can use that for simple Morse as well as for quadruplex, of course; but we found in our experience that the line was very much more quiet when the quadruplex was cut in than it was when we had simple Morse sets cut in.

Mr. Ryder: Apparently Mr. Miller and I are getting at the same thing in different ways. The coils that we are using are strictly impedance coils with closed magnetic circuit, so that apparently the same law will apply to both of them.

President Jacoby: Have the gentlemen had any experience with quadruplex parallel with telephone lines from inductive noises?

Mr. Miller: We have, I presume, probably eight or 10 quadruplex wires in the same line. The line we have our telephonic wires on has 27 wires on it. By properly transposing those wires there is no noise on it. It is as quiet as if strung around this room.

C. F. Annett, Illinois Central, Chicago: We have, say, about a 1,000-mile metallic circuit, with 2,000 miles of wires, in different parts of our system, quadruplexed, phonoplexed, and everything else; and the lines are perfectly quiet. We have between Chicago and Kankakee 56 miles of quiet circuits, phonoplex. Between Indianapolis and Fulton, Ky., and between New Orleans and Jackson, Miss., they are transposed every half mile, and perfectly quiet.

Mr. Ryder: I want to ask if Mr. Annett has successfully transposed against the inductive effect of the phonoplex?

Mr. Annett: We do not get any effect from it whatever. We have phonoplexed the whole distance from Chicago to New Orleans with the exception of a small piece between Water Valley, Miss., and Jackson, only a few miles. Our telephone circuit is completed 190 miles north from New Orleans; then north of Fulton, Ky., to Memphis, about 350 miles, the phonoplex runs parallel with the telephone circuit; then from Chicago south at the present time about 60 or 70 miles. You cannot hear anything at all from the phonoplex or quadruplex there. It is transposed every half mile.

President Jacoby: How long is your longest telephone circuit?

Mr. Annett: The longest at the present time is about 400 miles; but this is increasing every day, because we have four or five gangs of men stringing wire right along. By July 8th we will have Chicago and New Orleans connected; by way of Memphis it is 933 miles on that circuit.

President Jacoby: You have, as I understand, 400 miles of wires parallel with other wires that have the phonoplex thereon?

Mr. Annett: Yes, sir; we are using those circuits right along; the telephone wire is what we call a No. 10 B. & S. gauge; but it is larger than that. It is 173 pounds to the mile, and of copper.

President Jacoby: Are there many cables in that telephone circuit of 400 miles?

Mr. Annett: There is one place, like Ponchartrain, where we are using cable, but not in the same cable as the Western Union. We keep out of telegraph cables leading into offices. We use a duplex twisted insulated wire.

President Jacoby: One more question: Is your longest phonoplex running parallel with those telephone wires?

Mr. Annett: The longest phonoplex running parallel with telephone wires is the circuit, Chicago to Carbondale, 306 miles. Then, on the same wire we have practically from Carbondale to Jackson, Tenn., about 167 miles. We use the ordinary small spark coil furnished by the Edison company, and about 14 cells battery; we are working 306 miles phonoplex; that is practically the best circuit we have.

P. W. Miller: I would like to ask where those telephone lines terminate?

Mr. Annett: We are constructing line at the rate of about 30 miles a day at present. We have one circuit from Chicago to Dubuque, 186 miles, which is working perfectly. Then we have a circuit, Carbondale to Memphis, of 351 miles. We have also one extending south, through New Orleans to Jackson, Miss., that is 186 miles. We are using that circuit right along. At St. Louis we work through what is called the railroad "phonex," with which all the different railroads have a connection. In our office in St. Louis we have a number of departments there on circuit to Carbondale, 93 miles. That was the first circuit; that has been in operation about two months. It is used for all sorts of train details, yard details, communications between superintendent and trainmasters, instructions as to handling trains, arranging equipment, and arranging for special trains. The traffic department is using it in quoting rates. We expect to use it considerably for that. In fact, I think this morning we were a little short of telegraph facilities betwen here and Kankakee, between the superintendent's office and the trainmaster's, and it was suggested by the chief dispatcher that his stenographer be utilized part of the time to copy any of those messages. So we will send messages of that kind from the superintendent's office, some of which would be otherwise handled by mail; it will relieve the telegraph circuits, however, of probably about 50 messages a day in that particular locality.

L. B. Foley, Delaware, Lackawanna and Western, New York, N. Y.: I wanted to ask Mr. Annett if it was the object of his company in constructing so much telephone circuit to do away eventually with telegraph operators?

Mr. Annett: Of course, they say the main object was to increase our facilities for handling business, and whatever comes after that; and if we find we can handle business at certain points by telephone it might not be necessary to have operators. We may handle train orders if deemed advisable. The conductor may call for train orders himself, if it is not a telegraph station; probably we will equip the cabooses with telephones. We intend very shortly to equip wrecking cars with telephones, and let them be supplied with a connector so as to connect on to the two-wire metallic circuit, so that the wrecking crew can at once communicate with the train dispatcher at any point on the line, and conductors can communicate. Of course, those things will develop afterward. A good deal of the business that will be handled will be new business that never was thought of being handled by telegraph.

Just about a week or two ago the superintendent of the St. Louis division met me here, and gave me an instance of the usefulness of the telephone. He received a telegram to come to Chicago and see the general manager and talk with him in regard to certain improvements that were to be made at the East St. Louis yards. He was in St. Louis at the time; the message had been sent to him at his headquarters at Carbondale, and it was forwarded. In order for him to make the train for Chicago and take with him certain papers it was necessary for him to reach his office by wire and arrange to get the papers. He called up the phonex from the office of our general agent at St. Louis, where he was at the time, and made connection with our line at Carbondale, got his chief clerk, explained what papers he needed to be ready for him at Carbondale, and when he reached there the papers were in readiness; and he frankly stated that he could not have arranged that without stopping over a train, and do it surely and properly by means of telegraph messages, that it was necessary for him to explain in detail the nature of the papers, etc. But the papers were all ready and he came right on to Chicago in the morning in time for his appointment. He instanced this as an illustration of the many benefits that we are receiving from that line since it has been in operation.

We have only a few way offices on that line, Carbondale, Murphreesboro, and East St. Louis—three offices at the present time. There are at East St. Louis a trainmaster and the yard officers, who connect through that line with St. Louis proper. These officers have communication in this way direct with the general offices. About a week ago or more the superintendent at Freeport was arranging for some excursion trains at Rockford, and thought if he had a telephone connected there it would be a great advantage; so we got a telephone in the following morning; and he told me that it proved of great benefit to them in arranging for those excursions, and in going into detail as to just what was wanted.

P. W. Miller: I want to ask Mr. Annett if this so-called phonex at St. Louis is not a private-branch exchange of the Bell telephone exchange? Also, if his lines from Chicago out do not terminate in a private-branch exchange of the Chicago Telephone Company?

Mr. Annett: I have had a diagram made (page 4) showing these connections. The Chicago end is a private-branch exchange, furnished by the Chicago Telephone Company, and connecting with about 50 lines; then we have another exchange at Twelfth Street, connecting South Water Street, our local there, with another exchange. The line runs south to Carbondale, the next branch exchange; that is 308 miles. Next comes Memphis, Tenn., about 225 miles, with a switch at Fulton. The line from Fulton to Louisville is not started; it will be when the other lines between Chicago and New Orleans are completed, about July 8th. Memphis, Tenn., the next exchange, connects all our different offices and depots at Memphis. From Memphis the line goes by way of Granada, which is practically 100 miles. There is a switch at Granada, a small three-prong switch, with a line running north to Water Valley, which is the headquarters of the division; that is 29 miles from Granada. From Granada the line runs south through Durant, Miss., Canton, Miss., Jackson, Miss., and Macomb, to New Orleans. At New Orleans we have a branch exchange, which we lease from the Cumberland Telephone and Telegraph Company, a lessee of the American Bell Telephone Company. We have about 50 telephones in connection with that exchange. This line will be in operation to-night [June 19th] to Canton, Miss., 206 miles. The distance between Granada and New Orleans is 305 miles. The total distance from New Orleans to Chicago on this copper metallic circuit is 933 miles, and from Memphis, Tenn., to Fulton, Ky., and Louisville, 273 miles, where the private-branch exchange will be in operation in 30 days, with 30 telephones in connection. The line west to Omaha, 516 miles, is now completed to Dubuque, 183 miles. At Fort Dodge we have a two-way switch, with a line to Sioux City, 135 miles. The aggregate distance of all these circuits will be 1,950 miles when they are completed. There are now completed about 1,000 miles. We have about 75 offices here in Chicago. From Chicago south we are working with Kankakee. There is a gang now working south toward Champaign.

In my first experience in telephone lines I found difficulty in locating trouble in our long yard lines. The longest that we had of these was about 13 miles. I started in using a fuse block, bringing the two ends in. I first started using that in Memphis, Tenn., at one of our dispatcher's offices there in connection with the roundhouse; when there was trouble north he could not reach the roundhouse; so, by opening one side, we test in this manner. There is a metallic circuit comes in with a duplex wire. It brings both ends to that station: if there is a short-circuit on that, or a ground, you cannot do anything. If a line is in such shape, so much noise, that you cannot call up a station on the telephone, we call him up on the Morse, and tell him to open. Probably the first thing we will say is to cut out. The trouble man, as we call the lineman, can go to a telephone if hunting for trouble, and first open one side, and then the other.

You will notice that on this diagram we have between Chicago and Dubuque, 183 miles, only five offices; but at every station we dead-end the circuit at the office pole, and bring the end like that, which has a double connector. The lineman chasing trouble comes to this station, and he opens and puts in connection his test end. That is the standard; the Central Union and Chicago Telephone companies use these connectors, and we have already found them of great advantage. When we first started in we were not using them, but in a short time we found it was very important to have them; we put those right in between the two arms, double cross-arms, at the office pole. I believe it is a very simple cut-out. At times when we would want to get the best results along the line we would want an office cut out; we might have private conversation. So that cuts an office out. You can tell at once if anybody cuts in. Those plugs are also fused with 10-ampere fuses. In our short-line work we use down as low as one-half ampere, which blow out very rapidly. But now we are using five-ampere; the Central Union has adopted the same. In fact, we copied that from the Central. This idea of using an Edison cut-out struck me right at the first start, when we began building long lines, as being very simple and sure. It is either open or closed.

[*To be continued.*]

New Telephone Exchange at Saratoga.

Many new features that are of vital importance to the durability as well as the efficiency of a telephone system are embodied in the construction of the parts comprising the Independent system recently installed at Saratoga, N. Y. The main switchboard of the exchange, shown in the accompanying illustration, is a full central-energy lamp-signal multiple board, with double-supervisory clearing-out lamps. It is built with a frame capacity for 2,400 lines, with a present equipment for 500 subscribers. The frames are built with eight panels to the section, and arranged for three operators' positions. They are constructed of angle iron and well braced to make them strong and rigid. The sections are so made that when two or more are joined, they have the appearance of one solid frame.

The front and side of the switchboard, excepting the space for the jacks and signals, are covered with highly polished, dark-finish, solid mahogany cabinet work. The back of each section is provided with a dustproof roller curtain, made of heavy canvas and covered with dark red felt. The plug board is covered with mahogany-stained leather belting. The plug used is a two-way or metallic plug. It is of small, neat construction, but each part is of sufficient strength to make it strong and durable.

The supervisory lamps are placed into a fiber tube, which is provided at its top with a collared setting, holding the opalescent jewel. The glass jewel is protected from impact by the plugs, by an arched-wire protector fastened to the collar of the setting. This arched wire also serves as a handle, so the tube with lamp may be readily removed and replaced at any time from the top of the board.

At the top of the switchboard, in front of each section, is mounted an Acme trough reflector, with incandescent lamps. These reflectors are adjusted so that the light may be thrown properly on the front of the board.

The key shelves are made of five layers of wood, and are hinged, so they may be raised for inspecting and testing the keys and wiring. The plugs and double-supervisory clearing-out lamps are mounted on a mahogany-stained leather-covered board, back of the key shelves.

The keys are set on the key shelf with all their contact points toward the front, and the one key cable connects all the terminals along the bottom when the shelf is raised for inspecting the working parts. In each position is also placed a pair of circuit-changing keys for four-party, selective-ringing line use, for which the entire board is equipped.

In the front of the trough of the board under the key shelf, in each position, is mounted a pair of spring jacks, for operator's receiver connecting jacks. The answering jacks and the lamp-line signals are placed alternately in strips of 10, with 100 to the position. They are arranged in columns of five strips, or 100 signals in two panels, leaving one vacant panel between each operator, in each section. The multiple jacks are duplicated in every six panels, thus greatly reducing the space necessary for an operator to reach in making a connection.

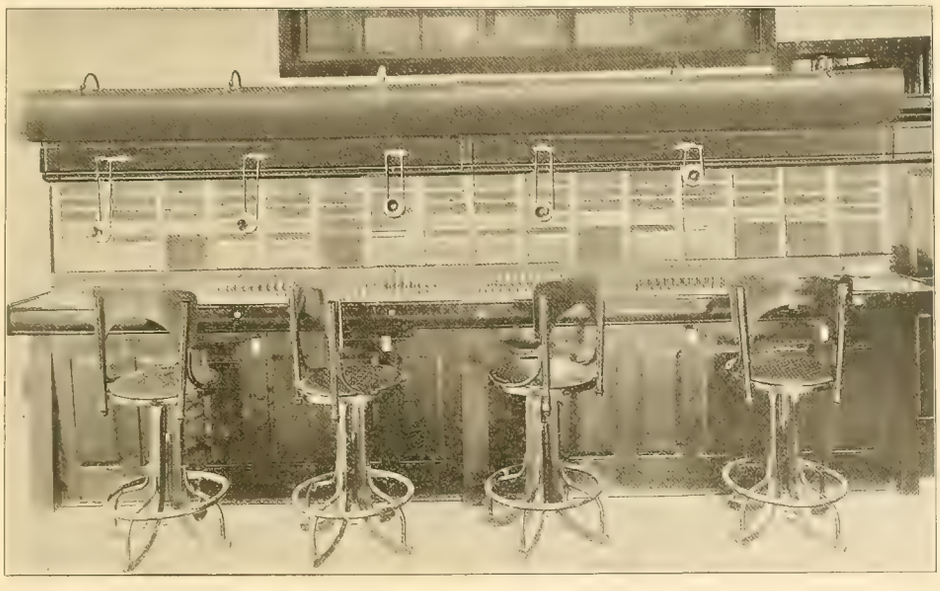
The transmitters are mounted on a nickel-plated brass octagon-shaped adjustable arm, provided in front with nickel-plated cord pulleys, set in oxidized hangings. The arm passes through an oxidized plate, which also forms an escutcheon on each side of the transmitter cords.

Each operator's position is provided with three pilot lamps, mounted in the leather-covered panel back of the plug board. One lamp is to indicate when a call is received, one when a disconnect signal is given, and one when an operator rings a subscriber.

All line relays, cord relays and operator's set relays are mounted on the relay rack. In the back of the switchboard no relays, condensers nor coils of any kind can be seen. All like apparatus is placed together at all times.

The battery plant of the exchange consists of a set of Chloride accumulators, with cells of lead-lined wooden tanks. The battery rack is constructed of heavy angle and channel-iron, well braced, to make it strong and rigid. The batteries are set on shelves of heavy slate slabs, supported on the angle-iron cross-bars of the rack. The power switchboard is constructed of a heavy marble slab, containing the switches and instruments, and mounted on a stand built of heavy angle iron, all suitably braced. All metal parts on the face of the power board are copper-plated, highly polished.

The power equipment consists of a two-horse-power Wagner motor, directly connected to a two-horsepower Roth charging dynamo, for the charging set. For the ringing set is furnished one Roth combination generator and a one-half-horsepower Wagner motor. The combination generator may be operated from the motor or from the storage-battery set.



NEW TELEPHONE EXCHANGE AT SARATOGA, N. Y.—MAIN SWITCHBOARD.

The subscribers' desk telephones are constructed with all of their metal parts of brass heavily nickel-plated. The switch is mounted in the head of the pedestal, with all of its contact springs for both sides of the circuits mounted in hard rubber, perfectly insulating the circuit from the pedestal and hook, and avoiding the use of any of the exposed metal parts for any part of the circuit at any time. The pedestal is provided with an adjustable head for the transmitter, so it may be raised up and down. This adjustable head is provided with a concealed stop for allowing its adjustment the proper distance only. The induction coil is mounted on a neatly constructed heavily japanned base. The cord terminals are supported on a fiber insulated bar mounted on the induction-coil base.

The wall instruments are constructed with the usual back board with shelf, the induction coil being mounted in the base of the arm. The coil box is provided with a false bottom, to which it is hinged and locked. The false bottom is permanently fastened to back board and can be conveniently opened for inspecting and testing the working parts. All wire terminals and connecting wires are mounted in the coil box, fully concealed when the box is closed. On this instrument, as well as on the desk set, there are no exposed metal parts, binding posts, screws or connecting wires that form any part of the circuit at any time. The instruments and all the exchange apparatus were furnished by the International Telephone Manufacturing Company of Chicago.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Storage-battery and Booster Equipment of the Chicago City Railway. Illustrated 1
Telegraph Companies' Competition 1
Edison Electric Meter. Illustrated 2
Geary Street-railway Proposition in San Francisco 2
Cincinnati-Toledo Electric Railway a Possibility 2
Death of Edward H. Jenkins 2
Electrical Exports in May 2
Electrical Association of New South Wales 2
Improvements in Wright Demand and Electrolytic Meters. Illustrated 3
Use of the Telephone in Operating Railroad Trains. Illustrated. Part I. (Association of Railway Telegraph Superintendents) 4, 5
New Telephone Exchange at Saratoga. Illustrated 5
Editorial 6
Society for the Promotion of Engineering Education 7
Charging Extra for Transformer When Wiring of Building Is by Another 7
Elaborate Isolated Plant on a Kentucky Stock Farm 7
Development of the Telephone Field 8, 9
Needed Improvements in Independent Telephony. By L. W. Stanton. (Independent Telephone Association of the United States) 8
The Situation in Detroit 8
General Telephone News 8
Indiana Telephone Items 9
Ohio Telephone Notes 9
Telephone Developments in the South 9
Telephone News from the Northwest 9
A Consideration of the Constancy of Magnets in Measuring Instruments. Illustrated 9
New Members of the National Electric Light Association 9
Comparative Acceleration Tests with Steam Locomotives and Electric Motor Cars. By B. J. Arnold and W. B. Potter. Illustrated. (American Institute of Electrical Engineers.) 10, 11
B. S. Barnard. Portrait 11
New Automobile Regulations 11
Requirements for the Paralleling of Alternators. By Henry E. Longwell. (Engine Builders' Association.) 11, 12
Improvements in San Diego 12
Westinghouse Electric-vehicle Equipments Illustrated 12
Chicago Street-railway Situation 12
Novel French Smoke-preventing Device 12, 13
What Causes Thunderstorms? 13

DEPARTMENTS.

Correspondence 13, 14
New York Notes 13
New England News 13
Canadian Intelligence 13
Southern Developments 13
From the Buckeye State 13, 14
Information from Indiana 14
Northwestern Notations 14
On the Pacific Slope 14
Personal 14
Electric Lighting 14
Electric Railways 14, 15
Power Transmission 15
Societies and Schools 15
Publications 15
Telegraph 15
Space Telegraphy 15
Miscellaneous 15
Trade News 15
Business 15
Illustrated Electrical Patent Record 16

CONVENTIONS AND EXPOSITIONS.

Electrical Contractors' Association of New York, Albany, N. Y., July 15th.

National Electrical Contractors' Association of the United States, Philadelphia, Pa., and Atlantic City, N. J., July 16th and 17th.

New York State Independent telephone men, Rochester, July 23d and 24th.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, White Mountains, September 9th to 11th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit, Mich., October 8th, 9th and 10th.

ONLY occasionally is attention drawn by statistics to the magnitude of the electric-lighting industry, which, although so familiar and widely extended, is still steadily growing. Thus, even the initiated would hardly suppose that there were under the jurisdiction of the Department of Electricity of the city of Chicago 1,015 electric-lighting plants, public and private, supplying current to 25,368 arc lamps and 1,203,285 incandescent lamps (16-candlepower equivalent). Yet such is the fact, as shown by the recently issued report of Mr. Ellicott, the city electrician. It is evident that while the telephone and electric railway are perhaps making more stir in the world just at present, the electric light is still shining steadily.

MUCH valuable information derived from practical experience with the use of the telephone in the operation of railroad systems was made public at the recent Chicago convention of the Association of Railway Telegraph Superintendents. No specific paper was presented on the subject, but the greater portion of the time of the association at the convention was devoted to its discussion. Telegraph superintendents of some of the largest and most progressive railroad companies in the country gave the results of their experience, and a long abstract of the discussion is begun elsewhere in this issue of the Western Electrician.

Probably of chief interest were the remarks of C. F. Annett of the Illinois Central Railroad Company, who stated that his company now had in successful operation 1,000 miles of metallic-circuit telephone lines and would soon have completed 2,000 miles of lines, connecting Chicago with New Orleans, St. Louis, Memphis, Louisville, Omaha and various other cities and railroad offices between these centers. Connections are made in the larger cities with the local exchanges of the Bell companies—in Chicago with the Chicago Telephone Company and in the southern cities with the Cumberland Telephone and Telegraph Company. That such a prominent railroad company as the Illinois Central should go so extensively into the adoption of telephones for the transmission of train and other orders is certainly indicative of a great development along this line. The account contained in this discussion is probably the best and most complete description of the system that has been published.

The experiences of the Lackawanna, Northern Pacific, Lehigh Valley and other railroad companies were also given by their telegraph superintendents, and many valuable points were brought to light, such as pertained to the use of composite circuits, transpositions, protection from high-potential circuits, testing for trouble, etc. However, all the discussion did not indicate the same degree of success with telephone lines, as Mr. Miller of the Chicago and Alton recited many of the difficulties which he had experienced. As a whole, the discussion is a valuable contribution to electrical literature and can be profitably read by all interested in telephone development.

A MONTH or so ago the Western Electrician made mention of the action of the British Institution of Electrical Engineers in adopting a report prepared by an influential committee of its members designed to influence the British government to remove "the present disabilities and restrictions which prevent electrical engineering from making the progress that the national interests demand and attaining at least the same level as in America, Germany and other industrial countries." Inasmuch as Great Britain and her colonies take nearly three-fourths of all the exports of electrical machinery from the United States, this agitation is scarcely of less importance in this country than in England. It is of interest, therefore, to observe that a deputation from the Institution laid the subject before the Right Hon. Gerald Balfour, president of the Board of Trade, on June 17th. Lord Salisbury had been asked to receive the deputation, but the premier turned the matter over to the Board of Trade, as the subject is one of which that department of the government would naturally take cognizance.

The deputation was a notable one, embracing such men as Lord Kelvin, James Swinburne, Professor Perry, Prof. S. P. Thompson, Colonel Crompton, Mr. Ferranti and Mr. Swinton. Mr. Swinburne stated the case of the electrical engineers, the report of the committee having been previously laid before Mr. Balfour. He asked that a stop be put to the injudicious action of local authorities in opposing electrical progress. Arbitrary boundaries, mostly of medieval ecclesiastical origin, should not limit the distribution or the growth of electrical systems. Municipal ownership was not specifically opposed, but the local authorities should not abuse their legal powers. The Board of Trade should have a larger electrical staff. Its classifications and regulations, so far as electrical enterprises are concerned, should be revised. The question of overhead wires, and others like it, should be reopened. Mr. Swinburne, who is the president of the Institution, concluded by asking that a royal commission be appointed to consider the whole question of electrical legislation.

Colonel Crompton said that the Board of Trade should protect private electrical enterprises from unreasonable hostility on the part of local authorities, and he recited his own experience with the Hove (municipal) corporation. Others spoke in the same strain. Mr. Ferranti pointed out that although the Board of Trade rules were very good originally, they were now too narrow. At present the rules tended to hamper the progress of the industry, because its promoters had not only to get over the mechanical and electrical difficulties of doing the work, but also over the inertia attendant upon the drafting of these rules, which fitted circumstances some years back, but which did not fit the present rate of progress at all. Germany and America had gone ahead in electric-railway work and had gained a great deal of practical experience before England had made a start. The present time seemed to be one of international industrial war, and the speaker thought that everything which would encourage the progress of work of all kinds in Great Britain would be to that country's advantage in supplying the markets of the world. The Board of Trade should investigate what was being done in other countries. Its regulations might well be revised every six months.

Mr. Balfour asked if this continual change would not add to the uncertainty. He said the Board would be glad to have the Institution lay before it a statement of proposed regulations to amend or supersede those now in vogue. He went on to say that he was in sympathy with much that had been said. He was afraid it was undeniable that the electrical industry in Great Britain was behind what it was in America and Germany, and perhaps some other of the continental countries. He did not contend that legislation, as applied to electrical industry, was not susceptible to considerable amendment, but he doubted whether that fully accounted for the comparative backwardness of the country in these matters. America is a new country, sparsely inhabited, with towns growing up like mushrooms; above all, with comparatively few established interests to contend with. The field was open and capital could readily flow in from these new channels. England is an old country with a very dense population and with a large number of strongly established interests, and strongly established interests always produced that conservatism which was strongly developed in England. He believed that it was these fundamental conditions rather than any actual local enactments which had tended to retard the development of the electrical industry in Great Britain as compared with the same industry in other countries. But the Board of Trade would always be glad to listen to any suggestions that might come from such a body as the Institution of Electrical Engineers, and it was just as anxious as anyone to secure that the public interests should be properly served by the great industry represented by the deputation. As to the appointment of a commission, he must consult his colleagues in the cabinet. Without further consideration he could not say what he should recommend to them. And so the deputation withdrew.

It will be seen that Mr. Gerald Balfour is not without the tactfulness of the politician, with which we are familiar on this side of the Atlantic. The whole subject is one of much interest, and its consideration shows that the English electrical men are not so lethargic as some contemporary American comment would lead one to believe.

Society for the Promotion of Engineering Education.

[Special correspondence of the Western Electrician.]

Pittsburg, June 28.—More than ordinary interest is shown throughout the country in this year's meetings of the American Association for the Advancement of Science and affiliated bodies, now being held at Pittsburg. The advance registration indicates that this meeting will outnumber, numerically, that of any other meeting held during the last decade, while the preliminary programmes assure an extraordinary number of papers of much interest in the fields of mechanical and electrical engineering.

The Society for the Promotion of Engineering Education, comprising 300 members, was in session yesterday and to-day. On Friday morning Professor Robert Fletcher, president of the society, and dean of the Thayer School of Engineering at Dartmouth College, delivered his presidential address, the subject being "The Efficiency Factor in Engineering Education." Professor Fletcher dwelt at length on the advantages and disadvantages attending the time spent on manual training in the engineering courses in the universities. He deplored the fact that perhaps too much was sacrificed for the sake of teaching the engineering student in the mechanical and electrical courses the handicraft of the machinist and artisan. The keynote of Dr. Fletcher's address was that the real engineering knowledge—the teaching of the principles underlying the profession—was endangered by the tendency to devote time that should be spent in the classroom to the handling of tools in the machine shop.

Following Dean Fletcher, Clifford Ricker, dean of the College of Engineering at the University of Illinois, addressed the society on "The Needs of Engineering Colleges." He, too, pointed out that a concentrated effort should be made to inculcate engineering principles in the student, more particularly the electrical-engineering student, who should have a comprehensive and thorough knowledge of the facts that are the basis of the electrical-engineering profession.

William D. Pence, professor of civil engineering at Purdue University; George F. Swain, professor of civil engineering at the Massachusetts Institute of Technology, and Palmer C. Ricketts, president and director of the Rensselaer Polytechnic Institute, discussed at length the value of non-resident lectures on engineering subjects. The gist of this discussion was that though no apparent great good could be expected from these lectures, owing to their being of a more or less general nature—yet the practice of having them should be encouraged. They tended to show to the students that outside the university world there is a larger world, where the principles of engineering are applied with beneficial results to humanity.

At the afternoon session on Friday Professor Charles P. Matthews, assistant professor of electrical engineering at Purdue University, presented a paper on "The Methods of Grading Students in Engineering Colleges." He was followed by Edward Orton, Jr., professor of ceramics at the Ohio State University, who proposed a plan for the "Subdivision of the Field of Chemical Engineering Education." Charles F. Burgess, assistant professor of electrical engineering at the University of Wisconsin, presented an exceptionally able and interesting paper entitled "Electrochemistry as an Engineering Course."

On Saturday morning the election of officers for the ensuing year took place. The following were elected: President, Calvin M. Woodward, dean of the School of Engineering, Washington University, St. Louis; vice-presidents, John J. Flather of the University of Minnesota and Fred. W. McNair of the Michigan College of Mines; secretary, Clarence A. Waldo of Purdue University; treasurer, Arthur N. Talbott of the University of Illinois; members of the council, W. M. Esty of Lehigh University, Henry S. Jacoby of Cornell University, Lewis J. Johnson of Harvard University, E. S. Orton of the Ohio State University, Arthur Rice of the American Society of Mechanical Engineers, and W. M. Toole of Syracuse University.

After the election of officers Elwood Mead, expert in charge of irrigation investigations in the United States Department of Agriculture, read a comprehensive and more than ordinarily interesting paper on "Courses of Instruction in Irrigation Engineering." He pointed out that to the profession of irrigation engineering the country owed the prosperous and vigorous cities of Denver, Salt Lake and Los Angeles.

Francis Caldwell, professor of electrical engineering at the Ohio State University, followed with a plan for substituting a more thorough system of records of laboratory notes and reports than are now in use at most technical schools. Arthur W. Franch, professor of civil engineering at the Worcester Polytechnic Institute, led a discussion regarding the abuses of the lecture system.

During the progress of the meeting on Friday word was received from Madison, Wis., of the sudden and tragic death of Professor J. B. Johnson, dean of the Engineering School of the University of Wisconsin. Professor Johnson was to have taken an active and prominent part in the general discussions at Pittsburg, and his terrible death caused a feeling of intense sorrow among his colleagues. Suitable resolutions were adopted and a telegram of sympathy sent to Mrs. Johnson.

All the sessions of the Society for the Promotion of Engineering Education were held in the main lecture hall of the Carnegie Institute. In addition, the Microscopical Society of America held a two-day meeting in the Phipps Botanical Conservatory in Schenley Park, and the American Association of Economical Entomologists and the Society for the Promotion of Agricultural Science held a joint two-day session in the east lecture hall of the Carnegie Institute.

W.

Charging Extra for Transformer When Wiring of Building Is by Another.

In the case of Snell against the Clinton (Ill.) Electric Light, Heat and Power Company, a petition was filed for mandamus to compel the company to furnish the petitioner with electricity for lighting his house, as was alleged, upon the same terms and conditions that it required from its other consumers. The petition alleged that the company refused to connect its wires with the petitioner's house unless he would pay for a transformer or converter, in addition to the usual charge of electric lighting, which payment he refused to make, on the ground that the company did not require it of its other consumers, but furnished them a transformer without any additional charge.

The facts found by the jury were, substantially, that the petitioner applied to the company to furnish electricity for lighting his residence upon the same terms and conditions required by it from other consumers, and that the company refused to do so; that the company had not required other persons to pay for the use of transformers for dwellings, and that it was its general practice and custom to furnish the use of them free of charge for its customers; that it refused to furnish the use of a transformer to the petitioner because it had not been employed to wire his house, he having had such wiring done by one not connected with the company; that the company refused to connect with the petitioner's house, on the ground that his residence was not properly wired, but the jury also found that such residence was properly wired; that the company had furnished transformers free of cost to consumers in cases where it had furnished the wires and had done the wiring of the building for compensation, and that it considered the profits accruing to it therefrom to justify it in furnishing the use of transformers without a specific charge for them. Thus was raised the question, whether or not, upon the evidence as found, the company made an unjust discrimination against the petitioner in charging for a transformer in addition to the regular rates for electric lighting. The Supreme Court of Illinois, reversing a judgment of the Appellate Court, holds that the company did.

The Supreme Court says that there is no statute regulating the manner under which electric-light companies shall do business in Illinois. They are therefore subject only to the common law and such regulations as may be imposed by the municipality which grants them privileges. At common law, whether or not a difference in the treatment accorded to different patrons amounts to a discrimination must depend upon the surrounding circumstances. A mere difference does not, of necessity, constitute unlawful discrimination. The company had been in the habit of furnishing transformers, as needed, without any extra charge, for all houses which were wired for electricity by it, but asserted the right to charge for transformers in cases where it did not do the wiring, as it made no profit on wiring in such cases. If it did the wiring, that was a business distinct from that of furnishing electricity for lighting purposes, just as the putting in of gas and water pipes into a house is a distinct business from furnishing the water or gas to flow through them. Being organized to do a business affected with a public interest, it must treat all customers fairly and without unjust discrimination. While it was not bound, in the absence of statutory enactments, to treat all its patrons with absolute equality, still it was bound to furnish light at a reasonable rate to every customer, and without unjust discrimination.

It has been held at common law, and, in the absence of statutes, in the case of common carriers, that, as long as they carry at a reasonable rate for every shipper, no one can complain if they are willing to carry for others at a less rate. If this rule be applied to this case, it will be noticed that the company demanded of the petitioner more than of any of its other customers. This was not the favor allowed by the common law, as just cited, but an unjust discrimination. And the court says that the company discriminated unjustly against the petitioner in any view of the law and the circumstances that it can take, so it followed that the latter was entitled to the writ asked for.

Elaborate Isolated Plant on a Kentucky Farm.

About seven miles north of Lexington, Ky., is an extensive stock farm, comprising 5,000 acres of land and owned by J. B. Haggin. The owner has built a fine mansion and has installed a complete electrical equipment, consisting of a power house, transmission lines, electric motors and lamps, and a 25-station telephone system. The contracts were let and work done under the supervision of Cary T. Hutchinson and Louis Duncan of New York city. The power house is a 25 by 50-foot, one-story building of bronze tile, with slate roof, and contains a battery room, 25 by 25 feet, and engine room, 25 by 25 feet. Two generating units, consisting of two 50-horsepower Westinghouse three-cylinder gasoline engines each direct-connected to a multipolar, 25-kilowatt Eddy 500-volt generator, furnish all the power. One generating unit is used at a time, the other being held as a relay.

The engines are remarkably even in their running, says A. R. Sawyer, who describes the equipment in the Wisconsin Engineer. They are started by compressed air, which is stored in a large tank, by a Christensen air pump, driven by a storage battery. The ignition circuit is supplied by a small dynamotor, the driving motor being 220 volts, while the ignition circuit is eight to 15 volts and four amperes. This circuit can be used for either engine. Each engine also drives a small sparking dynamo, giving two amperes at 10 volts. The ignition circuit of either engine can be changed at the switchboard from one of the generators to the other without stopping.

The generators are of the standard Eddy type—compound-wound—built to run at 300 revolutions per minute and to carry a 50 per cent. overload for three consecutive hours. The switchboard consists of six marble panels, four feet wide by eight high.

In the engine room are also two motor-driven Crocker-Wheeler boosters—one is series-wound for raising the voltage on the main house feeders when fully loaded, and is wound to carry 50 amperes and to generate 50 volts—the other is shunt-wound and is used in charging the storage battery so that the voltage of the charging generators can be constant as the battery becomes fully charged. In each of these boosters the 500-volt driving motor is direct-connected to a generator on each side. The generators may be run in multiple or used separately either to charge the storage battery or to furnish power to the various motors about the farm.

Three voltmeters are provided for registering the output, thus enabling the management to estimate accurately the cost of power or light.

The main house is wired on the three-wire system, with 450 volts between outside wires, and the neutral is grounded. The middle point of the storage battery is also grounded. The switching is so arranged that the charging booster can be used or not in charging the battery.

Circuit No. 1 leads to an elevator, where motors are used entirely for power—for running the elevator, crushing feed, grinding feed and pumping water. Circuit No. 2 leads to the main house. The feeders are of No. 00 copper in duplicate on 30-foot poles. They are a mile long to the rear of the coach house, from which point they are carried 650 feet underground to the main house. Circuit No. 3 is 1,000 feet long, of three No. 4 wires, and runs to the blacksmith shop and sawmill, where there are several motors, and temporarily the telephone exchange. Circuit No. 4 runs to the south entrance and lodge. This circuit extends along the pike roads—part of the way on the interurban telephone poles. The wiring in the main house, and in all the buildings, stables, etc., is in Greenfield conduit.

The storage battery consists of 224 cells of type F-13 Chloride accumulators, and type F-7 plates, giving a 180-ampere-hour capacity, which can be doubled by putting in F-13 plates at any time.

Power is furnished for pumping water to the various parts of the farm and to the main house, for two elevators in the main house, grinding corn and oats, shelling corn, grain elevator, sawmill, blacksmith shop, carpenter shop and lighting.

The cost of the electric equipment was between $35,000 and $40,000. The main house, which cost $300,000, is said to be wired more elaborately than most houses of its class, perhaps more than any other house in the United States.

Mr. Sawyer says that one is surprised to find with all this lavish expenditure a 25-station telephone system, with a central requiring an operator. In fact, an automatic central was tried and because it gave some trouble was thrown out without an effort to improve it.

DEVELOPMENT OF THE TELEPHONE FIELD.

Needed Improvements in Independent Telephony.[1]

By L. W. Stanton.

There are three giant problems—tariff, traffic and equipment—which are deserving of especial consideration.

In our larger cities there are thousands of families and hundreds of small tradesmen that cannot afford to pay for flat-rate individual service, neither can the telephone company from a financial standpoint afford to reduce its rate to meet these requirements. Party lines and measured service are the inevitable result.

With a good system of four-party-line selective, with the traffic details well worked out, the party-line service for the small user is almost as good as individual service. You say that it works an injustice to the subscriber who has individual service. It is quite the reverse. It is optional with him whether he will use the party line or not, but in 99 cases out of 100 he is glad to have a chance to telephone to his party even though it be over a party line.

Let us now look into the financial aspects of the party line. We will assume the exchange from which we draw our figures to be one of 4,000 lines, built at an average cost of $100 a line, and $25 extra for each additional party-line telephone, including the telephone, interior wiring, line drops, etc. We will assume the rate for individual service to be $48 a year; $15 a year for operating individual service telephones, and $7.50 a year to operate each additional party-line telephone. Figuring interest at five per cent. and depreciation at 10 per cent. on the amount invested, we find, by referring to the table below, that upon doubling the number of telephones on the line and decreasing the rate one-fourth we decrease the net revenue per telephone and increase the net revenue per line. What is most noticeable is that the net profit earned on investment per line is greater for both the two and a four-party line than for either a greater or less number. A point that should not be lost sight of in establishing party-line rates is that a dollar or two difference in the rate makes considerable difference in the net percentage earned on the amount invested, as is shown by the two rates on the four and eight-party lines.

Comparative Data of Party-line Service From 4,000-line Exchange.

Number of Telephones per Line.	Average Cost per Line.	Rental per Line per Year.	Cost to Operate per Line.	Interest on Investment per Line.	Depreciation 10 Per Cent. per Line.	Total Cost Operation, Interest and Depreciation per Line.	Net Earning per Line.	Net Earning per Telephone.	Net Per Cent. Earned on Investments per Line.
1	$100	$48	$15	$ 5	$10	$30	$18	$18	$18
2	125	36-72	22.50	6.25	12.50	40.75	31.25	15.62	25
4	175	27-108 24 96	37.50	8.75	17.50	63.75	44.25 32.25	11.06 8.03	25⅛ 18
8	275	20-160 18-144	67.50	13.75	27.50	108.75	51.25 35.25	6.41 4.40	18.6 13

We will now look at the party line from a traffic and tariff standpoint, which is an exceedingly complexed problem. There are three principal objections to the party line:

First, the annoyance from the bells ringing when someone else is wanted; second, the frequent report of "line busy;" third, service is not private.

The first objection can be almost entirely eliminated on party lines of four or less, providing the equipment is of proper design and the operating is good.

The second is a more difficult problem. If there are two or more parties on the line with unlimited service the line will frequently test "busy." To remedy this some form of measured service will be necessary. While it is admitted that measured service adds complications it is undoubtedly the most equitable method of charging. While there are several forms of measured service, there are none that entirely fill the requirements. Automatic apparatus either at the telephone or on the switchboard is not satisfactory, for in case the line called for should be busy there would be a call registered without the party securing the service. With either a meter or slot machine placed at the telephone it renders the service slow, for the operator must remain in on the line until the called-for party is secured, and the calling party has registered or deposited the required coin. This also works a hardship on the party called for, as it is necessary to wait until the party calling deposits the coin or registers. The system of measured service where a meter is used is also more expensive, inasmuch as it requires a visit to each telephone to take the reading of the meter before a bill for service can be rendered.

The system in use in a number of the largest Bell exchanges and the one which gives the best general results is that in which the operator marks down the number of the telephone of the party calling, and in case the call is not completed she draws a line through that number. Each hour these sheets containing the record of the calls are collected and sent to the billing department.

Measured service handled in this way gives the subscriber very prompt and efficient service. This class of measured service used in connection with a four-party line will give excellent results. Suppose you allow each party-line subscriber 600 or 1,000 outgoing calls a year on a four-party line, or 1,200 to 1,800 on a two-party line, at a minimum charge, with a fixed rate per message for all additional calls; all incoming calls free. Handled in this way the report "line busy" will be no more frequent than it is with individual unlimited service; in fact, the calls will probably average less per four-party line than with unlimited individual lines.

In a peg count which the writer examined where there were nearly 5,000 party-line telephones, all of which were either measured meter or nickel service, the average call per day, per telephone was 1.3.

In regard to secrecy or privacy of a properly designed party-line telephone, it is almost as private as an individual telephone. With a lamp-signal board and selective ringing, the different parties on the line have no means of knowing when a party is calling or being called, and if a line is in use they can readily hear another party come in on the line.

Up to the present time the call for the party-line equipment has not been very great, and the Independent manufacturers who have done so well in furnishing equipment have not given this subject the attention that it should receive in the future. One of the leading manufacturers is just placing on the market a four-party selective system which depends upon the number of frequencies to operate the bells. From the limited experiments the writer has had an opportunity to make, the system seems to possess valuable points over the pulsating bell type, which has been used by the Bell company.

One of the greatest needs of the Independent telephone interests is either for this association or a kindred association to take up, in a technical way, the practical subjects of traffic engineering and equipment. There are thousands of dollars being wasted through ignorance, which could be avoided to a considerable extent by action on the part of such an association.

With the millions there are invested and the opportunities there are open, it is a crime to the Independent telephone interests that a little closer union and more uniform equipment is not adopted. The day for long-distance telephony is just in its infancy, and for the Independent companies to handle their share of the traffic and give the class of long-distance service that will be demanded, they will be compelled to adopt a more standard form of equipment.

The writer's experience on the United States Telephone Company's long-distance lines is that where 20-volt and 40-volt common-battery systems made by different manufacturers are connected the results are unsatisfactory. So much so in one case, where a 40-volt system was installed, the former toll business at that place was almost lost for a period, owing to the inefficiency of the system for long-distance work. Later a change was made that remedied the condition to some extent, but the system has never given the service it should. The trouble just cited was not due to the fact that it was a 40-volt system, which voltage is probably nearer correct, but due to the fact that the system was improperly designed for receiving incoming toll business.

If the Independents expect to handle long-distance business in an up-to-date manner, deriving the greatest amount of revenue from the capital invested, building their connections by ticket wire and leasing their wires to brokers and large corporations to use for telegraph, while the telephone company is using the same for telephone purposes, considerable forethought and sound engineering will be required.

If the long-distanced trunk lines are to be built by different companies, they should consult each other, decide upon the class of construction and equipment, and, more important still, the location of their relay or switching stations; I mean locations along the trunk lines where testing for trouble is done, where operators are located for switching purposes, and where telegraph apparatus such as relays, repeaters, Morse panels, batteries, etc., are located for handling leased-wire work. The proper locations of these switching stations is a very important matter. They should be located a certain distance apart to get the best results from the telegraph apparatus. They should be located at junction points on the east and west and north and south trunk lines. This location is very important from three points of view. It is very important from a view of economically and properly handling the Morse. It is important from the fact that the operators should be able to switch their messages to any point of the compass, and third, it saves the expense of building and maintaining additional switching stations. From the foregoing I am in hopes that the Independent companies will realize the absolute necessity of an association to solve the problem that cannot be solved by such companies working separately.

1. Abstract of paper read before the Independent Telephone Association of the United States at Philadelphia, June 26, 1902. The author is superintendent of equipment for the Federal Telegraph Company of Cleveland.

The Situation in Detroit.

[From the Detroit Evening News of June 20th.]

When asked this morning if they were going to throw up their hands, the directors of the Detroit Co-operative Telephone Company entered a positive denial. Messrs. Burton, Ingram, Carhartt, Danziger and Gates held a meeting to-day after which Mr. Burton announced that a week ago they entered into contract with the International Telephone Manufacturing Company of Chicago for a switchboard with a capacity of 12,000 telephones. The agent of the company was present and confirmed the report. Mr. Burton added that next Monday the directors would receive bids from construction companies for outside wiring, and will be ready to close a lease for a building for the switchboard, when the work of installing it will be begun. It is intended to start with a section capable of taking care of 1,000 local telephones and 200 toll lines.

When asked point blank how much money the company had received on its 20 per cent. assessment, Mr. Burton declared it was about $27,000.

They have four places in view for the switchboard, but an option has been obtained on only one of them, and it is feared that a disclosure of the possible location would force up the rent demanded.

Fred Williams, who has been doing the company's offices work, is no longer connected with the enterprise, and the directors are now looking for a practical telephone man to act as manager. They complain that it takes too much of their time to look after all the details.

GENERAL TELEPHONE NEWS.

J. A. Hamilton and others of Marissa, Ill., have incorporated the Marissa Telephone Company.

The Randall Telephone Company of Randall, Kan., has been incorporated with $2,500 capital stock.

The Windsor Mutual Telephone Company of Windsor, Ill., has been incorporated by H. S. Lily and others.

At a regular meeting of the City Council recently the Bell Telephone Company was refused a franchise to enter Charlottesville, Va.

N. D. Ravenscroft, Ed C. Roth and others of Buckner, Mo., have incorporated the Jackson County Telephone Company of Buckner.

The Ellis County Independent Telephone Company of Waxahachie, Texas, has been incorporated with a capital stock of $100,000 by A. E. Shaffer and others.

The Texas and Western Telegraph and Telephone Company has been incorporated, with $200,000 capital stock, by James Douglass, Wm. E. Dodge and others. The headquarters of the company will be at Douglas, Ariz.

The laboring men of Des Moines, Iowa, are showing their sympathy for the striking telephone girls of that city by holding mass meetings and formulating plans for the carrying of the strike to a successful termination.

The Independent Telephone and Telegraph Company of Oakland, Cal., has been incorporated with H. C. Stillwell, A. J. Snyder, F. C. Watson and others as directors. The authorized capital stock of the company is $500,000.

The Home Telephone Company of Jamestown, N. Y., is kept busy by the Bell company, which company, although it has abandoned the poles which the Home company was ordered by the City Council to use, refuses to allow the Home company to string its wire on the poles and tears the lines down as fast as they can be put up.

The Delaware Long-distance Telephone and Telegraph Company has been incorporated with a capital stock of $250,000. The incorporators are Jesse Slinghuerr and Carroll T. Bond of Baltimore and John G. Gray of Wilmington, Del. The purpose of the company is to construct a long-distance telegraph and telephone line in Delaware, Maryland and Pennsyl-

Advertising the telephone—that is, advertising the use of the telephone, to extend its use by the public—is of comparatively recent date, but some clever work in this direction has been done in Chicago, New York and other cities. Printers' Ink, the advertising journal, praises the efforts of the Bell Telephone Company of Buffalo along this line. The "ads" of that company are prepared by C. A. Spaulding, the traffic manager of the company, and are effective. Mr. Spaulding is a former newspaper man, and his training has stood him in good stead.

Indiana Telephone Items.

The People's Co-operative Telephone Company of Colfax has been incorporated with a capital stock of $5,000. The incorporators are J. A. Morrison, E. L. Darby and others.

One of the severest storms that ever visited the state occurred recently and considerably damaged telephone property in six or eight counties. The highways were blocked with telephone poles and the wires were scattered over the fields. The farmers, in clearing the roadway, chopped a large number of serviceable poles in two. Lightning destroyed the local exchange of the Central Union Telephone Company at Alexandria, burning out the toll-line switchboard and disabling a part of the local instruments.

In a suit against the Central Union Telephone Company for damages to trees, caused by wires, the Indiana Supreme Court holds that an abutting property holder must allege ownership in fee to the middle of the street, and the location of the trees within the strip so owned. "Such an omission is fatal," said the court.

The Indiana State Board of Tax Commissioners will meet on the 14th of July for the purpose of fixing the annual assessment for taxation of all the property of telephone and telegraph companies, and the hearing of appeals from the county board assessments. It was generally understood that the state board intended to increase the assessment for telephone companies on some sort of good will or increase of earnings' basis, but the Supreme Court during the week upset such plans by holding that there was no law in the state authorizing or permitting the taxation of the good will of a business enterprise. F.

Ohio Telephone Notes.

Henry A. Everett and J. B. Hoge, president and secretary of the Federal Telephone Company, have sent a circular letter to all the stockholders of the Federal and Cuyahoga Telephone Companies, recommending that they purchase stock in the United States Telephone Company on the terms offered by Messrs. Barber and Hoffman. They consider it a good business proposition.

It is said that the Bell Telephone Company will oppose the repeal of the section of the Cleveland ordinance desired by the Cuyahoga Telephone Company, giving the company the right to change its rates slightly and alter its service to some extent.

The Citizens' Telephone Company of Batavia has increased its capital stock from $50,000 to $100,000.

Suit has been brought by the village of Hamler, near Napoleon, to prevent the County Mutual Telephone Company from building a line into the town. It is said the Independent companies are opposing the Mutual company.

The stockholders of the Citizens Telephone Company of Columbus have held a meeting to discuss the switchboard matter, but no decision has been arrived at. The officers are said to be favorably impressed with the automatic board which they saw in operation at Fall River, Mass. O. M. C.

Telephone Developments in the South.

The committee on fire and lighting of the city of New Orleans has reported unfavorably on two telephone ordinances, one from the Telephone Company of America, for a franchise, and a second known as the McFall ordinance, for telephone privileges.

The telephone exchange at Demopolis, Ala., was recently destroyed by fire at a loss of about $1,200.

The National Telephone Equipment Company has brought suit for $25,000 damages from the People's Home Telephone Company of Birmingham, Ala. The plaintiff asserts that this amount is due it for apparatus furnished, while the defendant alleges that the plaintiff did not keep the contract in the matter of supplies.

The Southern States Telephone Company of Norfolk, Va., has completed connection with the Tidewater Telephone Company of Gloucester Court House, Va.

The town of Henderson, N. C., has refused a franchise to the Bell Telephone Company. A local Independent company is already operating.

At Spartanburg, S. C., the Citizens' Telephone Company has been sold at public auction to satisfy a mortgage. L. W. Floyd of Newberry, S. C., was the purchaser at $23,000 L.

Telephone News from the Northwest.

The Duluth Belt Line Railway Company has put telephones in all its cars, so that the conductor can talk with the engineer in charge of the power station at the top of the hill.

The suit for the right-of-way in certain streets in Minneapolis between the Northwestern and the Twin City companies has been settled in favor of the former, the latter being forbidden to string wires below those of the other where they are constructed first.

The Litchfield (Minn.) Telephone Company has re-elected its old board of directors and declared a 10 per cent. dividend.

The Arlington Telephone Company has been organized at Moville, Iowa, with a capitalization of $5,000.

The Central Telephone Company has been incorporated at Broken Bow, Neb., with a capital stock of $35,000.

The Interior Telephone Company at Grinnell, Iowa, has increased its capital stock to $70,000.

Contracts have been let for the Northwestern telephone-exchange building at Fargo, N. D., and work on the conduit has been begun also. R.

A Consideration of the Constancy of Magnets in Measuring Instruments.

It is remarkable how many electrical measures depend upon the constancy of a permanent magnet. Good results have been arrived at in this direction, but the magnet generally remains, if not a cause of error, at least a cause of anxiety, and necessitates frequent operations of standardizing. Besides, it is difficult to distinguish the instruments with good magnets from the inferior ones. The Physico-Technical Institute of Germany, while recognizing that

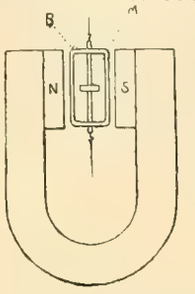


Fig. 1.

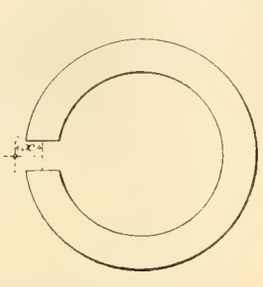


Fig. 3.

A CONSIDERATION OF THE CONSTANCY OF MAGNETS IN MEASURING INSTRUMENTS.

such instruments are often sufficiently exact, has been obliged to give up delivering certificates for apparatus with permanent magnets, on account of the inherent variability of that part.

A system of direct-current measuring instruments which was presented to the Société Internationale des Electriciens of France recently by Pierre Weiss, is said to preserve the practical advantages of permanent magnets and to be at the same time free from their capital disadvantage, the lack of constancy in their magnetization.

The usual type of instruments presents different kinds of errors. In those which are based upon the use of a fixed current-coil and a movable magnetic arrangement, the controlling magnet furnishes the couple which opposes the deviation of the movable part by the current. When the controlling magnet weakens, therefore, the sensitiveness increases. On the contrary, in the instruments with movable current-coil, such as the Desprez-d'Arsonval, it is the magnet which furnishes the deviating force, and the sensitiveness diminishes as the magnet weakens. These defects may be counterbalanced one by the other, by taking both the opposing and the deviating couple from the same magnet. Suppose, for instance, a Duprez-d'Arsonval galvanometer (Fig. 1) in which the wires carrying the current to the movable coil (B) are deprived of rigidity and whose movable portion carries a small piece of soft iron (M), which moves solid with it and which the magnet (NS) tends to keep in the direction of its field. It is easily seen that in order that the deflection produced by a given current traversing the coil should be independent of the field of the magnet, it suffices that the magnetic moment of (M) be constant. This condition is realized approximately by arranging the parts so that (M) is magnetized to about saturation. In reality it is not necessary to satisfy exactly the two conditions proposed—infinitely flexible conductors and magnetic saturation of (M); a small opposing elastic force may compensate for the imperfect saturation.

Graphically, the conditions of the problem are as follows: The abscissæ of the curves shown in Fig. 2 represent the values (H) of the field in which the moving part turns and the ordinates the currents (I) necessary to produce a given deflection α. For simplicity the field is supposed to be uniform. Then let A represent the total area of the coil and μ the magnetic moment of the small piece of iron (M). When the opposing couple is of an elastic nature, it may be represented by $C \times \alpha$ where C is a constant, and this gives

$$AHI \cos \alpha = C\alpha$$

I is thus in inverse ratio to H, and the curve is an equilateral hyperbola (Curve 1). Again, suppose that the opposing couple is of a magnetic nature; the equation for equilibrium will then be

$$AHI \cos \alpha = \mu H \sin \alpha$$

or

$$I = \frac{\sin \alpha}{A \cos \alpha}\ \mu$$

I is therefore proportional to the magnetic moment μ Curve 2 will represent nearly the magnetic intensity of the material of M, in function of H.

Experience shows that this curve has not quite the above form, and should be replaced by Curve 3, in which the horizontal asymptote corresponding to the saturation is replaced by a slightly descending asymptote. This is because the magnetization, instead of preserving an invariable direction in the iron piece (M), turns slightly with relation to the material, and this effect is stronger as the field is more powerful. Curve 4 of an instrument having an opposing force both magnetic and elastic is obtained by adding the ordinates of Curves 3 and 1, the latter being multiplied by a greater or less factor, according to the importance of the elastic force. This curve possesses in general a minimum (A) and a maximum (B), and there are thus two values of the field H_1 and H_2, for which a small variation of this field produces no error. By properly choosing the spiral springs, one can bring the minimum to confound itself with the maximum, in a point of inflexion with a horizontal tangent (5), which corresponds to a constant sensitiveness over a very wide extent of field. In a trial apparatus provided with an electromagnet in place of the permanent magnet, it was possible to show that the sensitiveness varied by only one six-hundredth part about its mean value, while the field passed from 1,000 to 2,000 gauss. The above considerations relate to a determined value of α, but may be extended to all the values of α relatively small for which the elastic and magnetic couples both increase proportionally to α

It is stated that the instruments constructed on the above principle by a French manufacturer have been remarkably successful, such as a 100-ampere ammeter and 125-volt voltmeter. They are of the usual round type, with the needle pivoted at the bottom and moving over a graduated arc at the top; they are designed mainly for industrial use. The magnet is a square bar bent into circular form, with a short air gap, having parallel faces (Fig. 3). In this space turns a bobbin of aluminum, carrying the coil of wire and having in its center the small iron piece. The coiled springs are formed of very thin silver strips. The regularity of such an instrument is said to be very good, as is shown by readings taken at different currents to produce deviations in the needle, while the magnet field has values of 500 and 600 gauss, respectively. The sensitiveness is shown to be independent of the field over the whole extent of the scale. When the field increases 20 per cent. the slight variations which occur are of the same order as the errors of observation. The compensation thus gives even more than was expected, in correcting equally well the effect of weakening of the magnet on the large and small deflections. When the magnet is made of good magnetic steel it gives, when freshly magnetized, a field of 700 to 800 gauss in the air gap. It is then demagnetized down to 600 gauss and the field which remains has a great stability and any notable weakening is quite excluded. But once calibrated, it is said, the instrument will even hold good for a new weakening of 100 gauss, or about 17 per cent.

One good point about these instruments is that printed dials can be used without having to be very accurate in the mounting. This is due to the fact that the movable coil may be shifted considerably

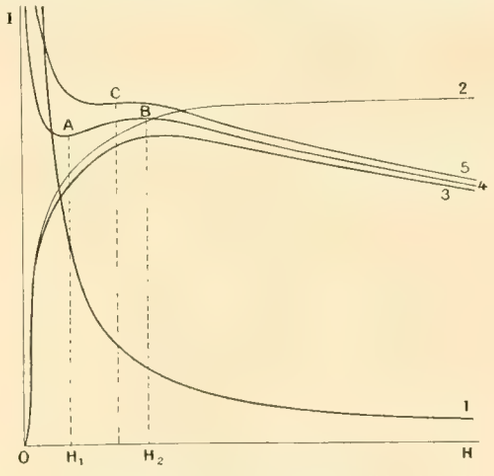


FIG. 2. A CONSIDERATION OF THE CONSTANCY OF MAGNETS IN MEASURING INSTRUMENTS.

from the center without affecting the graduation. Voltmeters (125-volt type) have been made which differed from each other and from the printed scale by only 0.3 to 0.4 volt.

As now constructed, the voltmeters have a movable coil of fine manganin wire, which, with the extra resistance, brings the total to 9,000 ohms. For the ammeters a deciamperemeter, mounted with a shunt, is used. The movable bobbin, with its coil, is of aluminum, which gives extreme lightness and diminishes the friction on the pivots.

New Members of the National Electric Light Association.

The action of the National Electric Light Association at its recent convention in Cincinnati in reducing the membership dues in the cases of companies operating in small cities and towns is bearing fruit. In the short time which has elapsed since the convention companies in the following-named cities and towns have become members: Altoona, Pa.; Atlantic City, N. J.; Auburn, N. Y.; Bloomington, Ill.; Covington, Ky.; Clinton, Ill.; Edwardsville, Ill.; Evansville, Ind.; Elizabeth City, N. C.; Fishkill-on-Hudson, N. Y.; Fulton, N. Y.; Jackson, Mich.; Lead, S. D.; Macon, Mo.; Manheim, Pa.; Muscatine, Iowa; Plymouth, Mass.; Red Oak, Iowa; Rockford, Ill.; Scranton, Pa.; Wheeling, W. Va.; Columbus, Ga.; Zanesville, Ohio.

Comparative Acceleration Tests with Steam Locomotive and Electric Motor Cars.[1]

By B. J. Arnold and W. B. Potter.

In connection with the preparation of a report on the use of electricity for the propulsion of trains of the New York Central railroad in the tunnel entrance and terminal in New York city, an invitation was extended by the General Electric Company to Mr. W. J. Wilgus, chief engineer of the railroad company, to use its experimental track (Fig. 1) and apparatus at Schenectady, and a series of tests were accordingly carried out under the direction of the authors of this paper. The tests were principally for the purpose of determining the comparison between steam and electric traction on short-haul suburban-passenger service. Owing to the short curves in the connecting tracks, the General Electric Company's track could not be used for the steam-locomotive tests. The steam tests were, therefore, made on the New York Central main-line tracks west of Schenectady.

The steam locomotive was built from the specifications of Mr. A. M. Waite, superintendent of motive power and rolling stock of the New York Central, by the Schenectady Locomotive Works. It was designed specially for the rapid acceleration

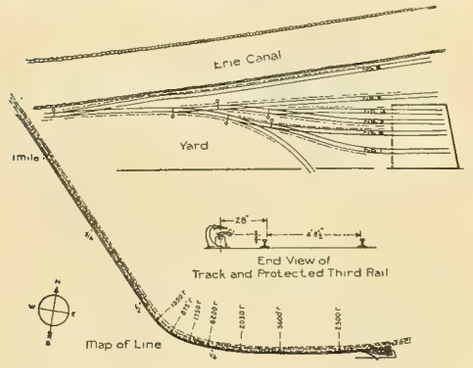


FIG. 1. COMPARATIVE ACCELERATION TESTS.

work required in suburban service, being provided with large grate area and heating surface, and a very large proportion of weight on its driving wheels.

The two electric motor cars were similar in form, 54 feet over all, each weighing about 35 tons, including the electrical equipment, which consisted of four General Electric 55 motors and type-M control. All axles being equipped with motors, the two cars together gave approximately the same weight upon the drivers as the steam locomotive. The acceleration was, therefore, directly comparable for trains of equal net weight, and to secure this comparison the same trail cars, arranged in the same order, were used in both the steam and electric tests.

In the steam runs the draw-bar pull, speed and time were recorded by an Illinois Central dynamometer car, and the same car was used with the electric motor cars to determine the relation between current input and draw-bar pull. The dynamometer car had to be returned before the elcetric runs were completed, but not before a large number of readings were taken, from which curves were plotted showing the relation between amperes and draw-bar pull with different weights of train behind the motor cars. The draw-bar pull thus determined has been plotted on electric-motor-car curves, which were taken subsequent to the return of the Illinois Central car. The order of the tests, both steam and electric, was as follows:

A train of six cars, including five standard passenger coaches loaned by the New York Central railroad, and the dynamometer car, was started and run over a mile of track, acceleration being made as rapidly as possible. These same runs were repeated, dropping off one car at a time, until only the dynamometer car remained. Automatic records were kept of the draw-bar pull, speed, time, distance and the strength and direction of the wind. The condition of rail and temperature were also noted. The same runs were repeated, using the two motor cars in place of the steam locomotive, the dynamometer car being used in some of the runs and a box car loaded to equal weight in subsequent runs. In the electric runs, additional records were kept of voltage, ampere and wattmeter readings. The wattmeter was not carried on the car, but was placed stationary at the point of feeding the third rail, thus avoiding any inaccuracy due to jarring. The voltage leads of the wattmeter were connected to the extreme end of the third rail and track, thus receiving at all times the exact voltage at the train, so that the energy delivered to the motor cars represented the net input and did not include losses in the feeder system.

The cars used in this test and the weights are given below:

			Pounds.
New York Central locomotive	No.	4107	214,000
General Electric motor car	No.	4	73,000
General Electric motor car	No.	5	70,000
Illinois Central dynamometer car	No.	17	45,640
New York Central coach	No.	1885	48,200
New York Central coach	No.	545	60,250
New York Central coach	No.	1709	53,700
New York Central coach	No.	508	51,450
New York Central coach	No.	1798	54,600

During the tests many runs were made, but for the illustration of this paper representative and average runs only are given.

The electric runs were made upon the General Electric experimental track against a head wind of 15 miles per hour. The rail was dry, the temperature 8° C., and the grade practically level. In the middle of the run there was a curve having a minimum radius of 875 feet, equivalent to about a 6½° curve, the effect of which may be assumed as approximately equivalent to the one per cent. up grade of the steam runs.

No. of Run.	Character of Load.	Weight of Load, Tons.	Total Weight Train, Tons.	Maximum Speed.	Average Speed.	Watt-hours per Ton Mile. From Volts Amperes.	Watt-hours per Ton Mile. From Wattmeter.
1	6 Trailers	157	228.5	36.4	27.2	75.9	79.4
3	5 "	130	201.5	37.9	28 6	78.4	82.0
5	4 "	104	175.5	39.1	29.8	84.3	86.9
7	3 "	77	148.5	41.0	30.6	84.7	93.4
9	2 "	47	118.5	42.8	32.0	98.5	99 4
11	1 "	23	94.5	44.7	33.1	115.0	114.0
13	No "	.....	71.5	46 7	34.6	132.3	129.0

All steam-locomotive runs were made upon the New York Central main-line track west of Schenectady against an up grade of 0.1 per cent. and a head wind of 15 miles per hour. The temperature was 4° C., and the rail wet with a very light-falling snow.

No. of Run.	Character of Load.	Weight of Load, Tons.	Total Weight of Train, Tons.	Maximum Speed, Miles per Hour.	Average Speed, Miles per Hour.
2	6 Trailers	157	264	39.0	28.2
4	5 "	130	237	41.3	28 4
6	4 "	104	211	40.9	27.4
8	3 "	77	184	45.7	27.3
10	2 "	47	154	48.0	30.1
12	1 "	23	130	50.9	33.0

Although this locomotive was especially built for suburban or acceleration work, and was provided with a large firebox, giving it facilities for rapid steaming, the pressure dropped from 200 pounds to less than 185 pounds during the first part of acceleration. In starting, the throttle was opened wide

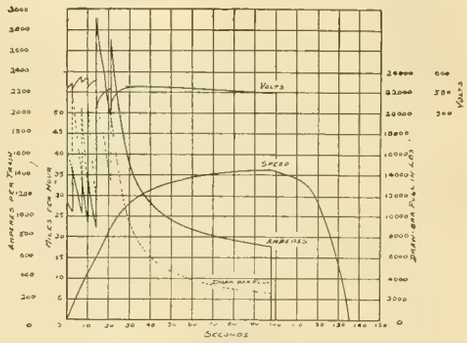


FIG. 2. COMPARATIVE ACCELERATION TESTS.—ELECTRIC RUN WITH SIX TRAIL CARS.

and steam used full stroke, the engine being hooked up as acceleration proceeded. Curves showing details of three of these runs are given in Figs. 2, 3 and 4. Fig. 2 is for an electric run with six trail cars, the weight of which was 157 tons, and, including the motor cars, 228.5 tons. Power was applied on 4,170 feet, the distance run was 5,380 feet and the watt-hours per ton-mile were 79.4. In Fig. 3 is represented a steam run with the same number of trailers and of the same weight. The total weight, including the locomotive, was 264 tons. The power was on for 4,035 feet, and the distance run was 6,150 feet. Fig. 4 shows an electric run with no trailers, the motor cars weighing 71.5 tons. The power was on for 4,080 feet, the distance run was 5,360 feet and the watt-hours per ton-mile were 129. The speed-torque curve of the GE55 motor is shown in Fig. 5.

While the electric runs had the advantage of dryer rails than the steam runs, the driving wheels were not slipped in either instance. Although the steam locomotive was able to give a maximum tractive effort at starting equal to that obtained electrically, this high tractive effort was not maintained, but immediately fell off with increased speed, even with the most expert handling.

As the acceleration curves produced by the steam locomotive and electric-motor cars have different shapes, and as in the two tests there was about the same weight upon the drivers, it is interesting to note how well this driver weight was utilized. This is shown by the following tables, giving the speed reached in 10, 20 and 30 seconds, with equal trailing load for both electric and steam trains:

MILES PER HOUR ATTAINED IN 10 SECONDS.

Number of trailers	1	2	3	4	5	6
Motor cars Nos. 4 and 5	22.5	20.7	17.3	14 4	12 6	11
Locomotive No. 1407	14	13	12.5	12	10	9.7

MILES PER HOUR ATTAINED IN 20 SECONDS.

Number of trailers	1	2	3	4	5	6
Motor cars Nos. 4 and 5	34	32.3	20.4	27.4	24.5	21.2
Locomotive No. 1407	25	21.2	21.5	19.5	18	16.3

MILES PER HOUR ATTAINED IN 30 SECONDS.

Number of trailers	1	2	3	4	5	6
Motor cars Nos. 4 and 5	38.2	36.4	34.2	32	30.3	28.1
Locomotive No. 1407	31.7	26.2	27	24.7	23.2	20

An inspection of the above tables brings out clearly the fact that the electric motors during acceleration can more effectively utilize the weight upon their drivers than a steam locomotive. As rapid acceleration is especially important when stops are a mile or so apart, the electric motor has an advantage in being able to cover the same distance in the same time with less energy expended and at less maximum speed than with the steam locomotive, owing to its being able to maintain its maximum accelerating rate for a longer period.

The average speed given in both steam and electric tables is the average speed of the train while it is in motion and does not include time of any stop at the end of the run. Starting from rest, the power was kept full on to the three-quarter-mile post, where the power was shut off and the brakes applied in such a manner as to bring the train to rest as near the mile post as practicable. In the tests the steam train ran from five to 15 per cent. over a mile before the train was brought to rest, and the electric trains from two to four per cent., but even with the longer distance the average speed of the steam runs only approaches that attained in the electric runs made over a shorter distance. A comparison of the two sets of runs on the basis of average speed is, therefore, not quite fair to the electric-motor car, as its average speed would have been considerably higher if the length of the run had been the same as that made with the steam locomotive. An inspection of the tables will show, however, that, even with the shorter distance run, the electric-motor cars were able to make higher average speeds than the steam locomotive over its longer distance, and these higher average speeds were obtained also with a lesser maximum speed.

The maximum speed of a train making a given run in a given time serves as an indication of its energy consumption. A train, therefore, which is so handled as to make a given run in a given time, with lowest maximum speed, will consume less energy for the run. The electric runs tabulated all show a lower maximum speed and a higher average speed than those runs made with the steam locomotive, and the energy consumption of the electric runs should, therefore, be less for the same service performed than with the steam locomotive.

The motors of an electrically equipped train may be placed upon the trucks of ordinary passenger coaches, each carrying its full complement of passengers, and thus lessen the gross weight by elimination of the locomotive. The true measure of comparison between steam and electrically propelled trains should be the energy per seat-mile, rather than per ton-mile, as the latter value is based upon the total train weight and includes a considerable proportion of dead weight embodied in locomotive and tender. The weight of the electric motors is much less than the weight of a steam locomotive capable of performing the same service, as the latter, in addition to its tender, must be heavy enough upon its drivers to provide a draw-bar pull sufficient to accelerate the train.

As an illustration, the following table has been prepared from these tests, showing the number of cars in the train, the number of passengers carried (each car seating 64 people) and the energy, which, for convenience, we have given in watt-hours, required per passenger for both steam and electric runs.

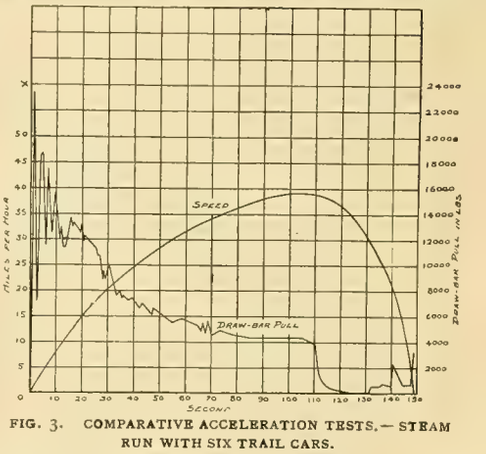


FIG. 3. COMPARATIVE ACCELERATION TESTS.—STEAM RUN WITH SIX TRAIL CARS.

NET ENERGY PER PASSENGER CARRIED.

Number of Cars.	Number of Passengers.	Watt-hours per Passenger. Steam.	Electricity.
6	384	43.9	29.7
5	320	52.2	32.1
4	256	57.5	33.5
3	192	77.4	37.5
2	128	103	45.2
1	64	187.8	45.2

This table is based upon the actual net energy delivered to the wheels of the train, and does not include the losses inherent to any system of operation. The results tabulated may, therefore, be considered as fundamental, and typical of the two systems of operation—the steam locomotive and the electric-motor car.

The following table gives the efficiencies for the

1. A paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers at Great Barrington, Mass., on June 19, 1902.

seven electric runs, the efficiency being the ratio between net-energy output to the wheels and total volt-ampere input:

EFFICIENCY OF ELECTRIC RUNS.

Trailers.	Average m. p. h.	Watt-hours per Ton Mile. Output.	Input.	Efficiency of Run.
6	27.2	59.1	79.8	74.1%
5	28.6	61	82	74.3%
4	29.8	63.8	84.9	75.3%
3	30.6	68	90.2	75.3%
2	32	69.6	99.6	69.9%
1	33.1	75.3	112.8	66.7%
0	34.6	76.8	130	61.5%

An accurate comparison of the relative efficiency or coal consumption of steam and electric power for similar service would require an extensive series of tests with indicator and dynamometer on the performance of the steam locomotive.

As a matter of interest, we have secured an approximate comparison from a single test by weighing the coal and water taken by steam locomotive No. 1407 for a period of 24 hours, covering four trips between North White Plains and Grand Central Station, a distance of 24.75 miles, on the Harlem division of the New York Central Railroad. The trips occupied about four hours, the yard move-

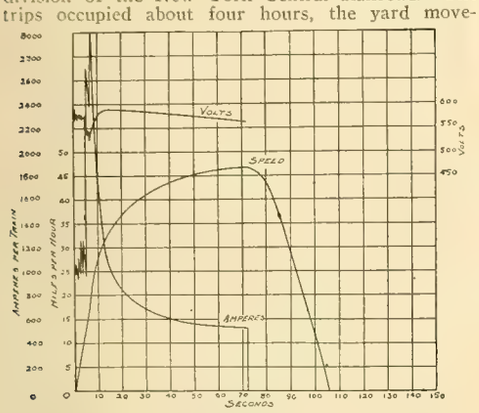


FIG. 4. COMPARATIVE ACCELERATION TESTS.—ELECTRIC RUN WITHOUT TRAILERS.

ments about one hour, and the locomotive was idle for 19 hours.

Following is a record of the service covering the 24 hours:

Total effective horsepower-hours, hauling coaches..... 861
Coal consumed..... 13,412 pounds.
Coal per effective horsepower-hour..... 15.6 pounds.

The effective horsepower-hour given above is the energy required for movement of the cars only, exclusive of the locomotive, and was determined from the draw-bar pull, taken by dynamometer car in previous tests over the same route.

The coal consumption covers all coal burned during the period of 24 hours, not only for movement of cars, but also movement in the yard and the banking of fires during lay-overs.

The effective horsepower-hour to move the cars serves as the basis of comparison with electric service, the coal consumed by the locomotive for whatever purpose being properly chargeable to the net work done by the locomotive during the period.

The efficiency of an electrical system, as an average under variable load, may reasonably be assumed as follows:

Engine	90%	Efficiency
Alternator	92%	"
High-potential transmission	98%	"
Transformers	97%	"
Converters	92%	"
Third rail	95%	"
Motors, including control	75%	" 51.33%

This percentage of effective horsepower output of

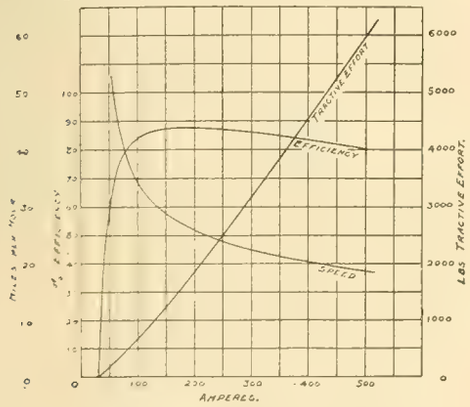


FIG 5 COMPARATIVE ACCELERATION TESTS.—SPEED-TORQUE CURVE OF G. E.-55 MOTOR.

motors to the indicated horsepower of the engine will vary somewhat, depending on the load factor. As an even figure, we will assume an efficiency of 50 per cent.

Coal consumption per indicated horsepower-hour from actual records of electric power stations, is in some cases less than two pounds, the average being about 2½ pounds. At the latter figure, the coal per effective horsepower-hour output of electric motors would be five pounds. Assuming the head-end air resistance as 10 per cent., and as the electrical equipment would increase the weight of the cars about 20 per cent., the actual comparison of coal consumption would be approximately in the ratio of 6.6 for electric and 15.6 for steam.

Assuming that coal for a power station can be purchased for 80 per cent. of the cost per ton of that used in the locomotives and that the cost of coal for electrical power is about one-third of the total cost, including maintenance and interest on investment, it is probable that the actual gross cost of electrical power would closely approximate the coal consumption of a steam locomotive in this class

FIG. 6. COMPARATIVE ACCELERATION TESTS.—ELECTRIC MOTOR CAR USED.

of service, the maintenance of the electrical equipment and attendance required being, however, considerably in favor of the electric power.

We wish to express our thanks to Mr. E. C. Schmidt, professor of railway and mechanical engineering, University of Illinois, for his able management of the dynamometer car, assisted by Messrs. J. F. Snodgrass and R. W. Lohmann; also to Messrs. A. H. Armstrong and E. F. Gould of the General Electric Company for their careful supervision and calculations of the electric test.

B. S. Barnard.

Bleecker S. Barnard, manager of sales for the American Vitrified Conduit Company of New York city, entered the electrical field as salesman with the American Vitrified Conduit Company in 1899. At that time underground conduit construction was not so well developed as at the present time, and the company was confining almost all of its output to the great subway systems in Baltimore and Providence. With Mr. Barnard's help this company has made rapid strides in the trade, and to-day it stands foremost in the manufacture of conduit. Not only has its deliveries represented the largest contracts in this country for conduit, but it is con-

B. S. BARNARD.

stantly shipping conduit abroad. The company's factories give it a very large capacity. One of them is kept busy making conduit for the great railway tunnel in New York city. The company's success is largely due to the persistent efforts of Mr. Barnard, who has not only worked up the business in a conservative manner, but is one of the most popular men in the trade, well known and well received at all times. Mr. Barnard has been a military man for 20 years as a captain in the Twelfth and Twenty-second regiments, New York city. He is a member of many social clubs, and is "hale fellow well met." At Cincinnati his company is laying some 2,000,000 feet of conduit for the Cincinnati Gas and Electric Company. In consequence, the exhibit of the American Vitrified Conduit Company at the recent electric-light convention in that city was of particular interest.

New Automobile Regulations.

New regulations for the operation of automobiles on the streets of Chicago were adopted by the City Council on June 30th on the recommendation of City Electrician Ellicott. The machines must have two brakes, one independent of the driving gear. Each brake must be powerful enough to bring the vehicle to full stop within 10 feet when traveling at the maximum speed of eight miles an hour. No part of the machinery of a vehicle shall be left running while standing in a public place or street without an attendant. Badges must be worn conspicuously, and only bells are allowed for alarms.

Requirements for the Paralleling of Alternators.[1]

By HENRY E. LONGWELL.

In a great many instances the difficulties experienced in paralleling alternators have been more or less completely overcome by tinkering with the governing mechanism on the engine, and consequently it has become fashionable to say that the troubles originate in hunting, oscillating, or otherwise faulty governors. This, however, is an unfair statement. Coincidence and cause are two entirely different things. The interaction between the generators is not necessarily caused by the hunting or oscillating of the governors, even though both phenomena are coexistent, and even though the latter tends to aggravate the former. A more fair statement of the case is, that the parallel operation of alternators imposes a duty on the governing mechanism of the engine which is abnormal and which is directly opposed to its natural function.

In a paper read before the meeting of the American Institute of Electrical Engineers by P. O. Keilholtz of Baltimore on October 25, 1901, it is stated in substance that the object of the specification is to limit the amount of cross-current that can flow between the generators. With a displacement of one seventy-second of the pitch angle between two poles, ahead or behind the position corresponding to uniform mean speed, two generators might be coupled together in parallel at the instant when the relative positions of the cranks of the two engines would be such that one generator would be the maximum distance in advance, and the other generator the maximum distance behind the position corresponding to uniform rotation. In this event the two generators might have a maximum relative displacement of one thirty-sixth of the pitch angle between two consecutive poles. With this displacement it is stated that the cross-current will be 10.9 per cent. of full-load current, provided the electrical characteristics of the alternators are such that the short-circuit current is 2½ times full-load current.

Now we find that for various reasons—constructional or otherwise—alternators are actually built giving short-circuit currents as low as 2½ times full-load current, while others are known to give as much as six times full-load current on short-circuit, and all of these are supposed to come within the limits of standard representative practice.

If, between the generators giving 2½ times full-load current on short-circuit when displaced one thirty-sixth of the pitch angle between two poles, the cross-current is 11 per cent. of the full-load current, then the cross-current between the generators giving six times full-load current on short-circuit when the phase displacement is one-thirtieth of the pitch angle between two poles—which displacement is allowable under the more liberal specification—would be a little over 31 per cent. of the full-load current—a ratio of nearly three to one

If the amount of cross-current allowable is a very important matter, it does not seem reasonable that the manufacturer of alternators should put out an invariable specification to cover the requirements of generators which differ so widely.

If 31 per cent. cross-current is allowable, why should the engine builder be burdened with the expense of making a flywheel to give a displacement which will cause only 11 per cent. cross-current? If, on the other hand, 11 per cent. cross-current is near the allowable limit, why should the engine builder be blamed when the generator builder furnishes machines that will give 31 per cent. cross-current with the specified displacement?

We are next led to inquire what is the effect of the cross-current, and we learn that it represents "sychronizing force" or the tendency of the generators to pull each other into step if the phases are displaced. We also learn that the force is such a percentage of the full-load torque of one machine, as the cross-current is of the full-load current.

We have been told that this synchronizing force is what makes paralleling possible and that the more we have of it the better; we are told that it checks the displacement of the rotating parts of the engine, resulting from the irregular crank-pin effort, and that with great synchronizing power in the generators, it requires a decided effort on the part of the engines to prevent the generators running well in parallel.

This looks so plausible that we have for years accepted it against the evidence of our senses, when, in fact, there is just one small grain of truth in it, i. e., that some synchronizing force is necessary to make paralleling at all possible. Synchronizing force is not one of the few good things which one cannot get too much of.

The synchronizing force tending to check the relative displacement between the generators exists only after the displacement has occurred; when the generators are in phase the force is nil, and consequently there is nothing to hold them there. I believe I am saying something new when I make the assertion that in every practical case, the effect of the synchronizing force of the alternators is to increase the irregularity of the angular speed of the engine instead of to diminish it. On first consideration, this proposition seems absurd, but nevertheless it is capable of being demonstrated practically, as well as mathematically.

Irrespective of whether a correction of the trouble

1. Abstract of paper read before the Engine Builders' Association of the United States at Pittsburg, Pa., on May 23, 1902.

could be effected by decreasing the sensitiveness of the governor, or improving the turning moment of the engine, or doing both simultaneously, the indisputable fact remains that with the original engine performance [on a test cited] a variation of 20 per cent. in the synchronizing power made the difference between success and failure in operating the generators in parallel, and this seems to indicate the utter fallacy of specifying the same characteristics in the engine for alternators in which the synchronizing force may differ by 200, or even 300 per cent.

The effect of the synchronizing force between the alternators is analogous to that of a spring capable of both extension and compression, and, considered apart from all other forces, will produce an oscillation of the rotating masses, the period of which oscillation depends on the intensity of the synchronizing force and the magnitude of the masses. The period of this oscillation has a very important bearing on the amount the angular displacement is augmented by the synchronizing force. With a period which I believe corresponds with the time of one revolution of the engine, the angular displacement seems to be increased indefinitely. As this natural period of oscillation is increased or decreased from the critical period, the effect of the synchronizing force on the displacement seems to decrease.

The whole matter is one of compromise. Let it be freely admitted that the irregularities in the action of the engine do set up electrical disturbances. The reciprocating engine will always have an irregularity in angular speed, and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by constructional and commercial limits from reaching absolute perfection. On the other hand, the electrical disturbances react on the engine, augmenting the inherent irregularities in the latter, and the intensity of this reaction is within certain limits under the control of the electrical engineer. It is therefore only when the engine builder and the electrical engineer each recognize the limits beyond which the other cannot go, and each endeavors honestly to make the task of the other as easy as possible, with due regard to the commercial excellence of the direct-connected unit as a whole, that we may hope that the parallel operation of direct-connected alternators will cease to be a subject for discussion.

Improvements in San Diego.

In addition to the machinery already in place, the San Diego Gas and Electric Company of San Diego, Cal., has lately installed two General Electric machines, one of 150 kilowatts' capacity and the other smaller. These are for incandescent commercial lights. Within a short time the company will announce a 24-hour service. All circuits have been overhauled and extended, and all commercial circuits have been changed to the three-wire system. Most customers are on meters and the charge is 20 cents a kilowatt-hour, whether for light or power. The company has also put in a new gas holder, to be known as a relief holder. Its capacity is 10,000 feet, while that of the large holder is 150,000 feet. The relief tank will regulate the pressure in the system.

The Union Traction Company of Saginaw, Mich., is reported incorporated with $50,000 capital stock.

Westinghouse Electric-vehicle Equipments.

A complete line of standard automobile equipments, embodying the latest improvements, as well as a broad experience, is now being offered by the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa. Each equipment includes everything of an electrical nature pertaining to the motive power of an electric vehicle, except the storage batteries, and is accompanied by wiring diagrams, with the aid of which the parts can be assembled by anyone familiar with the carriage-maker's art, assisted by a competent wireman.

The best features of railway and self-propelled vehicle motor practice have been embodied in the design of the motors. The frames are cylindrical in shape, and are especially adapted for universal methods of suspension and facility of removal, inspection or repair. Shoulders are turned on each motor end, making convenient the centering and attachment of any desired motor-suspension device. The bearings on all sizes, except the AA type, have babbit-lined boxes of generous dimensions, with automatic pad oilers. The AA motor, illustrated in Fig. 1, is provided with ball bearings, and one of the other motors is furnished with either ball or babbit bearings. The bearings may be removed without disturbing any other part of the motor.

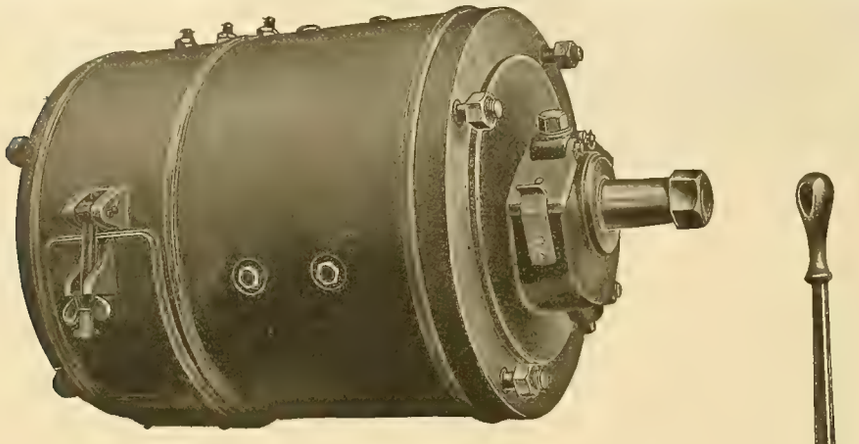


Fig. 1. Ball-bearing Motor.

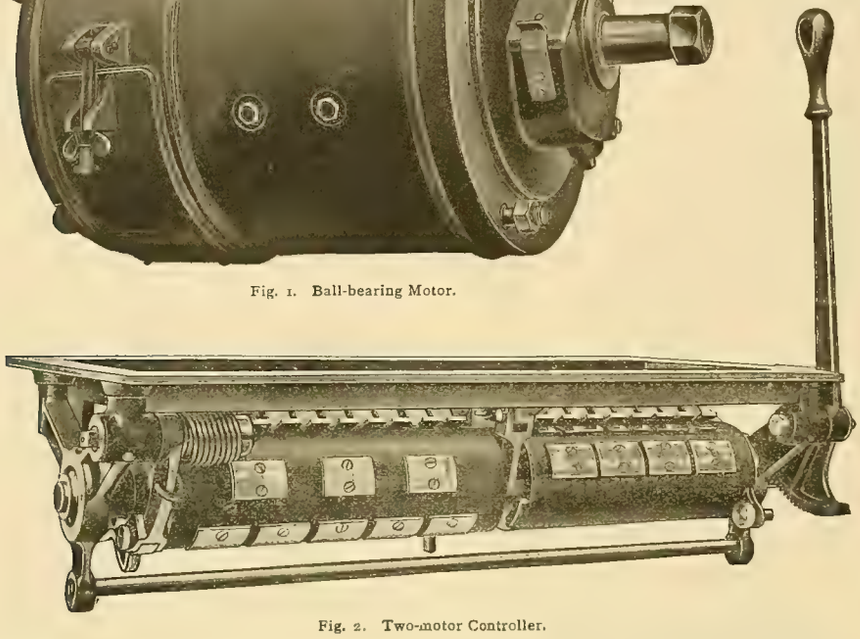


Fig. 2. Two-motor Controller.

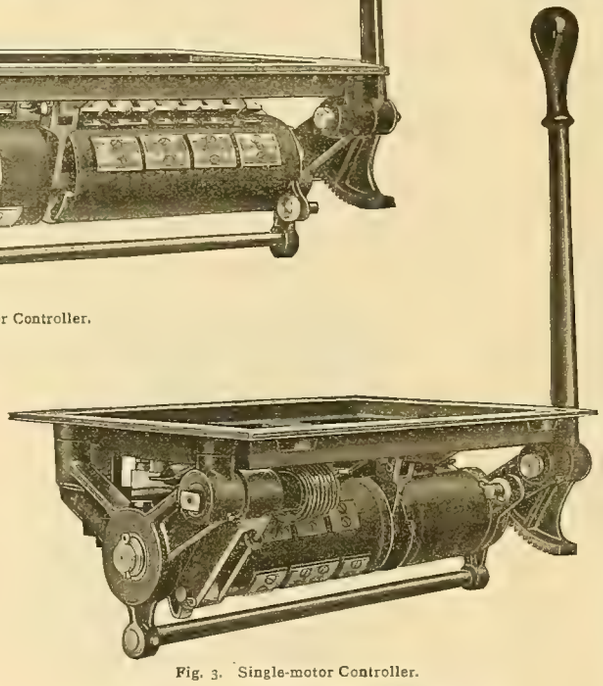


Fig. 3. Single-motor Controller.

WESTINGHOUSE ELECTRIC-VEHICLE EQUIPMENTS.

The motor armature is built up on a sleeve, and is machine-coil wound, the coils being very securely banded to prevent them from flying out at high armature speeds. The commutator and brushes are large; the latter are held in improved holders and are easily removable.

The motors are especially designed to meet the severe conditions under which an electric-vehicle motor is operated. It is said they will sustain, without injury of any kind or permanent loss of efficiency, a load of 100 per cent. above their normal rating for one hour, and will commutate perfectly up to at least 200 per cent. overload. The design has been carefully worked out with the view of obtaining low current consumption with a reasonable weight, which is especially important from the standpoint of mileage. Durability, also, has been considered one of the first essentials, and it is stated that these motors have run for weeks in the severest service with absolutely no attention, and that, in general, little care is needed, other than to see that the bearings are properly oiled. Recognizing the injurious effect of heavy discharges on both the capacity and life of storage batteries, the motors have been designed to give a higher relative torque or turning moment for a given current than is usual for this class of machines. This provides the necessary torque for starting, hill climbing or running through heavy mud without necessitating a heavy rush of current.

The motors are supplied in various sizes and for different speeds for vehicles, ranging from 1,300 to 5,500 pounds of gross loaded weight for single equipments, and from 2,600 to 11,000 pounds for double equipments.

The controllers are so designed that they may be let into the seat in such a manner that all parts are easily accessible from the top and front. The contact fingers may be removed from the top, and are easily adjusted. All contact and arcing parts are of hard-drawn copper. Controllers are built for single and double-motor equipments and have either three or four speeds, both forward and backward, according to the type of the equipment. The reverse drum or switch is part of the controller, and an interlocking device is provided, acting between the main drum and the reverse drum, and making it impossible to reverse with the controller in any other than the "off" position, the main drum being locked in that position unless the reverse drum is fully in the forward position or the reversed position.

The four-speed controllers have four notches, giving four uniform gradations of speed in either direction. When one of these controllers is used with a double-motor equipment, such as shown in Fig. 2, the connections are arranged so that the batteries may be always in one group in series, and speed variation is accomplished entirely by series-parallel arrangements of the motors and motor fields. This avoids all danger of unbalancing the batteries and renders the wiring less complicated. In the single-motor equipments (Fig. 3) the same number of notches are obtained, the batteries being divided into two groups, and placed in parallel for the two lower speeds. For the usual running speeds, however, the batteries may be in series.

Each vehicle equipment, besides the one motor or two motors required and the corresponding controllers with cable tips complete, consists of a two-pole or four-pole cut-out switch, a direct-reading battery-indicating instrument, a concentric charging receptacle and plug, 15 feet of duplex cable, battery-tray contacts, with cable terminals complete, wiring and wiring diagrams.

Chicago Traction Affairs.

Mayor Harrison of Chicago submitted to the City Council on June 30th the plan of Major E. B. Tolman, attorney for the board of local improvements, for the building of a municipal street-railway subway to be constructed by special assessment. The plan was referred to the local transportation committee. The council also ordered the corporation counsel to draw up an ordinance for the construction of a subway after the Foreman proposition for a bond issue on the subway itself as an asset. Consequently there are now three distinct subway propositions before the council, the Alexander-Washburne plan being the third.

At the same meeting of the council the "return fare" ordinance which compelled the traction companies to return fares or their equivalent in cases of breakdowns when the fault was the companies', was killed by the mayor's veto and the refusal of the council to change it so as to make the companies responsible no matter what the cause of the accident might be. The mayor declared the ordinance ineffective unless amended.

The council committee having in hand the ordinance introduced by the North Shore property owners of Chicago for the introduction of electric cars on the Evanston division of the Chicago, Milwaukee and St. Paul railway has decided to recommend for passage a measure which only provides for the changing of the motive power between Evanston and Wilson Avenue, so that the cars of the St Paul road could give a continuous ride to its patrons by running up an incline to the Northwestern elevated road.

Novel French Smoke-preventing Device.

Among recent French patents is one granted to Fuller for a process of burning smoke in furnaces by the electric spark. In most furnaces the combustion is incomplete, and the smoke carries off a large percentage of combustible. This is especially true when a fresh supply of coal is thrown on; the latter is distilled under the action of heat and a certain quantity of illuminating gas and tar is formed, these being driven up the chimney before they have a chance to burn. To assure their combustion, Fuller mixes them first with a certain quantity of air; the air has been previously heated by passing through a coiled tube placed at the outlet of the furnace. The mixture is ignited by a series of electric sparks which are formed above the grate between metallic or carbon points. The current is obtained from

thermo-piles, which are built into the masonry of the furnace. The primary current thus produced is sent into an induction coil and the secondary current forms the sparks. This process is said to suppress the smoke almost entirely and the current is produced in the furnace itelf. A battery of accumulators charged by the thermo-piles is arranged so as to assure the combustion of the smoke while the furnace is being lighted.

What Causes Thunderstorms?

Scientific investigators are not agreed on the cause of phenomena so long observed as those of electrical storms. A recent evidence of this is found in the columns of the Monthly Weather Review, issued by the United States government, in which exception has been taken to certain statements in a recent popular article written by Professor Simon Newcomb. One of the points at issue will interest the readers of the Western Electrician. It is the cause of the electrical phenomena accompanying thunderstorms. Professor Newcomb replies to his critic on this point as follows:

"The second point at issue is the cause of a thunderstorm. I attributed this to a rise of warm air and a fall of cold air to take its place. On this the editor remarks: 'The development of electricity by the rise of hot air and the descent of cold air is, we believe, a new thought in the physics of the atmosphere.'

"This remark seems to show that theoretical meteorology is either much less advanced or much more advanced than I had supposed. The above view was based purely on those casual observations which every one may make in the course of his life. When, however, they are challenged, one hardly knows where to begin. I shall, therefore, confine myself to a statement of propositions, asking the editor to point out where his dissent comes in:

"(1) In spring and early summer it frequently happens that the excess of temperature of the air near the ground above that at a higher elevation is greater than the excess in a state of adiabatic equilibrium.

"(2) The necessary result of this state of things is an instability of equilibrium. The colder air above at some point breaks through the stratum of warm air below and the latter rises up to take its place.

"(3) The result is a colder wind blowing away from the place where the descent occurs and toward the place where the air is ascending. We thus have the familiar phenomenon at the commencement of a thundershower, when, for a few minutes, a heavy wind blows away from the seat of the storm.

"(4) This state of things is nearly always accompanied by lightning, and the other phenomena of a thunderstorm.

"(5) Lightning is produced by an electric disturbance and involves a generation of electric potential. Why or how the motion of the air should generate this potential, I must leave to others.

"All I am stating are what appear to me the observed facts. If my propositions are wrong, I should like to have them corrected by a clear statement of the facts and causes of a thunderstorm."

To this the editor of the Monthly Weather Review, Professor Cleveland Abbe, makes this rejoinder:

"The second point under discussion is not precisely 'the cause of a thunderstorm.' There is no question as to the mechanism of thunderstorms. They are certainly composed of ascending currents which form clouds from which we get rain, lightning and thunder. The point at issue is as to the process by which electricity and lightning are formed. According to the original statement in Leslie's Weekly, as quoted in the Monthly Weather Review for August, 1901, page 377: 'The expanse of hot air tends to rise, and as it does so the air from around flows down and in and takes its place. By this change electricity is developed, and thus we may have a thunderstorm.

"This development of electricity by the rising of hot air, or the inflow of other air, is the hypothesis that we originally objected to as one that has not yet been accepted by electricians; still it may be true, and we hoped that Professor Newcomb would explain its reasonability. In his reply he simply states that 'lightning is produced by an electric disturbance and involves a generation of electrical potential.' This is, of course, merely another way of stating the same thing. It is considered necessary by physicists to explain, first, how the atmosphere or the vapor particles come to be electrified at all, as we know they are, and, second, how the gentle electrification of the atmosphere can give rise to the powerful lightning flashes of a thunderstorm. During the last few years J. J. Thompson and C. T. R. Wilson have made it appear plausible that condensation in saturated air begins preferably on the negative ions, and that in this way the raindrops bring the negative electricity down to the earth and leave the free, positive electricity behind in the atmosphere. Elster and Geitel have also accepted this view, but it may be modified by the next step in our knowledge. In view of all that has been said on this subject for a hundred years past, there would seem to be no reason for suggesting that the ascent of hot air and the inflow of other air develops electricity, but a new view quite recently suggested by Dr. Linke of Potsdam shows in what way this may be said to be true."

CORRESPONDENCE.

New York Notes.

New York, June 29.—At Wednesday's meeting of the Rapid Transit Commission, the formal signing by President Orr of the contract for the building of the Pennsylvania railroad's tunnel, was accomplished. By a vote of four to two, Mayor Low and Controller Grout voting in the negative, the board authorized the payment of $400,000 for extra work on construction in the Rapid Transit subway. This amount has been spent in the construction of electric ducts in the tunnel. In the original contract no provision was made for the building of ducts in the tunnel, it being stipulated that the wires should be strung. The board is of the opinion that the work shall be regarded as a part of construction and has passed a resolution to that effect, despite the protests of the mayor and controller. It is expected, however, that Controller Grout will refuse to pay the bill when it is presented to him, and there is a probability that the case will be heard in the courts. It is estimated that the total cost of building the ducts will be in the neighborhood of $1,500,000.

Major Ira A. Shaler, mention of whose injuries was made in my letter of last week, died this morning at the Presbyterian Hospital. Major Shaler was well known as an engineer, as he had performed many important works. He was forty years of age and an alumnus of Cornell. Major Shaler won his title while serving with an engineering regiment in Porto Rico.

The last wire to complete the four cables in the new Williamsburg Bridge was unreeled on Friday and taken across the East River before thousands of spectators and amid the tooting of hundreds of steam whistles. The starting of the wheel was followed by the hoisting of the American flag on the Manhattan tower. When the wire was stretched, the officials of the John A. Roebling Sons' Company, who are doing the cable work, gave three hearty cheers. The stretching of the final wire does not complete the cable work. The wires in each cable will now have to go through the process of squeezing, and the cables will then be banded and incased.

The Granite City and Venice Light and Power Company of Jersey City, N. J., has been incorporated with $100,000 capital stock by F. L. Arnold, G. A. Barker and D. Wight.

The Easthampton Electric Light Company of Easthampton, Suffolk County, has been incorporated with $48,000 capital stock. Everett Herrick of this city is one of the incorporators.

Albert C. Albertson, Christian A. Henricksen and John Allen, all New Yorkers, have incorporated the Electro-magnetic Railway Constructing Company with a capital of $1,000,000, to manufacture electrical machinery. M. L. G.

New England News.

Boston, June 28.—The directors of the Norwich (Conn.) Gas and Electric Company have ratified the stockholders' vote to sell the company's plants to the city. The company values the plants at $397,329 in addition to a mortgage of $400,000, which represents an issue of bonds. The city has voted to establish municipal gas and electric-light plants, but it will refuse to pay the price at which the company values its plants, and the matter will probably go to the courts.

The Connecticut Railway and Lighting Company is installing a storage-battery system to provide supplementary power for its Derby and Ansonia (Conn.) lines. The battery contains 260 cells. The regular power plant is overtaxed on busy days.

The People's Tramway Company of Putnam, Conn., and the Providence and Danielson Electric Railway Company have made a traffic contract. Their lines form a continuous route between Providence, R. I., and Putnam, Conn.

The mayors of Providence, Pawtucket and Central Falls, R. I., have made propositions for settling the strike of street-railway employes in those cities, but they have been rejected by Marsden J. Perry, the representative of the Union Traction Company, who said there was nothing to arbitrate, and that the strike was over, so far as the company was concerned. He said that the men were returning to work, and that the company could not use all that wanted work.

The transfer of the properties of the Union Traction Company of Providence, R. I., the Pawtucket Street Railway Company, and the Rhode Island Suburban Railway Company to the Rhode Island company, was completed at Providence on Tuesday. The lease will run 999 years, and the property transferred will probably be capitalized at $20,000,000. The Rhode Island company is controlled by the United Gas Improvement Company of Philadelphia. The following are the officers of the Rhode Island company: President, Marsden J. Perry of Providence; vice-presidents, S. P. Colt of Providence and Randall Morgan and Walton Clark of Philadelphia; secretary-treasurer, Lewis Lillie of Philadelphia; general manager, A. T. Potter of Providence. B.

Canadian Intelligence.

Toronto, Ont., June 28.—The Hull Electric Railway Company, operating between Ottawa, Ont., and Aylmer, Que., has passed into the hands of the Ottawa, Northern and Western railway, or, more properly, into the hands of the Canadian Pacific railway, which recently concluded the purchase of that system. The purchase price is said to have been $750,000. It is understood that a new company will be formed out of Canadian Pacific railway stockholders, which will run in close connection with the Canadian Pacific.

The Schomberg and Aurora Electric railway is finished. It extends from Aurora, a station on the Grand Trunk railroad in Ontario, 30 miles north of Toronto, to Schomberg, at the head of the water outlet, to Lake Simcoe. It will be pre-eminently a tourist line during summer and a freight and passenger line all the year around, as it passes through a rich farming country. Freight sheds and switching yards are to be built at the terminal, near Bond Lake. The Schomberg and Aurora will connect with the Metropolitan electric railway at Aurora, which will give it entrance into Toronto.

A company is in course of formation for building and operating a line of electric railway from Ottawa to Lachine, to connect with the Montreal Belt Line. The promoters claim that power will have to be transmitted no farther than 48 miles in each direction. It is proposed to make a $3 round-trip rate between Ottawa and Montreal.

The City Council of Ottawa has passed a resolution to buy the Ottawa electric railway and run it as a municipal road, and has given notice of an application to be made to the Ontario Legislature for permission to operate an electric railway in the city of Ottawa, or to acquire the property of the present street-railway company when its franchise terminates. It has also applied for permission to build a line to suburban points.

The St. Lawrence River Electric Power Company has been incorporated with a capital stock of $250,000. The incorporators are M. W. Beach and W. J. Redmond of Iroquois, Irwin Hilliard of Morrisburg, W. H. Meldrum of Peterboro, and D. A. King of Winchester.

The British Columbia Light and Railway Company has received a large cargo of steel rails from Europe. Mr. Buntszen, the manager, states that the numerous electric-railway extensions will now be rushed. H.

Southern Developments.

Charlotte, N. C., June 28.—The comptroller general of Georgia has rejected the schedules of both the Western Union and Postal Telegraph companies, averring that both are too small. An increase of $131,000 is asked from the Western Union.

The Hampton Roads Railway and Electric Company, started in opposition to the existing companies, has been formally launched at Newport News, Va.

The Jackson (Ga.) Street Railway Company, incorporated some time ago, has just perfected organization and will now furnish power for electric lights contracted for by the city. Machinery for the street railway will be bought at once.

It is reported that the Railway and Light Company of America, J. W. Middendorf of Baltimore president, is negotiating for the purchase of the Macon (Ga.) Electric Light and Railway Company.

At Alexandria, La., J. C. Allen is interested in a $50,000 proposed electric-railway belt line. The General Electric Company, it is said, will take a large part of the stock. The line will be about four miles in length.

It is said that the recent purchasers of the Richmond electric-railway and power-transmission companies paid about $4,000,000 for the properties.

The electric-light plant of the Crockett Electric Light and Ice Company at Crockett, Texas, has been destroyed by fire, at a loss of $15,000.

It is understood at Baltimore, Md., that an arrangement has been perfected for the purchase of the United Electric Light and Power Company by the Susquehanna Power Company of $2,000,000 common stock held by the United Railways and Electric Company. The Continental Trust Company, it is said, will finance the deal. Three developments of 40,000 horsepower each are contemplated on the Susquehanna River. L.

From the Buckeye State.

Columbus, June 28.—The Abbott Electric and Manufacturing Company of Warren has changed its name to the United States Brass and Manufacturing Company.

For the last five months the net profits of the Cincinnati, Covington and Newport railway have been $61,986.81, as compared with $40,372.67, for the same length of time last year.

The street-railway companies of Cleveland have both made an increase of 10 per cent. in the wages of their conductors and motormen. Now, the first year men will receive 20 cents an hour; men who have worked two years, 22 cents, and for the third and succeeding years they will receive 23 cents. The officers state that they have made the advance as a business proposition; that they realize that the only way to get and keep good men is to pay good wages, and that they are glad to give them all they can afford at all times.

Probate Judge Anderson of Akron has decided that the Barberton and Akron Belt Line Railway Company is not properly in court because of a defect in the organization, and that it cannot appropriate land to complete its right-of-way. The Barberton, Akron and Eastern Belt Line Railway Company is seeking a right-of-way over the same route.

C. W. French is the promoter of the first-named road and also of the Richland and Mahoning. On the latter, he asserts, work will be begun at once, although some have said that his roads are merely on paper and that he has no intention of building them

Efforts are now being directed toward financing the Lake Shore Electric Railway Company and getting it into shape to give a first-class service. This road has splendid possibilities with its line connecting Cleveland and Toledo, and it is hoped the syndicate will be successful in securing the necessary funds to put it fully upon a good basis. O. M. C.

Information from Indiana.

Indianapolis, June 30.—Beginning with to-day the Union Traction Company of Indiana will install express cars on its lines connecting this city with important towns in the gas belt. The cars were manufactured at the company's shops at Anderson and are models of their kind. There will be an express messenger and motorman in charge. The cars are 45 feet in length and 8½ feet wide, equipped with four Westinghouse motors of 75 horsepower each. The company will carry any kind of freight that can be put up in packages or conveniently crated. A rate schedule will be agreed on some time during this week. The merchants are insisting on a rate one-half lower than that charged by the steam roads.

Hugh J. McGowan, president of the Indianapolis Street Railway Company, returned from the East the past week and at once emphatically denied the stories sent out from Philadelphia that the United Gas and Improvement Company of that city had acquired a majority of the stock of the Indianapolis company.

The Fort Wayne and Southwestern Traction Company has filed a mortgage for $2,000,000 in favor of the State Street Trust Company of Boston to secure bonds. The line from Fort Wayne to Wabash is mortgaged for $1,000,000. The remainder will be held in the treasury to cover future extensions. This line reached Wabash on Friday, and the workmen are now laying track in Wabash.

A peculiar condition exists at Anderson, where the merchants organized a company to build an interurban electric-railway line from Anderson to Middletown. Mr. McCulloch of the Union Traction Company also desired to build to Middletown, but would not antagonize the merchants. Now that the Merchants' company is about to sell out to the Richmond and Northwestern Traction Company, Mr. McCulloch says he is no longer restrained and will build the Middletown extension at once, and in such case there will be parallel electric lines between Anderson and Middletown.

The appraisers appointed by the Cass Circuit Court at Logansport, to fix the value of the old canal bed for interurban purposes have placed the appraisement at $660 a mile. Condemnation proceedings are also in progress in Miami, Carroll and Tippecanoe counties, and there is no longer doubt that interurban cars will soon be running where canalboats plied from 1840 to 1870.

The Indianapolis Water Company has notified the Board of Public Safety that unless the city compels the Indianapolis Street Railway Company to provide return-current wires or some other change in its motor power that will protect water mains from electrolysis, the city will be sued for damages.

The Indiana Appellate Court has rendered a decision of importance to street-railway companies. It is to the effect that where a newsboy was ordered from a car at a time when he could have safely gotten off, but persisted in remaining thereon, though he was at first on the car by permission of the company, he immediately became a trespasser, and if later injured in an attempt to get off, pursuant to the reiterated order of the company's servant, it was not such wilful injury or negligence on the part of the company as to render it liable.

W. A. Hall has sued the Indianapolis Street Railway Company for $5,000 damages, and bases his complaint on a peculiar and interesting incident. The plaintiff was on one of the defendant's cars when he saw a small child running toward the moving car. The motorman apparently did not see the child and the plaintiff ran out on the fender to catch it. The motorman suddenly stopped the car, and the plaintiff, who had saved the life of the child, was thrown from the fender and injured. He charges the motorman with negligence. The lawyers say the plea raises the question of voluntary exposure to danger, and the case will prove interesting.

Two heavy closed cars on the Broad Ripple line collided four miles north of Indianapolis Saturday night, killing Motorman White, one passenger, and severely injuring 10 other passengers. The heavy rain obscured the headlights, and the fronts of both cars were crushed in. The fault is attributed to the dead motorman, who pulled out of a switch ahead of time.

A new electrical manufacturing company has been organized at Crawfordsville, to be known as the O. C. Irwin Electric Company. The company proposes to do a large business in the line of electrical supplies. The capital stock is $50,000. The company will be able to supply electric-lighting plants complete. The Irwin transformers will be made. O. C. Irwin is president and general manager and H. H. Long secretary.

The City Council at Richmond has appointed a committee to test the new municipal light plant and to employ an electric expert to assist in the work. This has aroused opposition upon the part of the mayor, who says it is a useless expense.

The Madison Light Company of Madison has been incorporated with a capital of $75,000 to light by electricity or gas the city of Madison. John H. Brown heads the board of directors. F.

Northwestern Notations.

Minneapolis, June 28.—The Sioux City Traction Company may reduce the grade of Riverside Hill and put in a double line from Sioux City to Riverside. The improvement will cost $30,000.

The light plant at Benson, Minn., has been purchased by the village.

The Charles City (Iowa) Lighting and Heating Company has been organized for the purpose of taking care of the largely increased business of the electric plant. The company has a capitalization of $75,000.

The Tacoma-Seattle Interurban Railway Company will establish headquarters at Tacoma, Wash., and will build a $15,000 general-office building.

The Ross-Dier Company has been organized for the purpose of building an electric road from Bozeman to Big Timber, Mont. The capitalization is $300,000.

The Shawano and Green Bay Traction Company, incorporated at Shawano, Wis., will build interurban lines from there to Green Bay, Appleton and Wausau.

The controlling interest in the Fort Dodge (Iowa) Light and Power Company has been sold to Healy Bros. & Kelleher. The sale involves a transfer of $67,000 worth of stock. R.

On the Pacific Slope.

San Francisco, June 26.—Frank Fletcher, mayor of Nelson, B. C., and the city engineer of the same place are endeavoring to make arrangements for securing waterpower on the Kootenay River, for the purpose of increasing the Nelson municipal light and power plant. The power for the municipal plant is now derived from Cottonwood Creek, but Mr. Fletcher states the demand exceeds the supply. About 1,000 horsepower additional is to be developed by the city.

The Riverside Power Company, Riverside, Cal., has awarded a contract to W. E. Tedley for the construction of a power canal along the bank of the Santa Ana River, capable of carrying 7,009 inches of water. Construction work began on June 10th and is to be completed by January 1st.

The United Gas and Electric Company of San Francisco, a sub-company of the Standard Electric Company, has secured control of the Pacific Power Company and its plant at 23 Stevenson Street, San Francisco. The plant includes a steam-power electric station and an underground distributing system, extending on both sides of Market Street. The plant will be used as a sub-station for distributing the Standard company's current for light and power purposes. A storage battery will probably be installed.

The Pacific Light and Power Company of Los Angeles, Cal., is preparing to install a new building, 150 feet square, on Third Street, Los Angeles, Cal. The structure will be of pressed brick. A boiler plant capable of developing 2,500 horsepower will be installed. Oil will be used as fuel. A.

PERSONAL.

John A. Beeler has been made general manager of the system of the Denver (Col.) City Tramway Company.

Thomas A. Edison has an article on "The Storage Battery and the Motor Car" in the current North American Review.

Walter F. Field, representing the Phillips Insulated Wire Company of Providence, R. I., visited Chicago recently, and was entertained by President W. W. Low of the Electric Appliance Company.

J. W. Peterson, who was formerly connected with the Chicago sales department of the Stanley Electric Manufacturing Company and the Northern Electrical Manufacturing Company, has been elected vice-president and general manager of the Electrical Equipment Company, Chicago.

C. N. Duffy, auditor of the Chicago City Railway Company of Chicago, has been elected secretary of the company, succeeding F. R. Greene, who resigns to take the presidency of the Chicago Street Car Advertising Company. Mr. Duffy has been auditor of the company since September 1, 1899, and will continue to perform the duties of that office in addition to those of the office of secretary. He has been a leading spirit in the Association of Street Railroad Accountants and has a national reputation as an accountant and auditor.

Mrs. Charles F. Brush, the wife of the well-known Cleveland inventor, died at her home in Cleveland on June 25th from the effects of an attack of malarial fever, from which she had suffered for several weeks. Mrs. Brush was born in Cleveland on May 21, 1854, and was married to Mr. Brush on October 6, 1875. Her maiden name was Mary E. Morris, and her father, John Morris, was a well-known business man of Cleveland. Besides her husband the deceased leaves three children, Misses Edna and Hellene and Master Charles F. Brush, Jr.

C. C. Burdick has been appointed superintendent of the St. Paul system of the Twin City Rapid Transit Company, succeeding Dow B. Smith, who has gone to Brooklyn to assume the responsibilities of superintendent of the Brooklyn Rapid Transit Company's lines.

Under date of June 27th the Boston correspondent of the Western Electrician writes: "Howard P. Quick, for 13 years chief draftsman and mechanical engineer for the Boston Elevated Railway Company, has accepted an offer to become engineer in charge of the design and construction of power plants in Kansas City for the Metropolitan Street Railway and Kansas City Electric Light Companies undertakings. He is only thirty-six years of age, but is a recognized leader in his profession and one whose removal from Boston is a distinct loss to the engineering talent of this section."

ELECTRIC LIGHTING.

The Merchants' Electric Light Association of Lafayette, Ind., has filed resolutions amending its articles of incorporation so as to include in its objects furnishing hot water for heating purposes and increasing its capital from $30,000 to $150,000.

The Charles City (Ia.) Electric Lighting and Heating Company has been incorporated with G. E. May as president. The company contemplates the erection of a new plant 80 by 80 feet, and an expenditure of $35,000 will be made for machinery and equipment.

A. F. & S. T. Meservey of Fort Dodge, Iowa, have sold to Healy Brothers and Kelleher of that city the controlling interest in the Fort Dodge Light and Power Company, which also operates three miles of street railway. The transaction involves the transfer of $67,000 in stock of the total issue of $125,000.

The Board of Supervisors of San Francisco has awarded the contract for lighting the public streets to the San Francisco Gas and Electric Company. The contract secures street lighting for 329 nights, with the conditions that the Board of Public Works shall designate during the year the nights when illumination is not required, not to exceed 36 in the year. This will insure practically every-night lighting during the foggy and winter season, and an extension of the system to the number of 100 new gas lights and 50 arc lights. The rates under this contract will be: For single gas lamp per night, 8.7 cents; triple-top gas lamps per night, 15 cents; arc lights per night, 37 cents. These rates depend upon the increase of 29 nights lighted over the old schedule, and will require the original appropriation of $275,000.

ELECTRIC RAILWAYS.

Articles of incorporation of the Vinton, Belle Plaine and Independence (Iowa) Interurban Railway Company have been filed. The capital stock of the company is $25,000.

Construction has begun on the new power house of the Denver (Colo.) City Tramway Company. This improvement entails an expenditure of $400,000 and will have double the capacity of the present plant.

The capital stock of the Muncie-Hartford City and Fort Wayne (Ind.) Traction Company has been increased from $600,000 to $1,000,000. The road will be pushed to completion as soon as possible and it is expected to have cars in operation in July.

It is stated that the Rapid Railway Company, the Cincinnati and Eastern Railway company and the Suburban Traction Company will soon erect at Covington, Ky., a $75,000 building, which will be used for a terminal and freight depot and for the offices of the companies.

The East St. Louis and Suburban Company has filed papers with the Secretary of State of New Jersey increasing its authorized capital from $3,000,000 to $5,000,000. The papers were signed by C. M. Clark, president, and George L. Eastbrook, secretary. The company was chartered in April last, to acquire and operate trolley lines in and about St. Louis, including the lines of the St. Louis and Illinois Suburban Railway Company.

Judge Tarrant, in the Circuit Court at Milwaukee, Wis., has declared illegal the ordinance granting a franchise to the Milwaukee, Burlington and Lake Geneva Railroad Company to build an elevated road into Milwaukee. This is the road in which Clarence Darrow of Chicago is interested. The suit to have the franchise declared void was brought by property owners on the streets over which the company intended to build its line. The company intended to build from Lake Geneva to Milwaukee on the surface and to elevate its tracks and come into the heart of the city over the streets. The suit was brought on the ground that there was no statute in Wisconsin whereby the city could grant a franchise to an elevated road.

The Camden Interstate Railway Company of Huntington, W. Va., has sold to a Pennsylvania syndicate all its electric lines in Huntington, Cen-

tral City, Ceredo and Kenova, W. Va., Catlettsburg, and Ashland, Ky., and Ironton, Ohio. The deal also will embrace electric-light plants in Ironton, Ashland, and Huntington. The consideration is about $2,000,000. John Graham and Edmund McCandish of Newville and John J. Henry and William North of Philadelphia are the leaders in the syndicate. Senator Camden of West Virginia was the chief stockholder in the old company. It is rumored that the syndicate has in view the purchase of electric railways in other Ohio Valley cities, the ultimate aim being to have a continuous line between Cincinnati and Pittsburg. John Graham was elected president of the new company.

POWER TRANSMISSION.

Work on the large transmission system of the Western Power Company of Los Angeles, Cal., involving the diversion and storage of the waters of the north fork of the Feather River in the Big Meadows, has been begun at several points under the direction of J. M. Howells, manager and consulting engineer.

The Atlanta Manufacturing and Improvement Company of Atlanta, Ga., has been organized with $300,000 capital stock for the purpose of erecting plants in and about the city of Atlanta for furnishing electric power to manufacturing concerns. A large amount of power will undoubtedly be supplied by the Chattahoochee River. James W. English, J. W. Montgomery and J. G. Good are among those interested.

The Kern River Power Company of California has let the contract for the construction of a 12-mile canal from a point near Kernville to the site of the new power house. The capacity of the canal will be 30,000 miners' inches. A transmission line of 110 miles long will connect the 15,000-horsepower plant with Los Angeles. Electricity will be supplied for the Huntington-Hillman railway system. The 1,600-horsepower plant now under construction in Los Angeles will be used as an auxiliary station. H. E. Huntington and J. W. Hillman are interested in both plants.

SOCIETIES AND SCHOOLS.

W. I. Gray of Minneapolis was elected president of the Electrical Contractors' Association of Minnesota at Duluth. The next meeting will be held in St. Paul in January.

The American Electro-therapeutic Association will hold its twelfth annual meeting at the Hotel Kaaterskill, Catskill Mountains, N. Y., on Tuesday, Wednesday and Thursday, September 2d, 3d, and 4th. The officers of the association are: President, Dr. Fred H. Morse, Melrose, Mass.; secretary, Dr. George E. Bill, Harrisburg, Pa.; treasurer, Dr. R. J. Nunn, Savannah, Ga.

The report has again been revived that the regents of the University of Wisconsin are considering the question of offering the presidency of the institution to Dr. Henry S. Pritchett, president of the Massachusetts Institute of Technology of Boston. Dr. Pritchett was in Madison several days ago, and it is asserted that he would favorably consider a call from Wisconsin.

PUBLICATIONS.

A revised price list on H.-G. pull sockets for use with incandescent lamps has been issued by the Western Electric Company of New York.

A small pamphlet distributed by the Pittsburg Transformer Company of Pittsburg, Pa., calls attention to the merits of its transformers.

A recent catalogue issued by the American Air Compressor Works of New York city describes various types of its air compresors and compressed-air specialties.

The Railway Appliance Company of 675 Old Colony Building, Chicago, is distributing a catalogue which illustrates and describes its various railway specialties, such as emergency knuckles, auxiliary couplings, car movers, etc.

The New Haven Novelty Machine Company of New Haven, Conn., has issued a catalogue and price list of its brass fittings for electric cables. These specialties include slidable sleeves, Y branches, pot heads and terminal heads.

TELEGRAPH.

Louis Degoll, president of the Rowland Telegraphic Company, has returned from Europe, where for the last two years he has been arranging for the introduction on the government telegraph lines of various European countries of the inventions of the late Professor Rowlands. An effort will be made to bring Rowland inventions into popular use in this country.

The Commercial Telegraph Union, which was recently formed in Chicago, has decided unofficially to oppose operators who are employed during the day from working three or four nights during the week for the Western Union Company. These men, it is understood, are gradually to give up their night work. This withdrawal it is believed will hamper the company and convince its officers that any discrimination against members of the union is likely to embarrass its service.

SPACE TELEGRAPHY.

The wireless-telegraph station to be located at the Annapolis Naval Academy will be placed at the Physics and Chemistry Building. The pole will comprise a lower mast, topmast and topgallant mast 170 feet in height. A sending and receiving station will be in the building. A set of wireless-telegraphy apparatus has been rigged up by Professor Terry. He sends signals and messages across the creek to the Naval Cemetery and to vessels out in the bay. He also uses it in instructing cadets to demonstrate its uses and principles.

A San Francisco report states that John D. Spreckels, the capitalist, whose name is associated with the industries of the Hawaiian Islands, is contemplating connecting the islands by wireless telegraphy with California. The decision to install such a system over this 2,000-mile expanse of ocean will depend, it is said, upon the outcome of an installation that is now being placed in service between Los Angeles and Cantalina Island, 40 miles out in the Pacific Ocean. Mr. Spreckels' vessels of the Oceanic Steamship Company, plying between Hawaii and San Francisco, may also be fitted up with wireless apparatus.

MISCELLANEOUS.

The Illinois Central Railroad Company is experimenting with electric interlocking switches at its junction with the Mobile and Ohio railroad, between Mounds and Cairo, Ill. Electric switch lights form a part of the system.

L. S. Flateau, an inventor of St. Louis, Mo., says that he has invented a rotary steam engine that is a success. He has exhibited an engine of 15 horsepower and asserts that an engine built on the same lines, with a diameter of six inches, will develop three horsepower from 100 pounds' pressure of air or steam.

A disastrous fire occurred recently in a building on Queen Victoria Street, London, England, partly occupied by the British General Electric Company. The fire spread very rapidly and mainly because the fire-department apparatus was insufficient. Eight girls were burned to death and seven others injured by jumping into a tarpaulin in the street.

Martin C. March and others of Los Angeles, Cal., have applied to the Los Angeles council for a franchise for the construction of a subway, which will extend for several miles under the streets of the city and contain electric-lighting and power and telephone and telegraph wires. According to present plans, the subway will be eight feet in height by 10 feet in width.

The Senate committee on the District of Columbia has made a favorable report on the joint resolution to enlarge the use of electric conduits in the District of Columbia. The resolution, in effect, proposes that the conduits now being used for street-railway purposes may also be used to carry the wires of the electric-lighting companies on such terms as may be agreed among the companies interested.

According to statistics of the world's principal copper supplies, issued by Henry R. Merton & Co. of London, the United States copper production for 1901 fell somewhat below that of the year previous, the total output for the year being 267,410 tons, compared with 268,787 tons, of the year before. The greatest increase in production was that of Canada, where in 1901, 18,800 tons were produced, and in 1900 but 8,500 tons.

Arguments on a motion to set aside a report entered by Special Master in Chancery Frank Wean two years ago in the noted Peoria (Ill.) electrolysis case were begun recently before Judge Grosscup in the United States Circuit Court at Chicago. The master's report was to the effect that the electric current escaping from the single trolley wires had caused the decomposition of the water pipe of the Peoria Waterworks Company.

A new French battery uses as a depolarizer the higher oxides of metals in presence of an acid or mixture of acids. Higher oxides of lead and especially of manganese are appropriate. Nitric and especially sulphuric acids are best used. In the latter case the reaction only takes place when the battery works, and, besides, no odor is given off. The inventor, Rosset, gives several methods of adding the acid to the cell. It is interesting to note that a battery of this kind can be recharged like a storage battery, as the electrolysis of the manganese salt which is present gives anew the bioxide at the positive pole.

A smoke ordinance is under consideration by the Chicago City Council which provides for the creation of a new department to be known as the department for the inspection of steam boilers and steam plants, and consisting of the boiler inspector, a supervising mechanical engineer, and chief smoke inspector. This board shall not only make inspection of steam boilers but shall conduct prosecutions for violations of smoke laws. The provision which is expected to work the greatest benefit in preventing smoke is that stipulating that every plan for a building shall be examined and approved before a building permit is issued.

The coke-oven blowers in the Buffalo (N. Y.) plant of the Lackawanna Iron and Steel Company are to be operated by direct-connected electric motors. Ten induction motors of 75 horsepower each have recently been purchased by the Lackawanna company for this purpose from the Westinghouse Electric and Manufacturing Company. Four induction motors of 100 horsepower each will be used for operating the gas-cleaning plant and the machine shop will likewise be driven by induction motors. This company has lately bought in all 151 type C Westinghouse induction motors of from one to 100 horsepower each.

The Chicago Underwriters' Laboratories, through Secretary W. H. Merrill, Jr., are calling the attention of electrical inspection departments to the fact that their records in electrical work now include reports on 1,356 devices and materials. Besides the articles, such as sockets, wires, switches, cut-outs, etc., covered in the "List of Electrical Fittings" issued semi-annually, the records embrace detailed descriptions, accounts of experiments on and records in practice of various arc lamps, attachment plugs, canopy insulators, circuit-breakers, conduits, flexible cord, heaters, insulating materials and paints, lamp adjusters, lightning arresters, measuring instruments, rheostats, sign machines, thermostats, transformers, X-ray machines, earthing devices, electric clocks, oil switches, physicians' appliances, etc.

TRADE NEWS.

The Morris Electric Company of New York has been incorporated, with $200,000 capital stock, to manufacture electric motors.

The Morris Electrical Company has been incorporated at Wilmington, Del., with a capital stock of $20,000, to deal in electrical goods.

The Automatic Incandescent Light Company of New York has been incorporated with $1,000,000 capital stock by J. McMullen, W. C. Harris and C. C. Braodle.

A company has been organized at Jonesboro, Ind., and chartered under the laws of South Dakota with a capital stock of $300,000 to manufacture tin plate on the Pacific Coast. It is the intention of the company to use electric power throughout. The president, J. M. Beavo, Jonesboro, Ind., may be addressed for further information.

The C. W. Hunt Company of New York is building two styles of storage-battery locomotives for handling cars in manufacturing establishments and for switching ordinary railway cars in and about mills and works. One style is for narrow-gauge tracks and the other for standard gauge. The locomotives are furnished complete, with special electric generating and charging sets.

The South Carolina Interstate and West Indian Exposition, which closed May 31st, awarded the American Steel and Wire Company gold medals for its cold-drawn-steel shafting, horseshoes, wire nails, rail bonds, wire rope, machinery and appliances for drawing wire, springs and spring wire, copper, iron and steel and aluminum wire. Silver medals were awarded the company for its bicycle and automobile spokes, rolled wagon skeins, underground and overhead wires and cables, and metallurgy of zinc, and bronze medals for its music wire, coal and coke, bale ties, and chemicals and colors. For the company's installation in the Commerce Building a diploma of merit was given.

At the recent meeting of the Canadian Electrical Association in Quebec the decorations supplied by the National Electric Improvement Company of New York, which controls the Elblight system of lighting, were a feature. The interior of the Chateau Frontenac, where the convention was held, was decorated with green Elblight cable and about 2,500 lights. Hearts, circles and other designs made of strips, and Elblight boards, bearing various ornamental designs, such as bunches of grapes, shields and emblems, were disposed effectively. The Dufferin Terrace, one-third of a mile long, was festooned from end to end with Elblight cable, and 2,000 lamps, blue, white, and red, the French national volors. The sight was a beautiful one, particularly the view from Point Levis, across the St. Lawrence River. The entire lot of Elblight material taken to Quebec was bought by enterprising residents of Quebec who intend to use it for decorations during the important festivities which will be held there this summer. The engineers, manufacturers and contractors looked upon the Elblight system with much favor and the prospects for a large business in Canada are bright. Russell Spaulding, the president of the company, attended the Canadian convention.

BUSINESS.

The engineering department of the Pittsburg Gage and Supply Company of Pittsburg, Pa., has secured, through Victor Beutner, engineer, an order for one pair of 600-horsepower Brown-Corliss twin engines to drive direct-connected generators at 136 revolutions per minute in the new mill of the Susquehanna Iron and Steel Company, Lancaster, Pa. The company has also secured an order for one complete White Star filtering system for the new plant of the West Moreland Light and Power Company, Greensburg, Pa., and another order from the Hoover, Owens & Rentschler Company, Hamilton, Ohio, for supplying two cross-compound engines of its manufacture, with a filtering system.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) June 24, 1902.

702,938. Trolley for Electric Railways. Frank W. Garrett, Johnstown, Pa., assignor to the Lorain Steel Company. Application filed September 10, 1901.

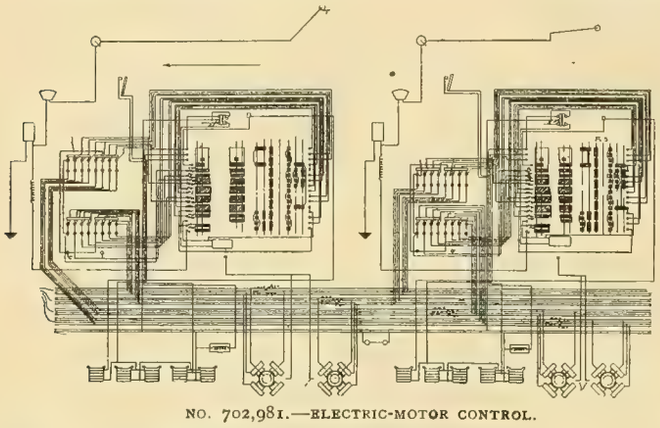
The trolley wheel is revolubly mounted on a fixed shaft or spindle and a longitudinally extending metallic member is seated in the shaft and spring-pressed into engagement with the inner bearing surface of the wheel.

702,981. Control of Electric Motors. Frank A. Merrick and Emmett W. Stull, Johnstown, Pa., assignors to the Lorain Steel Company. Application filed September 10, 1901.

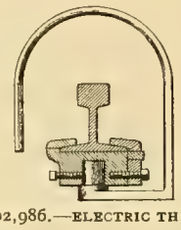
In the system are combined a number of train wires to which the motors are connected, four for each motor, and one or more manually actuated controllers on each car connected to each train wire, corresponding leads in the different controllers being connected to different train wires. (See cut.)

702,986. Electric Third Rail. Peter E. McIntosh, New York, N. Y. Application filed December 22, 1900.

The rail has a retaining chair clamp, consisting of a larger base part extending under the rail and upwardly at one side thereof and overlapping the web edge and provided with a projecting lug, and a lesser chair part, removably secured to the larger part and overlapping the rail edge on the opposite side and provided with an aperture with which the lug is adapted to engage in securing the parts together. (See cut.)



NO. 702,981.—ELECTRIC-MOTOR CONTROL.



NO. 702,986.—ELECTRIC THIRD RAIL.

702,989. Electrical Flush Switch. William J. Newton, New York, N. Y. Application filed July 26, 1900. Renewed March 21, 1902.

The device includes a switch blade, an oscillating barrel carrying and actuated by a spring-actuated member, push-buttons actuating a lever and an electric member operatively connecting the lever and barrel.

703,004. Field Telephone Set. Lambert Schmidt, Weehawken, N. J. Application filed August 8, 1901.

The set comprises a magneto-box with movable hook-switch, a transmitter, a receiver adapted to engage the hook-switch, a box to receive and support the instruments, a cover for the box, and a bar or block carried by the cover to engage and hold the receiver with the hook-switch open when the cover is closed.

703,022. Circuit-controller. Eugene W. Vogel, Chicago, Ill. Application filed July 23, 1901.

Combined with a conductor are a circuit having a fixed terminal supported adjacent to the conductor, and a movable terminal pivotally supported between the fixed terminal and the conductor, and adapted to be lifted into contact with the fixed terminal by the elevation of the conductor.

703,033. Electric Time Switch. Elmer H. Wright, Chicago, Ill. Application filed April 11, 1898.

Combined with the winding shaft are a lever arranged to act upon the shaft, a disk or segment mounted concentrically with the pivotal axis of the lever and provided with a peripheral portion of insulating material and an electrical contact device mounted upon a part operatively connected with the clock movement and arranged to travel upon the insulating portion and to form electrical connection with the disk when carried beyond the edge of the insulating strip.

703,036. Cloth-cutting Machine. John R. Baird, Buffalo, N. Y. Application filed May 28, 1901.

The machine is operated by means of a small electric motor carried on the frame of the cutter.

703,037. Street-railway Switch. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed March 25, 1902.

A switch point is combined with a switch-throwing device moved by the car, a yielding connection between the point and device, and electrically controlled means for rendering such connection rigid.

703,051. Electric Meter. Thomas A. Edison, Llewellyn Park, N. J. Application filed October 15, 1900.

See page 2

703,057. Railway Indicator. Lozelle F. Graham, San Jose, Cal. Application filed March 11, 1902.

An indicator for traveling vehicles is described. It combines a distance-meter actuated by the travel of the vehicle, means for indicating the distance traveled, electrically operated devices for actuating the distance-indicating means from the distance-meter, and means under the control of the operator for obtaining the distance-indication at any predetermined distance traveled by the vehicle. (See cut.)

703,091. Electric Bell. Albert F. Spencer, Ansonia, Conn., assignor to the Ansonia Electrical Company, Ansonia, Conn. Application filed February 21, 1902.

In the bell are an armature spring and circuit-breaker frame, a contact spring provided with a contact point, and an ordinary commercial screw arranged to support the contact spring and also to regulate the adjustment of the contact point relative to the armature spring.

703,128. Electric Time Switch. Clarence F. Heath, Providence, R. I., assignor to Charles S. Orr, and John W. Bond, Providence, R. I. Application filed March 11, 1902.

In the automatic switch described are a wheel, plungers mounted in the wheel and normally projecting beyond the face thereof, means for rotating the wheel, a lever arm pivotally mounted above the wheel and adapted to depress one of the plungers, a tripping lever mounted upon the lever arm and means operated by a clock for tripping the tripping lever.

703,134. Trolley. Phineas F. King, Cleveland, Ohio, assignor of one-half to Charles H. Tucker, Cleveland, Ohio. Application filed July 22, 1901.

The trolley combines a wheel rigidly mounted on a hollow spindle, the upper halves of the journal bearings for the spindle being integral with the trolley fork, and the lower halves detachable therefrom, a lubricant chamber in the upper halves of the journal boxes and openings from the chamber to the spindle.

703,135. Insulating Electric Conductor. Isidor Kitsee, Philadelphia, Pa. Application filed April 17, 1902.

A method of covering electric conductors is described. It consists in coating the conductors with a cellulose solution containing sulphur or its compound and then curing or vulcanizing the coating.

703,144. Electric Motor. James H. Mason, Brooklyn, N. Y. Application filed November 23, 1900.

The motor has an armature in two sections, separate windings on the sections and an iron sleeve joining the sections, whereby the armature is made virtually to consist of horseshoe magnets with outwardly turned poles and with neutral points in the sleeve.

703,145. Electric-railway Signal. Frederick C. Müller, Brooklyn, N. Y. Application filed March 10, 1902.

The signal comprises electrically controlled signal-indicating means upon a car, a striking device upon the road, and a single lever-striker and electric switch upon the car pivoted so as to move under friction and to retain the position to which it is moved until positively moved therefrom and adapted to be actuated by the striking device upon the road to control the circuit of the signal-indicating means.

703,153. Protecting Apparatus for Electrical Machines and Plants. Paul Rudhardt, Geneva, Switzerland. Application filed July 23, 1901.

The lightning arrester described consists of a tubular body of insulating material, pistons in the body and provided with shanks extending out of the same, a mass of mixed pulverized conducting and non-conducting material in the tubular body between the pistons, and other parts.

703,176. Electric Meter. François A. Brocq and Arthur Blanchet, Paris, France, assignors to Compagnie pour la Fabrication des Compteurs et Materiel d'Usines á Gaz Société Anonyme, Paris, France. Application filed March 27, 1902.

A casing containing the motor and indicating or registering mechanism is provided with an opening, extending through which are the armature shaft and commutator of the motor and one of the bearings for the armature shaft. A supplemental casing or box is detachably secured to the main casing to inclose the commutator and brushes and the bearing.

703,187. Burglar-proof Device for Safe Doors. Alvin M. Cushing, Springfield, Mass. Application filed March 17, 1902.

The device includes an electric alarm bell operated by a dry battery.

703,196. Insulated Wire. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Philadelphia, Pa., and Charleston, W. Va. Application filed February 14, 1901. Renewed November 21, 1901.

An insulating covering for electric wires is described. It consists of asbestos or similar material and an adhesive mixture, such as a silicate and an oxide, adapted to unite the asbestos firmly to the wire and to render the same impervious to moisture.

703,197. Manufacture of Insulated Wire. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Philadelphia, Pa., and Charleston, W. Va. Application filed February 23, 1901. Renewed November 21, 1901.

In the apparatus are a tank containing a liquid adhesive mixture through which the wire is adapted to be drawn to become coated therewith, a receptacle in which the fibrous material, comprising the covering, is adapted to be received, means for feeding the fibrous material from the receptacle, and means for blowing the material so fed upon the coated wire.

703,198. Insulating Metallic Surfaces or Wires. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Philadelphia, Pa., and Charleston, W. Va. Application filed November 9, 1901.

The insulating material consists of a paste of albuminous or gelatinous material and lime and dry and flaky asbestos impregnated with chemical salts.

703,199. Water, Acid and Fireproof Composition. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Philadelphia, Pa., and Charleston, W. Va. Application filed November 11, 1901.

An insulation for metallic conductors consists of a covering of asbestos coated with a mixture of oil and metallic oxides, the mixtures being combined by boiling until the free acid of the oil has been driven off.

703,225. Pole-changer. James M. G. Beard, Fruita, Colo. Application filed February 12, 1902.

A pole-changer for currents of high potential is described. It comprises a base, a vertical insulating standard mounted thereon, radially movable metallic arms pivoted upon the standard and provided with knobs, insulating handles connected with the arms for actuating the same, and means for connecting the arms with an electrical supply.

703,234. Electric Controller. John W. Brown, Jr., Philadelphia, Pa. Application filed March 7, 1902.

In the controller are combined a slab or plate of insulating material, concentric series of contact plates thereon, an operating spindle carrying a contact arm provided with openings and also constructed of insulating material, metallic plates carried on the upper surface of the arm, one of the plates being bent over the end of the arm and extended to engage directly with one series of the contact plates and spring-controlled brushes carried by the insulating frame in the openings thereof, the brushes being placed to engage others of the contact plates when the controller is operated.

703,274. Rail Bond. John E. Jones, Hazleton, Pa. Application filed May 1, 1902.

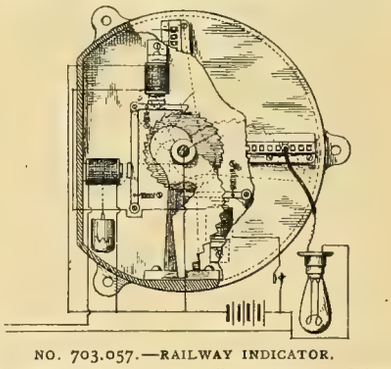
The rail ends have their webs cut away and are combined with fish-plates and a cylinder and piston bonding means within the cut-away portion of the rails and concealed by the fish-plates.

703,289. Process of Producing Caustic. Hugh K. Moore, Lynn, Mass., assignor to the Moore Electrolytic Company, Portland, Maine, and Boston, Mass. Application filed April 30, 1900.

The process of electrolyzing the chlorides, chlorates or sulphates of alkali metals is described. It consists in bringing an aqueous solution thereof into contact with one face of a diaphragm of sufficient porosity to permit free flow of the solution; passing an electric current through the solution and diaphragm to an unsubmerged foraminous cathode in contact with the other face of the diaphragm, thereby converting the metal into hydrate by the water of the undecomposed percolated solution and confining the liberated hydrogen gas in contact with the outer face of the cathode and thereby excluding atmospheric air, whereby the cathion solution flows by gravitation from the cathode without evaporation and without the carbonating of the hydrate.

703,297. Auxiliary Trolley Contact and Sleet and Ice-cutting Device. Walter H. Oliphant, Mount Holly, N. J. Application filed September 13, 1901.

The ice-cutting trolley wheel has a peripheral groove or wire seat, and openings extending from the bottom of the groove or wire-seat inward with respect to the axis of the wheel, and leading out through the side of the wheel, the edges of the openings which lie transversely of the wire seat being obliquely disposed with reference to the wire seat, whereby a shearing cut is obtained.



NO. 703,057.—RAILWAY INDICATOR.

703,308. Shade holder for Incandescent Electric Lamps. Edgar A. Russell, Wallingford, Conn. Application filed October 17, 1901.

The holder has a shade ring and a clamping ring made from a single piece of sheet metal.

703,329. Magnetic Separator. James C. Winder, Eastpoint, Ga., assignor of one-half to Daniel C. Lyle, Eastpoint, Ga. Application filed March 25, 1902.

Combined with the feed board are pole pieces arranged in slots with their working faces flush with that of the board, magnet cores, side plates connected to the cores and to the pole pieces, and core windings connected in series.

703,340. Electric Controller. Edwin C. Fellows, Philadelphia, Pa., assignor to the Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa. Application filed April 4, 1902.

The controller has contact plates, an operating arm for the same, and an overload and an underload switch, both of the switches being constructed to be closed by motion of the arm.

703,361. Third-rail System or Magneto-electric Railway. William H. Wright, Buffalo, N. Y. Application filed August 19, 1901.

The system comprises a third rail, a conductor conduit arranged beneath the rail and parallel thereto, means for connecting during the passage of the car the third rail to the conductor, an electromagnet on the car to operate the connecting means, means for energizing the magnet, and a trolley wheel journaled on the electromagnet and arranged to make contact with the third rail.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, JULY 12, 1902. No. 2

Düsseldorf Industrial and Trades Exposition.

By Frank C. Perkins.

During the present summer the German National Art Exhibition is being held at Düsseldorf, on the Rhine, and in conjunction with it an industry and trade exhibition for Rhenish Prussia and Westphalia. Many of the buildings of this exposition are of excellent architectural design, and the grounds and decorations are arranged in a very pleasing manner, the electrical effects being particularly fine.

In entering through the main gate of the exposition one enters Machinery Hall, which has large adjoining halls on the right and left-hand sides. On the side walls are hung photographs and plans of various works situated in Western Germany. On the right-hand side of the hall are exhibited the products of the mines and blast furnaces, steel and iron works of the region.

One of the most interesting exhibits is a large vertical triple-expansion steam engine (Fig. 1) of 3,000 horsepower, directly connected to an alternating-current generator and a direct-current exciter, the latter dynamo being mounted at the end of the engine shaft outside of the main alternator bearings. This high-power engine was constructed for the electric central station at Essen. The diameter of the high-pressure cylinder is 830 millimeters (32.67 inches), and the low-pressure cylinder is 2,050 millimeters (80.7 inches), while the intermediate cylinder measures 1,400 millimeters (55.12 inches) in diameter, and the length of stroke is 1,200 millimeters (47.24 inches). The speed of the engine is 94 revolutions a minute, and the low-pressure cylinder is constructed with cylindrical-valve gear, while the high and medium pressure cylinders are built with Gutermuth's distributing valve motion.

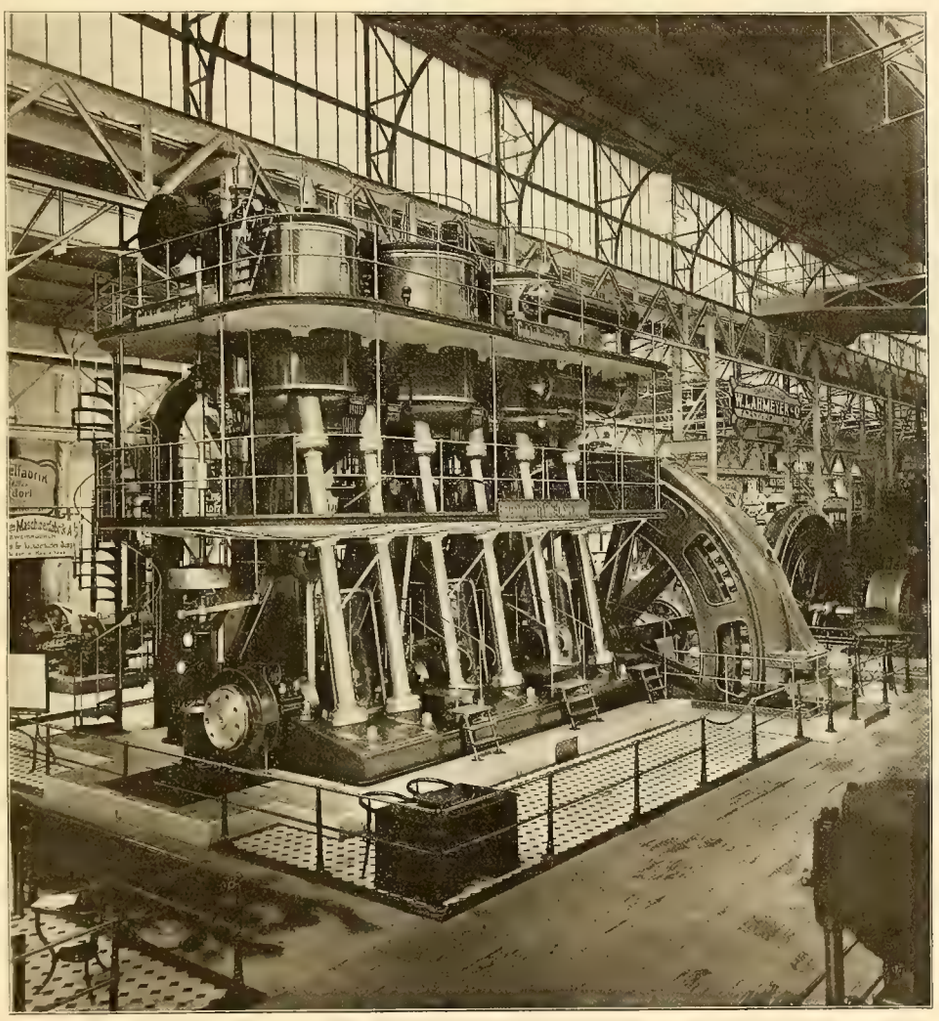


FIG. 1. DÜSSELDORF EXPOSITION.—3000-HORSEPOWER UPRIGHT ENGINE AND ALTERNATING-CURRENT GENERATOR.

In the right-hand side hall is shown the electric Riedler express pump, illustrated in Fig. 2 (next page). This pump has two simple-acting plungers, each 185 millimeters (7.28 inches) in diameter, with a stroke of 250 millimeters (9.84 inches) in length, and operates at a speed of 200 revolutions a minute. It is driven by a three-phase motor of 450 horsepower, operating at a potential of 2,000 volts and a speed of 200 revolutions a minute. This motor was constructed by the Helios Electric Company of Ehrenfeld, near Cologne. The Helios company also exhibits here an eight-horsepower, alternating motor of 110 volts' pressure and 1,800 revolutions, which drives an air compressor for filling the air chambers of the above-mentioned pump. This electric air compressor was constructed by Ph. Holscher of Berlin.

A double-tandem hauling engine has a stroke of 2,000 millimeters, with high and low-pressure cylinders, 850 and 1,200 millimeters in diameter, respectively. There are two large cylindrical rope drums on this engine, which are 1,750 millimeters in width, with a diameter of 8,500 millimeters, each with valve link motion and a special steam reversing gear. A net weight of 4,400 kilograms may be hauled at an average speed of 12 meters per second from a depth of 750 meters. The engine is fitted with a steam brake, a falling-weight brake, also the necessary safety apparatus, tachometer and depth indicator.

On the left-hand side of the hall there is a large blowing engine for blast furnace, having a stroke of 750 millimeters, and two air cylinders, 850 millimeters in diameter. This is coupled to a 1,000-horsepower blast-furnace gas engine built by the Deutz Gas Motor Company. It takes 1,000 cubic feet of air per minute at 135 revolutions and compresses it to 0.5 atmosphere. It is fitted with regulating gear, whereby it is possible, with the same motive power, but with altered aspiration, to compress the air to 0.75 atmosphere. The discharge of the air is effected by a return valve (Stumpf's patent); the admission by means of cylindrical valves.

In the left-hand side of the hall showing this large 1,000-horsepower gas engine and blowing engine for blast furnaces there is an electric overhead traveling crane, having a span of 16 meters. Its capacity is 40,000 kilograms, and it is equipped with a direct-current motor of 25 horsepower for lifting and one of six horsepower for traveling with a speed of 20 meters per minute. It has an auxiliary lifting gear for loads up to 8,000 kilograms at a speed of 10 meters per minute. The motors are of the direct-current type, built by the Helios Company of Cologne-Ehrenfeld.

Among the other important exhibits in this building are plans and illustrations of underground pumping engines, vertical and horizontal tandem rolling-mill engines, as well as a reversing rolling-mill engine and a blowing engine for Bessemer plants. There are also shown in this building the various girders, wheels, rails and bridge materials which are products of the great steel works and rolling mills at Oberhausen and Neu Oberhausen. The rail joints of different constructions exhibited include the butt joint of the Prussian state railway, with iron sleepers and plates, as well as another type of butt joint of the Prussian state railway, with wooden sleepers and plates. In the exhibit of tramway superstructure and girder rails there is shown a complete switch with spring action, a switch, with tongue worked by counterpoise, and a crossing, all to one meter gauge, and a group of field and pit railways, consisting of frames of the most varied construction, ready for use.

A most excellent exhibit shows axle and wheel-tire manufacture, the group including, among many other articles, the rough ingots, a pressed ingot for wheel tires, a pressed and punched ingot for wheel tires, a forged tire finished, and seven rolled-wheel tires of an internal diameter of 1,400 to 2,000 millimeters. Another group represents a construction of wheel centers and wheel disks, while another shows sets of wheels and axles for tramway use, and a third group shows the products from the plate mills.

"Fireflies" on the Stage.

At the Dearborn Theater in Chicago where "The Storks," a musical comedy, is running, there are a number of pretty scenic effects. The realism of one of the scenes, representing a landscape on a summer night, is made striking by the seeming presence of a number of fireflies. This pleasing illusion is due to electricity, and the device by which it is carried out was designed by F. H. Raeder, the electrician at the theater. The apparatus consists of a long, narrow wooden box which extends across the stage above the sky-line. Through this box is strung the main distributing line, which has 21 connections with smaller wires, and these fine wires, invisible to the audience, extend downward, through holes in the box, and terminate in two-candlepower incandescent lamps. These tiny lamps are hung at different heights and are connected so that they may be operated separately from the floor of the stage. As the current is turned on and the different bulbs are made to twinkle in exact imitation of a firefly, the whole device is swung in a line across the stage, giving the impression that the luminous insects are moving about, thereby creating a most realistic effect.

Massena Power Plant Sold.

The St. Lawrence Power Company's plant at Massena, N. Y., has been sold under foreclosure proceedings begun by the first-mortgage bondholders. The plant was bid in by Mark T. Cox of New York, representing the reorganization committee of the first and second mortgage bondholders for $500,000. More than $10,000,000 is said to have been expended in the Massena power scheme. English capitalists were heavily interested. The failure of the project was principally due, it is believed, to a lack of field in which to dispose of the company's product.

The North American and Postal Telegraph Company discontinued its office at Stillwater on July 1st after being established there for 11 years.

Improvements on Liverpool Elevated Railway.

Certain alterations and improvements are being made to the overhead railway of Liverpool, England, which show the importance of rapid acceleration on electric railways. This road was the first elevated railway to be operated electrically, being equipped about 10 years ago. The line is double-tracked and a little over 6½ miles long. It is supplied through a third rail at 500 volts, and the current is returned by means of a special rail return. Trains of two or three cars are operated, and under the old schedule ran the entire distance in 32 minutes, including 16 stops, at a speed of 12½ miles an hour. This required 14 trains running at five-minute intervals to handle the traffic.

Dick, Kerr & Co. are now installing a new equipment on the line, consisting essentially of new motors, which gives the trains a mean speed of 19½ miles an hour, and the whole distance is traveled in 20½ minutes. The acceleration is raised from 1.6 feet to three feet per second per second and the retardation from three feet to 4.8 feet per second per second. This rapid acceleration is possible owing to the excellent commutation of the motors, which will not spark when carrying 300 or 400 amperes—i. e., three or four times their normal current. The watts per ton-mile were increased from 110 in the old system to 137 in the new.

Each of the new trains is to be fitted with four 100-horsepower railway motors, designed by Sidney H. Short and built by the English Electric Manufacturing Company. The efficiency of the motor is between 90 and 93 per cent., and it weighs 4,200 pounds, or nearly 42 pounds a horsepower. The motor is completely inclosed in a cast-steel fire and waterproof shell, and the only opening is over the commutator and brushes. The motors are carried on each of the two end cars of the train. The controlling mechanism is in many respects similar to the series-parallel method of control adopted by Dick, Kerr & Co., and is fitted with a new blow-out device, which renders it perfectly proof against fire.

The 12 trains of the new type will replace 14 of the old, and it is a matter of interest that these new trains will accommodate exactly the same number of passengers as the old ones. With the previous equipment the trains ran 144 train-miles per hour, while in the new method they will run 216 train-miles per hour. There was a five-minute headway between the old trains, but under the new régime this will be reduced to 3½ minutes. In other words, the journey from one end of the line to the other will be made in two-thirds of the time taken on the old method, and, what is of great importance, the load on the power station will be more uniform, and, as a consequence, the machinery will be running under more efficient conditions.

As a comparison, the following table, given by a London contemporary, is of interest as showing the scheduled speeds with the new Liverpool equipments and those obtaining on other lines:

	Miles per hour, including stops.
Liverpool Overhead Railway	19
Manhattan Elevated Railway (New York)	13½
Metropolitan Elevated Railway (Chicago)	14.1
South Side Elevated Railway (Chicago)	14.6
Lake Street Elevated Railway (Chicago)	12½
City and South London	12½
Central London	14

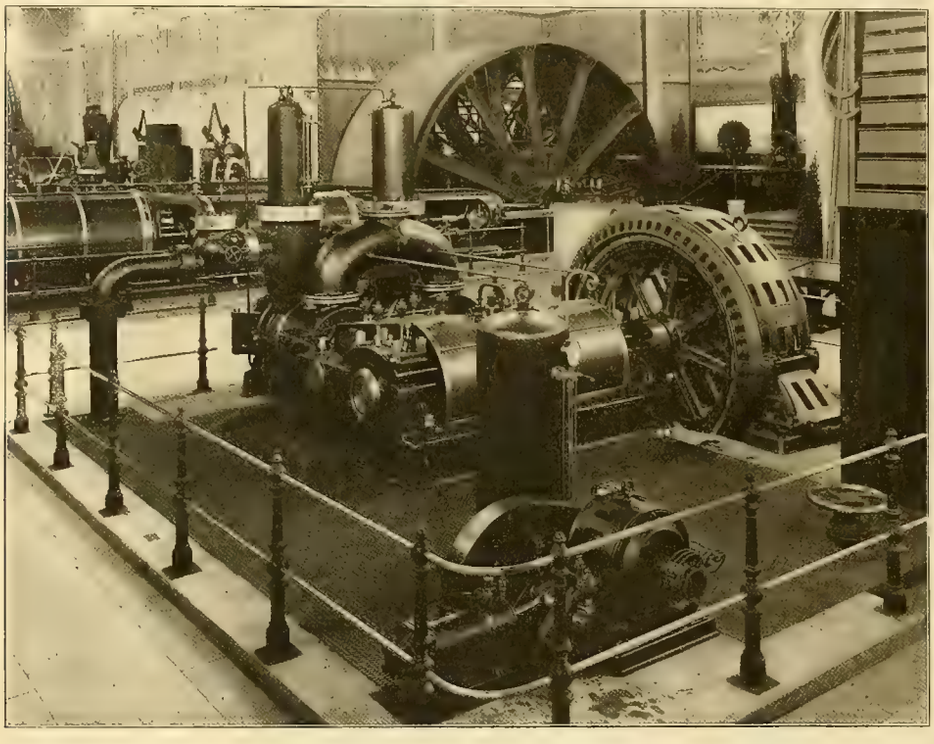


FIG. 2. DÜSSELDORF EXPOSITION.—450-HORSEPOWER ELECTRIC PUMP. (SEE PAGE 17.)

The Electrostatic Wattmeter in Commercial Measurements.[1]

By Miles Walker.

That a quadrant electrometer can be used as a wattmeter for measuring power has been known for many years. In the Transactions of the Royal Society (1891), Vol. 182, p. 519, will be found a discussion upon the subject by Ayrton, Perry and Sumpner, in which the precautions to be adopted in order to make a successful instrument are considered.[2] In 1898 Professor Ernest Wilson[3] published the results of some experiments which showed the accuracy of the instrument at all power factors. Mr. Addenbroke, in a paper before the International Electrical Congress at Paris in 1900[4] showed how the instrument could be arranged for universal electrical measurements. Nevertheless, the electrostatic wattmeter is almost unknown to electrical engineers, and certainly its advantages over other types of wattmeter are not fully appreciated. These advantages may be enumerated as follows:

(1) It can be made to give very accurate readings at low power factors.

(2) It is particularly well adapted for high-voltage work, because it does not require a high non-inductive resistance.

(3) It is cheap and simple in construction.

(4) When constructed for low-voltage work, it will not be so liable to be burned out by accident as an ordinary wattmeter.

(5) By the use of suitable adjuncts the same instrument can be used to measure any power from one watt to 5,000 kilowatts.

(6) Its operation is based upon simple laws, so that when its needle is controlled by gravity, it can be relied upon as a standard instrument.

The disadvantages connected with its use are:

(1) It is not portable.

(2) The controlling forces are in general small, so that the instrument, though dead-beat, is slow in reading.

(3) Its general behavior must be understood by the operator.

I propose in the present paper to discuss the principles that underlie the design of the electrostatic wattmeter for commercial work, and some of the uses to which the instrument can with advantage be applied. I am indebted to the Westinghouse Electric and Manufacturing Company for having had the opportunity of experimenting on this instrument, and to Mr. Percy H. Thomas, whose ideas and suggestions have been invaluable. It is one of the characteristics of American firms which have helped them to attain their present high position in the manufacturing world, that they are not afraid to spend a little money on theoretical investigation wherever there is a fair chance of some point being gained.

In designing an instrument for any class of work, it is desirable to know approximately the forces upon the moving part. The method of calculating the forces on the needle of a quadrant electrometer, as given in the standard textbooks, does not appeal to the ordinary engineer, because the result is not expressed in the units with which he customarily deals. The following simple method is perhaps more acceptable:

Consider a U-shaped piece of metal (C), Fig. 1, embracing a sheet of metal (B). Let the size of the plates be great compared with the distance (s) between them. Let (B) be constrained so that it can only move in its own plane along the line (O X). Let the length of (B) in the direction at right angles to (O X) be (l). Let V = number of volts of potential difference between (B) and (C). Then V/300 is the number of electrostatic units of potential difference.

If A is the effective area on the upper side of (B), 2A is the total effective area.

The total charge Q on the plate (B) will be $Q = (2A/4\pi s) \times (V/300)$ electrostatic units of quantity.

The total store of energy in the electrostatic field will be

$$W = \tfrac{1}{2}\frac{V}{300}Q = \frac{A}{4\pi s} \times \frac{V^2}{90{,}000} \text{ ergs}$$

Suppose, now, that the plates are connected to a generator so that the voltage between them remains constant no matter how they are moved, and the plate (B) is moved through a short distance dx so as to alter A by a little bit dA. The little change in the store of energy will be

$$dW = (dA/4\pi s) \times (V^2/90{,}000)$$

From Fig. 1, $dA = l\,dx$, and since the mechanical work done in moving the plate must equal the electrical work dW, we must have $dW = F\,dx$, where F is the force upon the plate. Therefore

$$F = (1/4\pi s) \times (V^2/90{,}000) \text{ dynes.}$$

If the plate (B) instead of moving parallel to itself, moves about a center, as at Fig. 2, we have $dA = r^2\,d\theta$, and $dW = T\,d\theta$, so that the torque

$$T = (r^2/4\pi s) \times (V^2/90{,}000)$$

where T is in dynes at a centimeter, r and s are in centimeters and V in volts.

Let $(r^2/4\pi s \times 90{,}000) = k$.

Take now the quandrant electrometer, Fig. 3, and let the pressure between the needle and one set of quadrants be V volts and the pressure between the needle and the other set be V + a. Then, as one set is pulling one way and the other set the other, the torque is proportional to the difference between the squares of the voltages, or

$$T = k\,[(V + a)^2 - V^2] = k\,(2aV + a^2).$$

If we connect a quadrant electrometer to an electric circuit in the manner shown in Fig. 4, in which the current to the motor is passed through a non-inductive resistance of R ohms, causing a drop of a volts, the torque on the needle at any instant will be

$$T = k\,(2aV + a^2) \qquad (1)$$

If, now, V is large compared with a, we have approximately

$$T = 2k\,a\,V = 2Rk \times V\,c.$$

The power supplied to the motor is V c, and if the needle is suspended so that its deflection is proportional to the torque, the deflection will be approximately proportional to the power supplied to the motor.

In the case of the alternating current, we must take for V and a the expressions $\sqrt{2}V \sin 2\pi n t$ and $\sqrt{2}a \sin (2\pi n t + e)$, respectively, where e is the angle of lag. Substituting these values in equation (1), integrating throughout one complete cycle and dividing by 2π, we get the mean value of the torque throughout the cycle.

$$T = 2V\,a \cos e + a^2 = 2Rk\,(Vc \cos e + \frac{c^2 k}{2})$$

The electrostatic wattmeter reads the power correctly whatever be the shape of the wave form, for at any instant the turning moment is proportional to the instantaneous value of the power, and the needle takes up a position that corresponds with the average of the instantaneous turning moments.

It will be seen that the term a^2 is independent of the power factor cos e, so that, when e is great, a considerable error may be produced in the measurement of the power, unless we take some precautions either to correct for this term or eliminate it altogether. Several methods are employed by the Westinghouse Electric and Manufacturing Company for eliminating the term a^2 when working with low power factors. The best method to adopt in any particular case depends upon the kind of measurement that is being made. When working with high voltages, in measurements upon insulation losses, it is convenient to use only a fraction of the total voltage for the term V. The reason for this is that if we put 30,000 or 40,000 volts between the needle and quadrants we would be troubled with brush discharges, unless a very big instrument with large rounded conductors was employed. It is more convenient to take a tap off the transformer supplying the power and make the connections as in Fig. 5. If the ratio betwen the total voltage of the transformer and the voltage upon the needle be n, we can eliminate the a^2 term by putting in series with the transformer, at the terminal opposite the one to which the quadrants are attached, another non-inductive resistance, such that the drop in that resistance is equal to a $(n/2 - 1)$.

Suppose, for instance, that $n = 4$ and that to get a good reading we have a resistance of 0.1 ohm between the quadrants. If we put a resistance of $0.1 \times (4/2 - 1) = 0.1$ at the opposite terminal of the transformer, the instrument will read correctly

1. Paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers at Great Barrington, Mass., on June 20, 1902.

2. See also Prof. J. A. Fleming's Alternate-current Transformer, Vol. II., p. 551.

3. Proc. Roy. Soc. (1898), Vol. 62, p. 356; also Elec. Review, London, March 4, 1898.

4. Electrician (London), Oct. 5, 1900; also Elec. Eng. (London), Feb. 2, 1900.

whatever may be the values of V, a or e. The proof of this is as follows:

The voltage between the needle and one set of quadrants is $(V/n + a/2)$, and between the needle and the other set of quadrants it is $(V/n - a/2)$.

$$T = k\left[\left(\frac{V}{n} + \frac{a}{2}\right)^2 - \left(\frac{V}{n} - \frac{a}{2}\right)^2\right] = \frac{2\,k\,V\,a}{n}$$

The simple application of this rule occurs when $n = 2$. In this case $(n/2 - 1 = 0$, so that no additional resistance is required. In making measurements at pressures of 10,000 volts, it is convenient to connect the needle to the middle point of the transformer supplying power, and then the a^2 term is eliminated.

In other cases where it may be inconvenient to insert the additional resistance an amperemeter may be inserted, from the reading of which a may be calculated, and the readings corrected. The term a is equal to c R. The calibration of the instru-

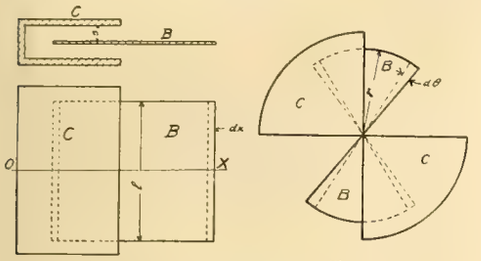


Fig. 1. Fig. 2.

ELECTROSTATIC WATTMETER FOR COMMERCIAL MEASUREMENTS.

ment and correction of the readings may be carried out very simply in the following manner: One pair of quadrants is connected to the needle and a continuous voltage V_1 (say, 100 volts) is applied between the needle and the other set of quadrants. From the deflection D_1 produced we get the constant of the instrument from the formula

$$K D_1 = V_1^2.$$

In any measurement of power if our arrangements are such that the a^2 term does not appear, then for any deflection D we calculate the power from the equation

$$\text{Watts} = (n K D/2 R)$$

But, if we cannot neglect the a^2 term, we use the formula

$$\text{Watts} = \frac{n K D}{2 R} + \left(\frac{n}{2} - 1\right) C^2 R$$

The instrument connected up as in Fig. 5 (preferably with $n = 2$) is suitable for making measurements on dielectric losses in insulating material. In these tests there is no objection to making R very large, so that good deflections can be obtained even when the current is exceedingly small. For instance, the power supplied to a few square inches of paper subjected to a pressure of 20,000 volts between metal plates can be measured with considerable accuracy.

The accuracy of this instrument with low power factors, its wide range and freedom from burning out, make it suitable for general testing purposes, whenever low power factors are likely to be met with. It is well known that when the power of a three-phase motor is measured in the ordinary way, with two successive readings on a wattmeter, one of these readings will be negative, or of very low power factor, when the motor is lightly loaded.

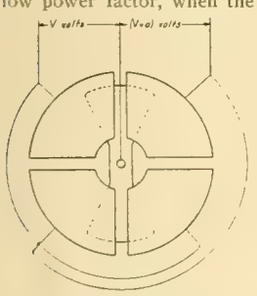


Fig. 3.

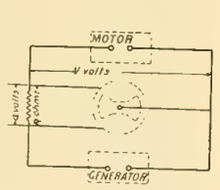


Fig. 4.

ELECTROSTATIC WATTMETER.

We may have to take the difference between two readings, both of which are inaccurate on account of the effect of the low power factor upon an ordinary wattmeter, and the final results will be very far indeed from accurate.

An electrostatic wattmeter can be made to read power supplied at pressures as low as 100 volts, but in order to get good forces upon the needle it is desirable to increase the voltage a between quadrants. This necessitates the elimination of the a^2 term in equation (1). The best method of doing this for low-voltage commercial work is that shown in Fig. 6. (T_1) is the transformer supplying the power to be measured. (M_1) is the apparatus absorbing power. (T_2) is a series transformer of suitable ratio, whose secondary is connected in series with a non-inductive resistance (R). One pair of quadrants is attached to one end of this resistance and the other pair to the other end, the needle being connected to the opposite side of the system. The middle point of the resistance (R) (or, if preferred, the middle point of the secondary of the transformer) is connected to the same terminal of the apparatus absorbing power as the primary of the series transformer. If a is the voltage across the resistance (R), it is easy to see that the torque

$$T = k\left[\left(V + \frac{a}{2}\right)^2 - \left(V - \frac{a}{2}\right)^2\right] = 2\,k\,V\,a$$

The series transformer can be made so that the error due to its use is not more than one part in one thousand on high power factors and one part in one hundred on low power factors.

A simpler method, though not quite so satisfactory, is that shown in Fig. 7. Here an auto-transformer (T_3) has its middle point and one terminal connected to the resistance (R), and the two outer terminals are connected to the quadrants. The middle point of the transformer being connected directly to the apparatus (M) in which the power is absorbed, the a^2 term is completely eliminated.

For polyphase work, it is convenient to use an instrument with two needles on the same shaft, just as in an ordinary polyphase wattmeter. The connections for a three-phase instrument are shown in Fig. 8.

For a standard instrument, in which the deflecting forces are not too small, a bifilar suspension is the most satisfactory means of controlling the needle. Several precautions, however, must be taken to make a bifilar suspension satisfactory. The well-known formula for this suspension tells us that for small deflections the turning moment in grams at a centimetric =

$$\tfrac{1}{4}\,(1 - m^2)\,(P\,y\,z/L)\,\sin\theta$$

where m is the ratio between the difference and the sum of the tensions in the fibers. P is the total weight of the needle in grams, y the distance between the fibers at the top, z the distance between the fibers at the bottom, L the length of the fibers and θ the angle turned through. All the distances are in centimeters. From this it is seen that it is very necessary to keep the tensions in the two fibers constant. A very good method of doing this is to hang the block to which the fibers are attached to short strips of phosphor-bronze at a considerable distance apart in the manner shown in Fig. 9. A line joining the strips is at right angles to the line

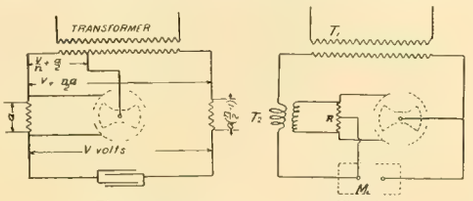


Fig. 5. Fig. 6.

ELECTROSTATIC WATTMETER.

joining the fibers, so that the block is free to tilt and equalize the tension in the fibers. By the addition of small weights screwed in two projecting arms, the ratio between the tensions may be adjusted to any degree of precision, and when once adjusted is independent of changes in the leveling of the instrument.

It is desirable to have the distance between the fibers as great as possible, so that microscopic changes in this distance from accidental causes will not change the constant of the instrument. From one-eighth inch to one-fourth inch makes a good working distance, if care is taken to make the point of suspension of each fiber perfectly definite.

Fine phosphor-bronze strips make strong and satisfactory suspending fibers. The spindle of the needle should be fairly heavy, so that the tension of the fibers is not altered perceptibly by small unbalanced electrostatic attractions. By putting weight in the spindle, the moment of inertia of the needle is very little increased. The needle should be made as rigid as possible and with a very small amount of inertia. For high-voltage work, the forces upon the needle are so great that a single needle is sufficient. For low-voltage work it is best to use a number of small needles in a multicellular instrument. The moment of inertia of the needle, even if its thickness remains constant, goes up as the fourth power of its linear dimensions; whereas, the turning moment only goes up as the second power. A number of small needles can, therefore, be made more rigid and with smaller moment of inertia for the same turning moment than one big needle.

The needle and all attachments must be so shaped and guarded as to have no forces upon them except those due to the quadrants. For this reason it is well to avoid making projections on the frame or stationary parts of the instrument that can attract or repel any part of the needle. All visible parts of the needle and its spindle should, as far as possible, be figures of revolution, so that even if there is an unsymmetrical field outside the quadrants, it cannot produce a turning moment. The mirror should be placed in a cylindrical metal screen, kept at the same potential as the needle.

The distance between the needle and the quadrants is a matter that requires some consideration. In high-voltage work the distance must, of course, be great enough to prevent accidental sparking over. Any unbalanced forces on the needle due to want of symmetry are decreased by increasing the distance from needle to quadrants. As there is no great difficulty in getting sufficient turning moment with high voltages, it is well to allow ample distance. An instrument intended to work up to 10,000 volts should have an inch as the shortest distance between needle and quadrants. The greatest difficulty met with in very high-voltage work is the brush discharge that occurs from the needle. This sets up electric winds, which react upon the needle and make it wander. The liability to brush discharge depends upon the steepness of the gradient of electric potential in the air space surrounding the needle, and can be very much diminished by rounding off all edges. The electric winds set in at a voltage far below that required to produce visible brush discharge. In fact, a needle intended for a pressure of 10,000 volts should have its edges rounded off to a radius of not less than one-eighth inch, and should be nicely polished and free from dust in order to work well. I believe that much of the trouble that has arisen in electrostatic instruments for high-voltage work is due to incipient brush discharge rising from badly designed surfaces.

In a low-voltage instrument the distance (s) between quadrants and needle is settled by very dif-

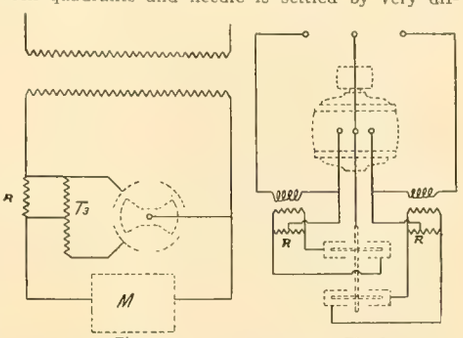


Fig. 7. Fig. 8.

ELECTROSTATIC WATTMETER.

ferent considerations. Even when there is very little chance of sparking, this distance should not be reduced below a certain limit. If the constant of the instrument is to be very accurately maintained, about one-fourth inch should be the lowest limit. Any shifting of the needle up or down from the central position changes the constant. When the needle is exactly central, the rate of change of the constant is 0. For small departures from the middle position, the rate of change of the constant is proportional to $4\,g/s^2$, where g is the little distance from the center. The smaller (s) is made, the more important become small movements of the needle in a vertical direction, due to expansion of the fiber or other accidental cause. However, if (s) be at least one-fourth inch, a movement of the needle of 1-200 inch from the middle position causes an error of less than 0.05 per cent. A departure of 1-100 inch from the middle position, which should never occur in a well-made instrument, would cause a change in the constant of 0.2 per cent. Another source of error arises from having the distance (s) too small in instruments controlled by a bifilar suspension. The attraction between the needle and the quadrants adds to or subtracts from the tension of the fibers, according as the needle is below or above

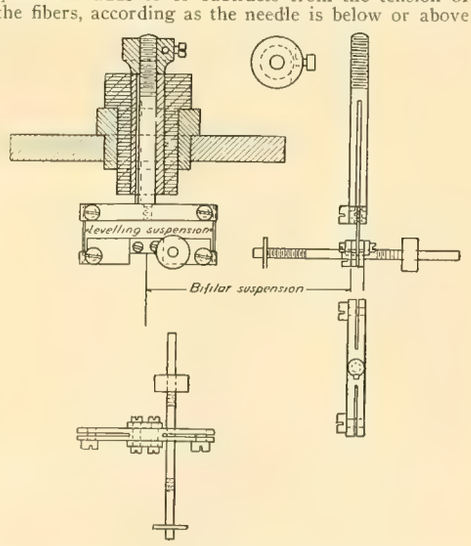


FIG 9 ELECTROSTATIC WATTMETER.

the middle position. Where a fair distance between needles and quadrants is allowed, and sufficient weight put into the spindle, the error due to this cause is entirely negligible. The needle may be damped either by a copper cup swinging in a magnetic field or by a liquid damper.

The accuracy of an instrument depends greatly upon the closeness with which it preserves its zero. It is much more important to make an instrument which preserves its zero at all times than to make one which will give large deflections for small turning moments. A deflection can always be magnified or carefully read, but a wandering zero is a continual source of error. For this reason, a bifilar suspension with a considerable distance between fibers is the most satisfactory for a standard instrument. We have used very successfully a suspension consisting of a single phosphor-bronze strip 0.001

inch thick and 0.02 inch wide. This shows very little "creep," and any error due to change of zero can be eliminated by taking the mean of readings on opposite sides of the zero.

When the accuracy of the readings is not so important, ordinary phosphor-bronze springs may be used to control the needle. For high-voltage transmission lines, the electrostatic wattmeter has an advantage over other types for switchboard use, in not requiring a high-voltage transformer. A good commercial instrument can be made for this purpose with a spring control.

A Michigan Railway with Interesting Possibilities.

Michigan daily papers contain the information that the Michigan Suburban Railway Company, which operates the line between Lansing and St. Johns, has obtained an extension of its permit to use steam power for traction. The account says: "The permit has been granted in all the townships and villages through which the road runs, and is good until December 14th. The permit was originally given on account of the inability of the company to complete its electrical equipment within the time specified in its franchises. The time was extended until July 1st, but on account of litigation now pending in the Ingham County Courts, its funds have been tied up, and it was unable to finish the electrical construction. The extension asked for was its last resort, the only alternative being to suspend traffic altogether. There was a strong demand for a continuation of the train service, and there was no material opposition to the extension of the permit."

This is undoubtedly the railway in which B. J. Arnold of Chicago is interested and which, it is presumed, he will equip with his new electro-pneumatic single-phase railway system described at the recent convention of the American Institute of Electrical Engineers.

Pacific Cable Question.

The Commercial Pacific Cable Company has made a proposition to the United States government to hasten the construction of its cable across the Pacific, offering important advantages to the government in return for the use of the surveys made by the United States steamship Nero for a cable route connecting San Francisco, Honolulu, Midway Island, Guam and Manila. The officials of the company state that they are asking these plans solely in the name of their own company, and that no other cable company, domestic or foreign, has joined in the application.

The Navy Department is earnestly desirous, for military reasons, that the cable shall be laid as soon as possible, but certain safeguards are desired, and these are being considered by the officials of the department. It is regarded as essential that the route shall be all American, a point which will be secured by the use of Midway Island as a relay station, and a provision to avoid touching on foreign soil between the terminals. Another point at issue is that the United States government should have preferential in rates and time of transmission for its messages, and have the sole right, in its discretion, to use the cable in time of war. The subject has been referred to the attorney-general for an opinion.

Rival Canadian Power Companies at Niagara Falls.

There is a fight in progress between the two great power companies located on the Canadian side of the Niagara Falls as to the amount of power each may develop. The Ontario Power Company, which is already constructing a plant to be fed from the Welland River, has applied to the commissioners of the Queen Victoria Niagara Falls Park for the right to construct a second in-take, this one to be directed from the Niagara River. Part of the plan was to build a dam in the rapids in the vicinity of Dufferin Islands and, with the head gained there, convey the water by conduit to the power house near the upper suspension bridge. A supplementary agreement prepared provides that the company shall pay a rental of $30,000 a year instead of $15,000, and a certain rate per electrical horsepower per annum, by the following scale: From 20,000 to 30,000 horsepower, $1; from 30,000 to 40,000, 75 cents; over 40,000, 50 cents. This application has called forth opposition from the Canadian Niagara Power Company, which is also building a plant for which water from the Niagara River will be utilized. The attorney-general of the province of Ontario will hear the parties at an early date.

Automatic Rural Mail Carrier.

Edward Hamilton of Liberty, Ind., a young man of nineteen, has invented an automatic mail carrier for rural-delivery boxes. When letters are dropped in the delivery box the carrier automatically starts, carrying the letters and papers to the house, where it dumps its load, notifies the inmates by ringing a bell and immediately returns. By touching a button at the house the carrier can be brought back at any time to receive letters for the mail carrier. The construction is simple, electricity from batteries in the house being used to operate the device.

The Bremer Lamp.[1]

By Siegmund Saubermann.

The Bremer arc lamp differes from others in two respects—the chemical combination of the electrodes and their arrangement at an acute angle. Neither principle is absolutely new. In the "Lampe Soleil" devised by Clerc and Bureau, two conveying carbon rods led through a marble block, so that the arc should bring the calcium carbonate above it to a white heat. And long before Bremer additions of metallic compounds of the most varying sorts were made to solid and cored carbons in order to obtain (and often with success) steadier burning of the arc. The essential of the invention is in the determination of the fact that, if the carbon electrode contains more than 20 to 25 per cent. of calcium, silicon or magnesium salts, a better utilization of the high temperature of the arc for the emission of light is obtained than has been possible hitherto in practice. The best result is with halogen combinations of metals of the beryllium group. According to Bremer, the increase of the proportion of the salt to 50 or 80 per cent. even occasions a still greater gain in light; the small strength of such composite carbons and their quick decomposition, even at moderately high temperatures, prevents their practical application. As a matter of fact, in order to attain the necessary consistence and a certain rigidity, the electrodes containing 20 to 30 parts of calcium fluoride must be covered with a hard, glassy covering, formed by laying on a solution of a mixture of borax, silicic acid, soluble glass and similar substances. In addition, before the customary baking together, the electrodes

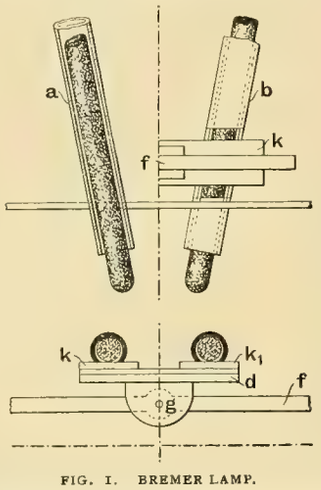


FIG. 1. BREMER LAMP.

are provided with small quantities of boron, common salt, potash, tartar and various silicates, which, acting to a certain extent as fluxes, prevent the otherwise unavoidable scorifying of the carbon points.

The considerable increase in light produced by all these processes may be fairly easily explained by the fact that the particles of the metal salts torn off and taken with the passage of electrical energy from the anode to the cathode are oxidized in the 3,900-degree electric flame and brought to bright incandescence. One must not only consider the ions streaming across, for in such composite electrodes the ends nearest to the arc are in a more or less liquid state, and thus groups of molecules, or even much greater particles, may be carried along. At all events—and spectroscopic examination offers

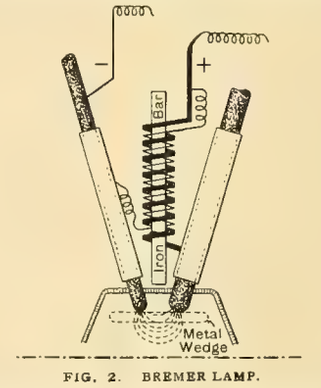


FIG. 2. BREMER LAMP.

grounds for this conjecture—it appears that in the arc all sorts of chemical processes favorable to the emission of light take place, of which the electrolytic decomposition of the salts and the subsequent oxidation of the metals come first under consideration, as the deposit on the upper part of the lamp consists mostly of calcium oxide, silicon, dioxide and other non-volatile metal-oxygen combinations.

The construction of the lamp is based on the phenomenon observed by the Geneva physicist, de la Rive, and already frequently utilized, that the arc formed between two electrodes which are parallel or slightly inclined to one another is much greater than in the case of electrodes in a straight line. To allow for the dropping off of the molten slag from the carbons it is absolutely necessary to support them from the top. In addition, the well-known effect on electric currents in magnetic and electrostatic fields is made use of in order to obtain a particularly large arc—a matter of considerable importance for the Bremer lamp, in which the space between the electrodes is the chief source of the light. In other lamps this is of secondary importance, for the carbon points and not the arc itself emit the main quantity of the light. The volume of the source of light in the Bremer lamp is 200 to 250 cubic millimeters, while in ordinary lamps it ranges from 50 to 100 cubic millimeters, and it is apparently in this that the main cause of the greater intensity of light for the same consumption of energy lies; for the arc, consisting as it does of white hot and, therefore, conducting metallic oxides, offers

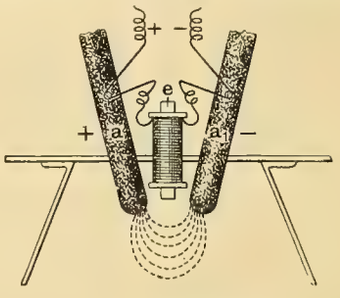


FIG. 3. BREMER LAMP.

no more resistance to the passage of current than the shorter non-luminous one.

Merely the regulation of the acute-angled disposition of the electrodes offered some difficulties, but these have already been overcome for the greater part with the aid of an innovation patented by the Eos Company of Neheim. Fig. 1 shows the simple system of the apparatus, in which the carbons are pushed forward as they burn. (a) and (b) are tubes which guide the carbons; they have a slit through which the clamping checks (k) and (k_1) press against the electrodes. (k) and (k_1) are insulated from one another and fastened on the pressure plate (d), in which two projecting metallic holders carry the arbor (g). The latter is in direct connection with the electromagnetic regulating mechanism, and by means of it the keeper (f) acts on the plate. While the lamp is burning, the keeper (f) exerts a suitable pressure upon the plate (d), through the link (g); this is conveyed equally to the two carbons. As the current through the arc decreases, a differential or shunt current passes through one magnet coil, the magnet draws the keeper back, the pressure on the two carbons is

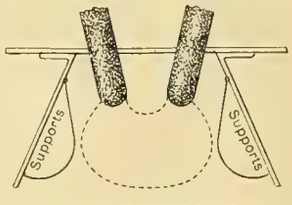


FIG. 4. BREMER LAMP.

diminished equally, and they sink downward. This decreases the resistance of the arc again, and the magnet comes out of action and allows the keeper to return to its former position, pressing the carbons against the sides of the tubes.

Several Bremer lamps can be connected in series, and, as the two carbons are normally clamped fast in the manner above described, and do not touch one another, the arc is struck as follows: When the current is switched on, part of it passes through the relay, and presses forward the keeper, allowing the carbons to slide down upon a metallic wedge which then supports them. The main current then finds a closed circuit through this wedge, and the shunt coils are no longer magnetized. Consequently, the carbons are once again clamped, and the metal wedge, which is fixed to a movable lever, drops back by its own weight. Now, the arc which is formed is subjected to the action of the series electromagnet, which drives it downward forcibly, and the action becomes greater as the arc approaches nearer to the magnet by the burning away of the carbons. The increased deflection increases the resistance of the arc, the magnet is exerted to a still greater extent, and acts on the carbon feed as already described, the carbons falling by their own weight. In continuous-current lamps only the positive carbon need be impregnated. Fig. 2 shows the arrangement of the differential winding, and is self-explanatory, and Fig. 3 the simple shunt-wound electromagnet acting as a blower. For the sake of clearness, the arrangement of the lever arm and carbon holder is omitted in these figures. (a) and (a_1) in Fig. 3 are the two electrodes connected with the mains, and (e) is the magnet, which is in shunt.

Herr Bremer believes he can trace variations in the light to actual bodily oscillations in the arc, and on this assumption he endeavored to remedy this trouble by a sort of throttling of the flame and by adding bulging "supports" for it, as shown in

1. Abstract of a paper read before the Elektrotechnischer Verein of Vienna; translated by the London Electrician.

section in Fig. 4. This pattern has not yet been introduced generally. These "supports" are insulated from one another, as it has been demonstrated that all bodies are electrical conductors at high temperatures. They are made of very refractory material, which, however, only withstands the high-arc temperature, because it is considerably reduced by the oxides. Supporting the flame in this manner prevents its being affected by the rising gases.

While the lamp mechanism is arranged in the upper case of the lamp, the carbon ends project into a conical reflector, which directs downward the light produced, and in this it is assisted by the dazzling white coating of lime and silica acid, which is being continually renewed upon it. In addition to this, the reflector forms a sort of reservoir for the hot gases which are developed, by means of

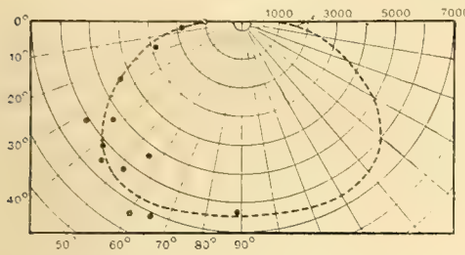


FIG. 5. BREMER LAMP.

which, according to the Harthmuth principle (of sheltering the carbon ends from the air), higher temperatures are obtained by retaining the heat near the carbons, and a slow consumption of the carbons is caused by the want of oxygen. The latter is of particular importance, as the consumption of impregnated electrodes is twice as fast as that of ordinary cored or solid carbons, even though the carbon consumption in the Bremer lamp is actually no more than in ordinary lamps, in consequence of the diameter of the former being only one-third of the carbons in the latter.

With the composition of the electrodes now employed, the light is uncommonly rich in rays of a wave length of 680 to 500 millionths of a millimeter. Thus the red and yellow rays preponderate, and the blue and violet ones are not of much account, so that the general impression of the color of the light is that of a golden yellow.

Of the numerous photometric measurements of the light given by electric flames containing oxides, those made by Professor W. Wedding of the Charlottenburg technical college are of the greatest interest, on account of the disinterestedness of the experimenter. The first was with a continuous-current lamp, without globe, which required a current of 12.3 amperes at 44.4 volts. The mean current varied at most by 0.3 ampere during the test, and the voltage 2.5 volts. The lamp worked fairly well, although it was one of the first made at the factory and did not include the more recent improvements. The candlepower was measured at various angles to the horizontal, and was approximately:

Degrees.	Hefner candles.	Degrees.	Hefner candles.
At 0	991	At 45.4	6,520
At 6.7	1,470	At 51.1	6,250
At 16.8	3,202	At 55	5,410
At 26	4,060	At 59.2	7,420
At 32	6,080	At 65	6,070
At 36.8	5,220	At 90	6,180
At 42	6,670		

From this table one can see already that the conical reflector assists the illumination, for it directs the greatest part of the light actually downward, and, in fact, fairly uniformly within an angle of 90 degrees around the arc as center. Above this it diminishes considerably to the horizontal, but still always amounts to 1,000 candlepower. This is particularly clearly shown in Professer Wedding's diagram (Fig. 5), in which the dotted line shows the approximate maximum candlepower. The same lamp,

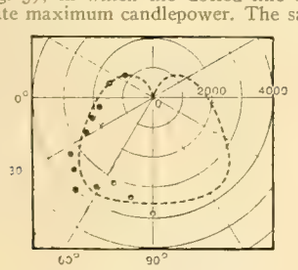


FIG. 6. BREMER LAMP.

when provided with a frosted globe, gave the following photometric results:

Above the horizontal—

Degrees.	Hefner candles.	Degrees.	Hefner candles.
At 18	497	At 12	1,160
At 32	713	At 8 5	1,040
At 15.2	1,216	At 0	1,140

Below the horizontal—

Degrees.	Hefner candles.	Degrees.	Hefner candles.
At 10.5	1,791	At 51.4	1,000
At 21.2	2,115	At 57.6	3,180
At 39	2,782	At 65	3,126
At 25.2	3,419	At 76	3,116
At 43.4	3,774	At 90	3,838

From this table and Fig. 6 it is seen that the frosted globe absorbs a not inconsiderable part of the light, but, on the other hand, it distributes it uniformly in all directions, so that a Bremer lamp does not show the usual shadow on the lower and upper hemisphere, but appears as an almost uniformly bright sphere. From the two measurements it will be noted with astonishment that an electrical source of light, with a consumption of 12.3 amperes at 44.4 volts (= 546 watts), or, if the 10.6 volts lost in the resistances are reckoned in, 677 watts, can furnish a maximum candlepower of 6,400 and a hemispherical candlepower of 4,320 Hefner candles. This corresponds to $545/4{,}320 = 0{,}126$ watt per Hefner candle, or, including the loss in the resistance, $677/4{,}320 = 0.157$ watt per candle. The ordinary continuous-current arc lamp, with its 0.55 watt per candle shows badly in comparison. In the case of the alternating-current lamps on the two systems, the consumption in the Bremer lamp to that in the ordinary lamp is as two to one.

BOOK TABLE.

PRIMARY BATTERIES: THEIR THEORY, CONSTRUCTION AND USE. By W. R. Cooper, M. A., B. Sc., 1901. London: The Electrician Printing and Publishing Company. Pp. (5½ by 8½ inches) vi., 324, with 131 illustrations. Price in London, 10s. 6d.

Books on the subject of primary batteries are few, and the appearance of a work as up-to-date and complete as this one should be welcomed. Mr. Cooper devotes considerable space to discussions on the simple voltaic element, local action and polarization and the theory of the voltaic cell, and the matter is treated in a thoroughly practical manner. Ionisation, electrolytic conductivity, osmotic pressure and Nernst's electrolytic solution pressure are all set forth in a way which will make them easy to understand. The descriptions of the various cells have been prepared with care and with the object of describing only those cells which are in general use, or of particular theoretical interest. The cells described are classified under the heads of non-chemical cells or thermopiles, one-fluid cells, two-fluid cells, dry cells, standard cells and carbon-consuming cells. The author also shows what the various kinds of batteries, such as Leclanché cells and dry cells are capable of doing, and compares the capabilities of one type with another. The use of curves obtained from the author's own personal experience make these descriptions and tests of value and round out the information so that any practical electrical engineer may acquaint himself with all the facts he is apt to need in intelligently employing the various cells. The chapter on standard cells is an important one, as is also that on carbon-consuming cells, which gives the results (mostly disappointing) up to the present time in this method of generating electrical energy. The book is well illustrated and the subject matter is arranged in a convenient form for reference.

HANDBOOK FOR STREET-RAILWAY ENGINEERS. By H. B. Andrews, C. E. 1902. New York: John Wiley & Sons. Pp. (three by five inches), xxi., 202, with illustrations and tables. Price, $1.50.

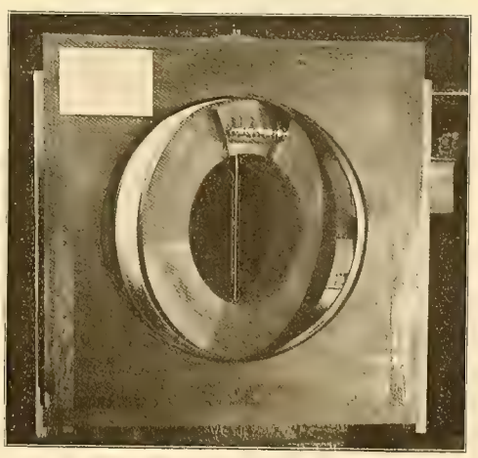
This is a handy book for engineers who have in charge the design and construction of street railways, the laying out of tracks or structures, or the furnishing of equipment. The introductory chapter takes up mensuration and trigonometrical formulæ, and is followed by chapters devoted to circular curves, compound transition curves and plain curves, with the necessary descriptions and tables. Under the heading of miscellaneous information are given track-construction tables, pavements, chemical specifications for rails, and tables giving cost of track construction. Separate chapters explain formulæ and diagrams for determining bending moments and the strength of materials. The electrical information in the book consists of definitions of common electrical terms, copper-wire tables, a series of tests on Phonoelectric wire, copper calculation, aluminum and electrical conductors, and a short description of the storage battery as applied to railway work. A chapter is devoted to tables of middle ordinates for curving rails, lengths of circular arcs and chords, natural sines and cosines and natural tangents and cotangents. The last chapter gives a table of average percentages of the expenditures for the gross income of all the street railways in the state of Massachusetts, which will be found very useful for reference.

Peruvian Development.

A recent British consular report contains some rather interesting facts concerning electrical development in Peru. The use of electricity for purposes of illuminating is, it seems, increasing rapidly in that country. Lima and Arequipa are electrically lighted and companies are being formed for lighting Calloa and Chiclayo in the same manner. The electrical equipment chiefly comes from the United States. British electrical machinery is barely mentioned in Peru. German dynamos and motors have been tried, but, although well finished, they are looked upon as being too complicated. Telephonic networks exist in the departments of Lima, Piura, La Libertad, Arequipa and Ica. The total length of lines is probably over 3,000 miles. Moreover, a number of applications for further authorizations to put up new installations have been made lately. Most of the telephonic appliances now come from Sweden. An electric-lighting company has been formed at Trujillo. Power is to be obtained from a waterfall on the river Moche, near Poroto, about 21 miles from Trujillo. The waterfall is about 180 feet, and is calculated to generate 200 kilowatts of electric energy. Three-phase transmission is to be adopted. The installation should be complete by December, and will create a demand for electrical appliances.

A New Laboratory Induction Coil

A new induction coil for large currents and adapted for laboratory purposes was described by Professor F. C. Caldwell of the Ohio State University at the recent Pittsburg meeting of the American Association for the Advancement of Science. The type of ironless induction coil described is, of course, not new, but its construction on such a large scale had not hitherto come to the attention of the author, and it was thought the data obtained would therefore prove interesting. As shown in the illustration, this coil is made up of two concentric coils wound on spools with spherical bottoms. The resistance is 1.4 ohms and the maximum impedance is 40 ohms approximately. The spool for the outer coil was made removable, and this coil is mounted inside of a circular frame. In winding the outside coil brass tubes were included for the shaft carrying the inner coil to pass through; brushes carry the current to the inner coil. Both coils are wound in sections, which can be connected in series or parallel. The coil is wound with No. 8 wire—10 layers of 20 turns each in the stationary coil and nine lay-



A NEW LABORATORY INDUCTION COIL.

ers in the rotating, making a total of 380 turns. The outside diameter of the inner coil is 20 inches, the width of the coil 2⅞ inches. There are approximately 100 pounds of wire in the apparatus.

A Radiometric Receiver for Electric Waves.

Gordon F. Hull of Dartmouth College, Hanover, N. H., described a radiometric receiver for electric waves at the recent Pittsburg meeting of the American Association for the Advancement of Science which has many points of interest. Two silvered strips of glass or mica, of the proper length for the waves used, are marked at their centers by a fine diamond scratch. They are mounted vertically in the focus of a parabolic mirror, with their centers opposite and near two small, thin, mica vanes, which are at the ends of an arm of a torsion balance. The resonators and torsion balance are placed under a bell jar, from which the air can be exhausted. The radiometric action due to the heating at the mica scratches or high resistances can be observed by a telescope and scale. The sensitiveness can be made greater than that of the Klemencie thermo-element, and the deflections are quantitative.

A Portable Photometer for Measuring Light Distribution.

One of the papers presented before the physical section of the American Association for the Advancement of Science at the recent Pittsburg meeting described a portable photometer for measuring light distribution, and was prepared by Dayton C. Miller of the Case School of Applied Science, Cleveland, Ohio. The arrangement described is a special form of photometer, which may be moved in any way, as about a pivot, for quickly measuring with moderate accuracy the relative intensity of light sent out in any direction from a source. A Lummer-Brodhun screen is used to compare the light from the source with that from a standard illumination, the latter being capable of measured regulation from zero intensity to the maximum required. The application of the photometer to the measurement of the distribution of light throughout a room, as by a window prism, was described.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Düsseldorf Industrial and Trades Exposition. By Frank C. Perkins. Illustrated	17, 18
"Fireflies" on the Stage	17
Massena Power Plant Sold	17
Improvements on Liverpool Elevated Railway	18
The Electrostatic Wattmeter in Commercial Measurements. By Miles Walker. Illustrated. (American Institute of Electrical Engineers.)	18, 19, 20
A Michigan Railway with Interesting Possibilities	20
Pacific Cable Question	20
Rival Canadian Power Companies at Niagara Falls	20
Automatic Rural Mail Carrier	20
The Bremer Lamp. Illustrated	20, 21
Book Table	21
Cooper's "Primary Batteries"	21
Andrews' "Hand-book for Street-railway Engineers"	21
Peruvian Development	21
A New Laboratory Induction Coil. Illustrated	21
A Radiometric Receiver for Electric Waves	21
A Portable Photometer for Measuring Light Distribution	21
Editorial	22
American Association for the Advancement of Science	23, 24
Accuracy of the Zero in the Dynamophone	24
Interesting Hydraulic Development in California	24
The Progress of Electric Space Telegraphy. By G. Marconi. Part I. (Royal Institution.)	24, 25
Long-distance Alternating-current and Hydrodynamic Phenomena Compared. By Henry T. Eddy. (American Association.)	25
D. & W. 250-volt Plug Fuse. Illustrated	25
Development of the Telephone Field	26
Michigan Telephone Company Defaults Interest on Bonds.	26
Southern Telephone Developments	26
Telephone News from the Northwest	26
Indiana Telephone Items	26
The Des Moines Telephone Strike	26
General Telephone News	26
Telephone Men	26
Manufacturers and Dealers	26
Use of the Telephone in Operating Railroad Trains. Part II	27, 28

DEPARTMENTS.

Correspondence	28, 29, 30
New York Notes	28
Southern Developments	28
New England News	28, 29
Canadian Intelligence	29
From the Buckeye State	29
Information from Indiana	29
Northwestern Notations	29
Beyond the Rockies	29, 30
On the Pacific Slope	30
Personal	30
Electric Lighting	30
Electric Railways	30
Publications	30, 31
Miscellaneous	31
Trade News	31
Business	31
Illustrated Electrical Patent Record	31, 32

CONVENTIONS AND EXPOSITIONS.

Electrical Contractors' Association of New York, Albany, N. Y., July 15th.

National Electrical Contractors' Association of the United States, Philadelphia, Pa., and Atlantic City, N. J., July 16th and 17th.

New York State Independent telephone men, Rochester, July 23d and 24th.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, White Mountains, September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

IT IS to be regretted that failure—temporary failure, at least—has overtaken the great Massena hydro-electric power plant on the St. Lawrence River. The project was a large one and was interesting from a technical point of view, but the reason assigned for the failure—lack of a field in which to dispose of the company's product—is probably the true one. It is said that $10,500,000 has been sunk in the enterprise, and the future of the plant is problematical. The moral is an obvious one. Every power-development company, to be successful, must have customers who will take the power at profitable rates as well as the capacity to supply them. Sound business principles must be applied in power-development schemes as well as elsewhere, as not a few investors have discovered to their cost.

THAT is a bold project that John D. Spreckels is said to have in view—the establishment of wireless-telegraphic service between San Francisco and the Hawaiian Islands, a distance of over 2,000 miles. According to the report, Mr. Spreckels' experts are now conducting experiments between Los Angeles and Catalina Island over a distance of 40 miles. These tests will be successful, one may suppose; but a commercial service over a 2,000-mile expanse—that is a different matter. However, Marconi has received brief, irregular messages up to that distance, and the possibility is at least worth testing, particularly as it can be done at an expense that will be comparatively small if the patent rights can be adjusted. This is an era of Pacific-cable building, and the question of the possibilities of space telegraphy was brought up in Congress during the debate on the Corliss bill for a government cable. It will be remarkable—and disconcerting in many quarters—if wireless communication with Honolulu shall be established by the time the cable is ready for use; but in the present state of the art such a result can hardly be looked for. Nevertheless the prospect is alluring even if slight, and if a wealthy and enterprising man shall put it to actual test, he will deserve the gratitude of all friends of progress.

THE Supreme Court of Iowa recently made an interesting comparison in a lawsuit growing out of the death of a telephone lineman from contact with a 2,500-volt arc-light circuit. It says that in some cases the duty of electric-lighting and power companies to prevent the escape of dangerous currents of electricity may be likened to that of the keeper of a ferocious animal. But it is certainly not the rule of law applicable to such cases that the company is absolutely liable for any injury done by escaping electricity. Such a company, says the court, is engaged in conferring a public benefit, and, although it is by the nature of its business bound to exercise great care, yet the care required is, after all, only that reasonably consistent with the performance of its functions. It should, along the highway and in proximity to places where persons may rightfully go, insulate its wires, or by putting them out of the way avoid danger to persons who without negligence might otherwise be injured by casually coming in contact with them. And when the lighting wire is supported on poles which support other electrical wires, which must be attended to by linemen of other companies, the company operating the lighting wire is bound to know that there is danger of such linemen coming in contact with the lighting wire and being injured thereby, if it is not properly insulated, and it will be negligent if it fails to use proper precautions against injury to such linemen of other companies. But the duty to insulate for the protection of persons who may come in contact with the wires does not exist as to parts of the line where no one could reasonably be expected to come in contact with the wire.

This is good sense, and, coming from high authority, must be regarded as good law as well. There is some divergence on this point between the courts of different states, but the Iowa decision (it is the case of Knowlton against the Des Moines Edison Light Company) is so just and reasonable that it might well be cited as a universal precedent.

IS IT true that while this is the year of the gasoline automobile next year will see the triumph of the electric vehicle? Some of the shrewdest storage-battery men believe this to be the case and are laying their plans accordingly. It is figured that a revulsion against the gasoline vehicle for city use is coming, owing to municipal restrictions, noisy operation and danger of explosion, and that the quiet, modest, entirely unobjectionable electric machine will soon have the preference, although not, of course, to the entire exclusion of its more boisterous rival, which will always have a field of usefulness from which it cannot be ousted. There is no doubt that the prospects of the electric automobile, in the contest of types, are decidedly improving. Perhaps Mr. Edison, with his widely heralded light-weight accumulator, has had something to do with this tendency; but, whatever the cause, it does exist, and electrical men are congratulating themselves thereat.

TELEPHONE contracts, according to the decision of a Canadian court, must, to be legal, reasonably safeguard the interests of the subscriber as well as the company supplying service. A Windsor (Ont.) lawyer bearing the honored and aggressive name of Murphy brought suit against the Bell Telephone Company of Canada to secure an adjudication of the matter and won. He wished service in his office, but refused to sign the proffered contract. The company thereupon withheld its service, and the suit was brought. Mr. Murphy contended that the company had no right to demand of him his signature to a contract containing clauses which did not protect the patron, but gave all the protection to the company, and left the patron liable to the company in many ways. Particular objection was noted to one clause, by which the subscriber cannot hold the company responsible for any damage caused by the telephone wires which enter the building. The judge coincided in this view, holding that the company is wrong in asking patrons to sign such an agreement, and he issued a perpetual injunction to compel the giving of telephone service to the plaintiff so long as he pays in advance like other subscribers. The plaintiff was also awarded $10 damages for the time his connection was cut off, and the company was assessed the costs. Notice of appeal was given, but as telephone contracts are probably not exempt from the considerations of equity governing the interpretation of all other contracts, it is a fair assumption that the doctrine enunciated by Mr. Murphy's efforts will be upheld.

EVEN the best of us sometimes fall into the error of using the injudicious superlative. So conspicuous a person as the president of Harvard University, in conferring the degree of master of arts—not particularly distinctive, by the way; why not doctor of science?—on a brilliant electrical engineer, is reported to have spoken of the recipient as "the foremost expert in applied electricity of this country, and therefore of the world." Now, without abating the honor due any man, the cautious and well informed technical man would not have said that. Who is, indeed, the foremost expert in applied electricity in the United States? Bell (A. G.), Brush, Edison, Pupin, Scott, Sprague, Stanley, Steinmetz, Stillwell, Tesla, Thomson, Weston and perhaps several others must needs be considered. Some men are eminent for what they have done; others for what they are doing. Some have achieved eminence in one branch of the art, some in another; a few are all-around men. Yet the specialist may outclass the man of more general experience. In short, it is impossible to single out one man as the foremost electrical expert of the country. Hardly any one but a non-electrical college president would have ventured to make a dogmatic selection. This fact does not, however, detract from the appropriateness of bestowing an honor on the recipient of the degree, who is worthy of the distinction, and more. The gentleman in question would, no doubt, if called upon, state his position in the domain of science and engineering in terms different from those which were used.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

[Special correspondence of the Western Electrician.]

Pittsburg, July 5.—In many respects the Pittsburg meeting of the American Association for the Advancement of Science and Affiliated Societies from June 27th to July 3d, was one of the most successful which the association has ever had. While the attendance was not very large, yet it was composed of members of the active working class, many of them being fellows of the association. The registration showed 435 members of the American Association for the Advancement of Science in attendance; in addition to this, there were about 200 members of the affiliated societies, bringing the total attendance up to 635. This ranks the Pittsburg meeting as the fourth in size of the meetings held during the last 10 years. The geographical distribution of members in attendance is especially interesting, nearly every state in the Union being represented by five or more members. It is gratifying to note that the attendance of active working members from the South was double that representing the same region in any other meeting.

A number of important measures concerning the future of the association were considered and several amendments to the constitution were adopted, which will render the council more permanent in its membership and undoubtedly more efficient in its work. The matter of giving publicity to the papers read was brought up at the general meeting and was acted upon favorably and unanimously. In the past the press reports of the various papers read have been handled by the daily-newspaper reporters, who invariably picked out what appeared to them to be humorous and eccentric utterances, which resulted in caricaturing rather than in treating seriously the papers and the authors. To prevent this in the future, each section and affiliated society will appoint a press secretary, who will make it his business to see that the proceedings are correctly and interestingly reported from day to day.

About 60 new members were elected during the Pittsburg meeting and 80 members were made fellows.

A matter of considerable interest to the electrical engineers throughout the country is the election of Mr. George Westinghouse to an honorary fellowship in the association. This honor was bestowed upon him out of respect to his inventive powers and executive abilities, which have in the past decade aided materially the great and substantial progress made in the field of applied science, and for his encouragement to the men in his employ in the various Westinghouse industries to devote their time and talents to the advancement of pure science.

Socially, the Pittsburg meeting was of an exceptional nature, all the educational, religious, business and social organizations in Pittsburg and Allegheny uniting in their efforts to make the meeting an unqualified success. Mrs. William Thaw extended the courtesy of her beautiful home, Lyndhurst, at Fifth Avenue and Beechwood Boulevard, on Wednesday afternoon. The Engineers' Society of Western Pennsylvania extended every courtesy to the visiting delegates, and the "smoker" on the steamboat Annie J. Roberts on the Monongahela River on Thursday night will be long remembered by those who had the good fortune to be present.

Four interesting public lectures were given to the citizens of Pittsburg by the association and affiliated societies out of appreciation for the many courtesies and hospitalities extended during convention week. Dr. Leonard P. Kinnicutt of Worcester, Mass., discussed and illustrated the "Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment." Dr. Charles E. Bessey of the University of Nebraska delighted his audience with an illustrated lecture entitled "Evolution Among Microscopic Plants." Captain Sibert of the local United States engineer's office gave, with pictures, his "Experiences in the Philippines in Repairing Damages to Bridges and Railroads Which Were Inflicted by Retreating Insurgents." Robert T. Hill of the United States Geographical Society delivered an address to an audience that crowded the Carnegie Music Hall to the doors on "His Experiences on the Island of Martinique During the Recent Volcanic Eruptions."

President Ira Remsen of the Johns Hopkins University was elected president of the association and will succeed President Asaph Hall at the next meeting, which will be held at Washington, D. C., from December 28, 1902, to January 3, 1903.

Papers Before Physical Section.

The papers which were read before the association proper and in joint session with the more closely affiliated societies were numerous and of a high order. About 360 papers were presented, which is a large increase over the number read at the last meeting of the association. Of the numerous papers read, those presented by Sections B and D, physics and mechanical science and engineering, respectively, were of an especially interesting nature. Of the 45 papers read either actually or by title before Section B, 17 related to electrical subjects. A summary of the contents of some of these papers is given as follows:

Professor H. S. Carhart, University of Michigan, brought forward some experiments which point very strongly toward a new theory of electrical cells.

J. S. Shearer took up the study of expansion coefficients between the temperature of melting ice and that of liquid air. This work was called for in order that chemical apparatus for low-temperature work may be properly designed.

Professor C. S. Moler of Cornell University described a very interesting plant, in which a potential of 12,000 volts is obtained by running 24 dynamos of 500 volts each in series. The full-load current is 0.22 ampere. The operation of this plant has proved very satisfactory.

W. Ambler and F. Allen, after a careful set of experiments with a liquid-air machine, find that 116 grains of this substance can be made by one horsepower in one hour, and that only about two per cent. of all the energy expended is stored up in the liquid.

E. F. Nichols and G. F. Hull of Dartmouth College have revised their determination of the pressure exerted by light and find that it varies only four per cent. from that deduced from theory.

Dr. F. Allen of Cornell University presented some results of experiments on retinal fatigue and persistence of vision, which have an important bearing upon the theory of how we see colors.

A preliminary note on the effect of percussion in increasing magnetic intensity was presented by G. F. Stradling of the University of Pennsylvania. Iron, steel and nickel are magnetized and then demagnetized by reversing the current. Percussion causes a development of poles in the same direction as before demagnetization. These increase in strength with tapping and then grow weaker.

The electrical conductivity of non-conducting powders saturated with electrolytic solutions was compared with the conductivity of the supernatant liquor, by Ernest Dorsey of Annapolis Junction, Md. For coarse-grained powders the two are proportional, but when the power is fine the conductivity of the saturated powder at first increases more rapidly than that of the supernatant liquor, with the result that for quite dilute solutions the conductivity of the saturated powder, as measured in a cubical cell, a pair of whose opposite sides served as electrodes, may even exceed that of a volume of the supernatant liquor equal to that of the solution in the powder as measured in the same cell.

C. A. Skinner of the University of Nebraska spoke on the conditions controlling the drop of potential at the electrodes in the vacuum-tube discharge. The drop of potential is explained by the presence of ions which strike the electrodes and rebound perhaps several times before they succeed in getting rid of their charges. Since the negative ions have greater freedom of motion than the positive ones, the accumulation of ions is different at the two ends of the tube and consequently the fall of potential also differs.

Some observations showing the oscillatory character of lightning were presented by A. W. Smith, University of Mississippi. A drop of water falling during a lightning flash had several successive positions. A fence post photographed from a moving carriage gave six partially superimposed images. The period of oscillation was calculated to be from 0.02 to 0.03 second.

A new laboratory switchboard jack was treated by Professor F. C. Caldwell of Ohio State University. A convenient jack and plug of neat appearance were described. The cost of the plug is about 10 cents and of a complete terminal with two tubes, 26 cents. One hundred amperes flowing for 15 minutes produced a scarcely perceptible rise of temperature in jacks which had been used for several months.

George A. Hoadley of Swarthmore College gave a photographic study of the alternating arc. Photographs taken from a rotating mirror mounted with its axis parallel to the line of the two carbons show two luminous intervals each cycle. When one carbon is replaced by zinc there is but one luminous interval each cycle. In this case a direct-current ammeter indicates the passage of 10 or 12 amperes from the zinc to the carbon in the arc. When a magnet is held near the arc, the photographs, taken now from a mirror with its axis at right angles to the line of carbons, show alternate displacements of the bright band to the right and to the left. If the lower carbon is double, one-half the current can be made to go to one carbon and the remaining half to the other carbon, thus splitting the alternating current into two intermittent direct currents.

A. J. Wurts gave a very interesting address on the Nernst lamp, the substance of which has already appeared in the technical press.

The theory of the electrolytic rectifier was discussed by K. E. Guthe of the University of Michigan. The paper described the method of investigation and was illustrated by curves showing the relation between the current and the polarization or condensation voltage with different metals and salt solutions. The cause of the effect was located in the gas layer at the anode.

Among the other papers presented were those of which the titles follow: "On the Complex Product of Electromotive-force, Current and Other Vectors," by H. T. Eddy, University of Minnesota; "On the Magnetic Behavior of Nickel-copper and Nickel-tin Alloys," by Bruce B. Hill, University of Nebraska; "On the Effects of Electrolytic Condensers in Alternating-current Circuits," by A. Trowbridge and E. R. Wolcott, University of Wisconsin; "On the Accuracy of the Zero in a Dynamophone," by J. Burkitt Webb, Stevens Institute; "Note on a New Form of Variable Inductance Coil," by F. C. Caldwell, Ohio State University; "Rayleigh's Alternating-current Phasemeter," by E. S. Johnonott, Rose Polytechnic Institute; "A Radiometric Receiver for Electric Waves," by Gordon F. Hull, Dartmouth College; "A Portable Photometer for Measuring Light Distribution," by Dayton C. Miller, Case School of Applied Science. [Some of these papers appear in abstract elsewhere in this issue; others will appear in succeeding numbers of the Western Electrician.—Ed.]

A number of interesting papers relating to electrical subjects were read before the American Physical Society. Special mention might be made of two papers by L. A. Bauer of the United States Coast and Geodetic Survey entitled "Results of Recent Magnetic Investigations," illustrated by charts; and "Some Recent Interesting Magnetic Disturbances Registered at the Coast and Geodetic Survey Magnetic Observatories," illustrated by lantern slides; and another, "On the Action of a Condenser in an Induction Coil," by J. E. Ives, University of Cincinnati.

Papers Before Mechanical Science and Engineering Section.

Section D was favored with an unusually large number of papers, many of them of the highest practical and scientific value. Professor R. H. Thurston, dean of the Sibley College, Cornell University, gave a resume of the trend of progress in prime movers. While immense progress has been made in the efficiency of heat engines, very much remains to be done. Steam turbines have become recently very important. But, of course, the efficiency of the turbine and of the ordinary steam engine are tending to the same point.

Frank H. Cilley, one of the engineers in charge of the construction on the new East River extension bridge, gave some interesting examples showing that ordinary methods of determining the stress upon certain forms of framed structures are at fault—sometimes seriously so—because changes of form due to the act of loading at different stages of the process, are not sufficiently considered. In this line of thought Professor Thomas Gray of the Rose Polytechnic Institute discussed the "Ratio of the Transverse to the Longitudinal Elastic Strain Produced by Longitudinal Stress." In a following paper Professor Gray showed it probable that the effect of hardening upon steel is to diminish its rigidity, rather than to increase it, as is the common supposition.

Professor Mansfield Merrimann showed that one additional line of hose of the same size from a hydrant reinforcing a stream already in action increases the nozzle efficiency by about 40 per cent., a third line by about 25 per cent., a fourth by about 10 per cent., while the increase from a fifth or sixth line or more is too small to be of value.

Professor R. S. Woodward of Columbia University entertained the section by a discussion of some of the curious uncertainties still existing in the meaning of the language of engineers. He suggested what he considers necessary reforms in the technical language of engineers. His position, however, aroused a lively controversy, in which the well-known engineer, William Kent of Passaic, N. J., led the opposition to Dr. Woodward.

Professor David P. Todd of Amherst gave the section some account of a planatary orrery mechanism for showing the motion of the heavenly bodies now in process of construction at Amherst, and occupying a building of more than 60 feet diameter. He asked the section for some suggestions upon the mechanical arrangements of this very large piece of school apparatus.

Professor J. Burkitt Webb gave a description of an ingenious device, by which, with a telephone, the strain upon a rotating shaft could be ascertained with great accuracy; also another device for showing the power exerted by floating automobile objects like self-propelling torpedoes.

Professor Gray showed that for high pressures ball bearings become unsuitable and must be replaced by other devices.

An interesting contribution was that of Professor Calvin M. Woodward, dean of the mechanical department of Washington University of St. Louis. He is prominent on the committees which are regulating the various competitions to take place at the Louisiana Fair. He published before the section, for the first time, the rules and regulations which are to govern the contests in air navigation. With this paper was given the section an account of the excellent scientific investigation in the line of ærody-

ramics now being carried on at the University of Georgetown by Professors H. Matullath and A. S. Zahn.

Professor H. T. Eddy of Minnesota University presented a valuable contribution, in which he had worked out to a larger degree than heretofore the close analogy between pump action upon water under various conditions and the action of an alternating electric current. [This paper appears elsewhere in this issue of the Western Electrician.—Ed.]

Professor J. C. Nagle of the Texas Technical School contributed an article upon the "Effect of Weeds and Moss Upon the Coefficient of Discharge in Small Irrigating Canals."

Professor Albert Kingsley gave an interesting paper, fully illustrated by diagrams, showing in original ways how the "Compound Pendulum" can be considered by graphic methods.

M. M. Kann of Pittsburg talked of "Crushed Steel and Steel Emery—an Artificial Abrasive." This is a recently invented form of steel whose manufacture has grown up in Pittsburg and founded a new industry. The various grades of the product of this new company have replaced sand in rock sawing, emery in steel sawing, diamonds in core drilling of rocks, emery and other substances for beveling, shaping and polishing various refractory materials like granite, steel and glass.

Papers by W. K. Hatt, E. S. Farwell and J. H. Granberry were, in the absence of the authors, read by title.

Professor W. T. Magruder illustrated a newly devised and simple method of determining with very small error the coefficient of v in the expression pv^n. This is the formula of the curve connected with the indicator diagram by which the efficiency of various kinds of engines is measured. The special point in Professor Magruder's paper was the use of the planimeter in the calculation of the exponent.

W.

Accuracy of the Zero in a Dynamophone.

A note on the accuracy of the zero in a dynamophone was presented by J. Burkitt Webb of Stevens Institute, Hoboken, N. J., before the physical section of the American Association for the Advancement of Science at Pittsburg. The dynamophone is a new dynamometer, in which the energy transmitted per revolution is measured by the twist of the shaft transmitting it, the twist being measured while the shaft is in motion by an electrical method in which no contact is made with the shaft.

It consists of two armatures or hooked wheels mounted on the shaft at a sufficient distance from each other, each wheel having a telephone magnet with its coil mounted in front of it in such a way that it can be revolved about the shaft. The distance of the telephone magnets from the armatures is also adjustable. These two telephones are connected in series with a receiving telephone which, when the two telephones are properly adjusted to opposite phases and equal amplitudes, gives no sound, or indicates zero. When the shaft twists under the transmission of a moment the observing telephone must be revolved through the angle of twist to obtain the zero or opposition of phase.

As in some cases the observing magnet can be revolved through a small angle without perceptibly altering the zero, it is advisable to discuss the accuracy of the same regarded as a question of the interference of waves of the same period, with slightly different overtones, and to use a method of observation which avoids the difficulties to a great extent.

Interesting Hydraulic Development in California.

Hydraulic mining having been prohibited by the national government in many parts of California, the hydraulic-development companies of that state are very profitably turning their attention to power and irrigation projects. The Central California Electric Company has recently purchased two 1,000-kilowatt Westinghouse alternating-current generators, which will be direct-connected to waterwheels and used to supply power to Grass Valley, Nevada City, Sacramento and adjacent towns. This is the third station to be installed by the company, two other stations having now been in operation for a number of years. The Central California Electric Company's system is a part of that of the South Yuba Water Company, which controls 400 miles of main-ditch line in the heart of the Sierra Nevada Mountains. Formerly the water was used for hydraulic mining, but this having been stopped on account of the filling up of the rivers with "slickens," the water now is sold to ranchers and fruit growers for irrigation purposes. Before being sold to the farmers, however it is transmitted in pipes to stations at different points along the system where electric energy is produced and conducted 35 to 50 miles to adjacent cities.

Damage to the extent of about $10,000 was caused by a fire recently in the car barns of the Chicago and Joliet Electric Railway Company at Joliet, Ill. Two cars were practically ruined and four others scorched. By hard work the fire department saved the barns and several other cars from destruction. The loss is covered by insurance.

The Progress of Electric Space Telegrapy.[1]

By G. Marconi.

Part I.

Wireless telegraphy, or telegraphy through space without connecting wires, is a subject which at present is probably attracting more world-wide attention than any other practical development of modern electrical engineering. That it should be possible to actuate an instrument from a distance of hundreds or thousands of miles and oblige it at will to reproduce audible or visible signals through the effects of electrical oscillations transmitted to it without the aid of any continuous artificial conductor strikes the minds of most people as being an achievement both wonderful and mysterious. If we examine the subject closely we may, however, come to the conclusion that, although telegraphy through space is certainly wonderful, as are likewise all natural and physical phenomena, yet it is certainly in no way more wonderful than the transmission of telegrams along an ordinary telegraph wire. The light and heat waves of the sun and stars travel to us through millions of miles of space, and sound also reaches our ears without requiring any artificial conductor. Is it not, therefore, wonderful that man should have devised means by which he is enabled to confine electricity conveying messages or power to a wire and cause the effect which we call an electric current to follow all the turns and convolutions which may exist in the wire?

We find that the first systems of telegraphy used by mankind were truly wireless. A bonfire built on a hill by a band of aboriginal Indians conveyed a signal wirelessly by etheric waves—in this case light waves—to Indians on another hill, perhaps miles distant. Even to-day there are innumerable systems of what may truly be called wireless telegraphy in practical use. A red light at a railway crossing conveys a signal by waves through the ether to the eye of the engine driver. The red light is the transmitter, the eye the receiver.

The method of space telegraphy of which I intend speaking to-night is founded on a comparatively new way of controlling and detecting certain kinds of etheric waves, much slower in rate of vibration than light waves, called Hertzian waves, after the scientist who first demonstrated their existence. The mathematical and experimental proof by Clerk Maxwell and Heinrich Hertz of the identity of light and electricity, and the knowledge of how to produce and detect certain previously unknown ether waves, made possible this new method of communication. I think I am right in saying that the importance of the discoveries of Maxwell and Hertz was realized by very few, and even, perhaps, so recently as a year ago a great number of scientific men would have hardly foreseen the advances which have been made in so brief a time in the art of space telegraphy.

The time allowed for this discourse does not permit me to describe all the various steps which have made possible the results recently obtained nor to describe the work of the numerous workers who have contributed to the advance of the subject, but I hope it may be of interest if I describe the various problems which have lately been solved, and the very interesting developments which have taken place in my own work during the last few months. I shall first briefly describe my system as used in my early experiments six years ago, and afterward endeavor to explain the various improvements and modifications which have since been introduced into it.

The transmitter consists of a modified form of Hertzian oscillator, the main feature of which is in having one sphere of the spark discharger earthed and the other connected to an elevated capacity area or to a comparatively vertical wire. The two spheres are also connected to the ends of the secondary winding of an induction coil or transformer. When the key is pressed the current of the battery is allowed to actuate the spark coil, which charges the spheres and the vertical wire, which, when discharging, causes a rapid succession of sparks to pass across the spark gap. The sudden release caused by the spark discharge of the electrical strain or displacement created along certain lines of electric force through space by the charged wire causes some of the electrical energy to be thrown off in the form of a displacement wave in the ether, and, as a consequence, the vertical wire becomes a radiator of electric waves. In this connection it is interesting to remember that Lord Kelvin showed mathematically more than 40 years ago the precise conditions under which such a discharge as we are considering would be oscillatory. It is easy to understand how, by pressing the key for longer or shorter intervals, it is possible to emit a long or short succession of impulses or waves which, when they influence a suitable receiver, reproduce on it a long or short effect, according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

The receiver consists of a coherer (on the nature of which I hope to make a few further remarks later) placed in a circuit containing a local cell and a sensitive telegraph relay actuating another circuit, which works a trembler or decoherer and a recording instrument. In its normal condition the resistance of the coherer is infinite, or at least very great, and the current of the battery cannot pass through it to actuate the instruments, but when influenced by electric waves the coherer becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell to actuate the relay, which in turn causes another stronger current to work the recording instrument and also the tapper or decoherer, which is so arranged as to tap or shake the coherer, and in this way restore its sensitiveness. The practical result is that the circuit of the recording instrument is closed for a time equal to that during which the key is pressed at the transmitting station, and in this way it is possible to obtain a graphic, acoustic or optical reproduction of the movements of the key at the sending station. One end of the tube or coherer is connected to earth and the other to an insulated conductor, preferably terminating in a capacity area similar in every respect to the one employed at the transmitting station.

I noticed that by employing similar vertical rods at both stations it was possible to detect the effects of electric waves, and in that way convey the intelligible alphabetical signals over distances far greater than had previously been believed possible, and by means of similar arrangements distances of transmission up to about 100 miles were obtained.

It was soon, however, realized that so long as it was possible to work only two installations within what I may call their sphere of influence a very important limit to the practical utilization of the system was imposed. Without some practical method of tuning the stations, it would have been impossible to work a number in the vicinity of each other at the same time without interference caused by the mixing of messages. The new methods of connection which I adopted in 1898—i. e., connecting the receiving vertical wire or aerial directly to earth instead of to the coherer, and by the introduction of a proper form of oscillation transformer in conjunction with a condenser so as to form a resonator tuned to respond best to waves given out by a given length of aerial wire—were important steps in the right direction. I referred at length to this improvement in the discourse which I had the honor to deliver at this table on February 2, 1900. I had, however, realized at the time that one great difficulty in the way of achieving the desired effects was caused by the action of the transmitting wire. A straight rod in which electrical oscillations are set up forms, as is well known, a very good radiator of electrical waves. In all what we call good radiators electrical oscillations set up by the ordinary spark-discharge method cease or are damped out very rapidly, not necessarily by resistance, but by electrical radiation removing the energy in the form of electric waves.

It is a well-known fact that when one of two tuning forks having the same period of vibration is set in motion, waves will form in the air, and the other tuning fork, if in suitable proximity, will immediately begin to vibrate in unison with the first. In the same way a violin player, sounding a note on his instrument, will find a response from a certain wire in a piano near by, that particular wire, out of all the wires in the piano, happening to be the only one which has a period of vibration identical with that of the musical note sounded by the violinist. Tuning forks and violins, of course, have to do with air waves and wireless telegraphy with ether waves, but the action in both cases is similar. It is very important to take into consideration the one essential condition which must be obtained in order that a well-marked tuning or electrical resonance may take place. Electrical resonance, like mechanical resonance, essentially depends upon the accumulated effect of a large number of small impulses properly timed. Tuning can only be obtained if a sufficient number of these timed electrical impulses reach the receiver. As Professor Fleming so graphically puts it in one of his lectures on electrical oscillations, to "set a pendulum in vibration by puffs of air we must not only time the puffs properly, but keep on puffing for a considerable period." It is, therefore, clear that a dead-beat radiator—i. e., one that does not give a train or succession of electrical oscillations—is not suitable for tuned or syntonic space telegraphy.

As I pointed out before, a transmitter consisting of a vertical wire discharging through a spark gap is not a persistent oscillator. Its electrical capacity is comparatively so small and its capability of radiating waves so great that the oscillations which take place in it must be considerably damped. In this case receivers or resonators of a considerably different period or pitch will respond and be affected by it.

Early in 1900 I obtained very good results with another arrangement in which the radiating and resonating conductors each take the form of two concentric cylinders, the internal cylinder being earthed. By using zinc cylinders only seven meters high and 1.5 meters in diameter good signals could easily be obtained between St. Catherine's Point, Isle of Wight, and Poole, over a distance of 30 miles, these signals not being interfered with or read by other wireless-telegraph installations worked by my assistants or by the Admiralty in the immediate vicinity. The capacity of the transmitter due to the internal conductor is so large that the energy set in motion by the spark discharge cannot all radiate in one or two oscillations, but forms a train of slowly damped oscillations, which is just what is required. A simple vertical wire may be compared

1. Lecture delivered before the Royal Institution, London, June 13, 1902.

with an empty teapot, which, after being heated, would cool very rapidly, and the concentric cylinder system with the same teapot filled with hot water, which would take a very much longer time to cool. In the receiver the closely adjacent cylinders which give it large electrical capacity cause it to be a resonator possessing a very decided period of its own, and it becomes no longer apt to respond to frequencies which differ from its own particular period of electrical oscillation, nor to be interfered with by stray ether waves which are sometimes caused by atmospheric disturbances, and which occasionally prove troublesome during the summer.

[To be continued.]

Long-distance Alternating-current and Hydrodynamic Phenomena Compared.[1]

By Henry T. Eddy.

The analogy between a steady flow of water in a long pipe under the action of a constant head and a continuous current of electricity under some constant pressure, such as is furnished by one or more cells of a battery, has often been employed to give a clear elementary physical conception of the mathematical relations expressed in Ohm's law. In this case the applied pressure is gradually consumed by the resistance experienced by the current, and in strict analogy with the flow of water, the loss per unit of length is proportional to the product of the square of the current and the first power of the resistance. So far as the mathematical relations are concerned, the two problems are identical.

It is the object of this paper to extend this hydrodynamic analogy to the more complicated case of long-distance transmission by alternating currents in general.

Telephone transmission will be specifically considered in order to include the general case of variable frequency. The importance of thus extending and enlarging this analogy will be evident when we reflect that all the complicated phenomena of long-distance electrical-power transmission, by any combination of land lines and cables with their sending and receiving apparatus, may be completely reproduced in all its details of operation by simple pumping machinery, with its transmission pipes and air chambers, whose manner of operation may be made clear to anyone without the aid of higher analysis. Let us first take the case of a double-acting pump cylinder and piston, in which the two ends of the cylinder are connected by a simple pipe or by-pass without valves. When this apparatus is filled with water and the piston is moved back and forth by a uniformly rotating crank, the water is forced through the by-pass alternately from one end of the cylinder to the other. If the by-pass is short, the resistance to motion may be taken as due to fluid friction only, since the inertia of the water may then be disregarded. This is in every particular analogous in the manner of its operation to a sinusoidal electromotive force acting in a circuit whose induction and capacity may be disregarded in comparison with its ohmic resistance.

But in case the pipe connecting the ends of the pump cylinder be made very long and the size sufficient to reduce the friction greatly, we may disregard this in comparison with the resistance due to the inertia of the water. The resistance due to inertia is proportional to the product of the mass of the water moved by its acceleration. Since this acceleration is greatest at the beginning of the stroke and vanishes at middle of the stroke, where it changes to a retardation of amount increasing to the end of the stroke, it is evident that the phase of the current lags a quarter of a revolution or period behind that of the pressure, the pressure being a maximum at the beginning of the stroke, and the current a maximum at the middle of the stroke. During the retardation of the piston the inertia of the water acts to drive the piston forward, and (disregarding friction) as much energy is returned to the piston during retardation as is exerted by it during acceleration, so that on the whole no loss of energy occurs during the stroke. In these particulars this case differs from that previously considered, where the pressure is in phase with the current and energy is expended against resistance during the entire stroke.

Now, suppose that fluid friction and inertia coexist in the connecting pipe; it is evident that their coexistence does not affect the separate actions which have been described. The current or flow back and forth is that due to the reciprocating motion of the piston, and the pressure is the resultant of the two pressures already described, differing in phase by a quarter of a period. The lag of the current will therefore be less than a quarter of a period.

The inertia of the motor is entirely analogous to the self-induction of an electric circuit and the case of combined fluid friction and inertia is mathematically in every particular the same as an alternating-current circuit having distributed ohmic resistance and self-induction.

Next let us imagine the short by-pass first considered to be sufficiently increased in diameter to make it a globular chamber as large or larger than the cylinder itself, and let it be furnished with an elastic diametral diaphragm (of sheet rubber, for example), which occupies a diametral position whenever the piston is at the middle of the stroke. It is evident that when the piston is at the beginning of the stroke the tension of the stretched diaphragm exerts a negative pressure or suction to force the piston forward in its stroke, which vanishes at the middle of the stroke, after which the pressure exerts a retardation, whose amount increases to a maximum at the end of the stroke. But the total energy exerted by the diaphragm and restored to it are equal.

The action of the diaphragm differs from the action of the inertia of the water previously considered in the one particular only: It exerts its greatest forward pressure at the instant the inertia exerts its greatest back pressure, consequently when we disregard fluid friction, the phase of the current is one-quarter of a period in advance of the pressure.

It thus appears that the effect of such a diaphragm is opposite to that of the inertia of the water, so that a diaphragm having sufficient tension would completely destroy the effect of the inertia of the water. The general effect of this arrangement is to relieve, to a greater or less extent, the greater pressures, positive or negative, at each end of the stroke arising from the inertia of the water. Furthermore, it may be noticed that a somewhat different device from that just mentioned might be employed, whose resultant action would nevertheless be of the same nature. For example, instead of enlarging the by-pass, let two equal air chambers be placed on it, near each end of the cylinder. This is, in fact, the manner in which relief is actually obtained in pumping machinery, from the shock and greatly increased pressure at the beginning and end of the stroke, arising from the inertia of the water. Mathematically, the effect is the same as that of the diaphragm previously described.

The operation of the diaphragm and air chambers just considered is strictly analogous to that of capacity in an alternating-current circuit, the diaphragm to capacity in series, and the two air chambers to capacity in shunt, and by these self-induction may be neutralized to a greater or less extent, according to their relative amounts.

We have thus far considered merely the peculiarities of the transmitting or connecting pipes in their relation to the double-acting force pump regarded as the source of energy. We need next to consider a receiving pump which shall take and utilize the energy not expended in fluid friction. Let the receiving pump be assumed at first to be exactly like the force pump, and to actuate a crank, flywheel and other machinery on which energy is expended uniformly. The crank end of this second cylinder is connected directly by a pipe with the crank end of the force pump, and the other end likewise. In this case the energy expended in fluid friction and inertia may be neglected, in comparison with the energy transmitted. This arrangement will transmit power from the driving crank to the driven crank, much as would a belt or train of cog wheels. But suppose now that the second cylinder is connected to the first by very long pipes, miles long, for example, in which the inertia of the water becomes a controlling factor of the transmission. It would evidently become practically impossible to make the water oscillate with any rapidity in such a closed pipe under ordinary circumstances. But let there be a series of air chambers uniformly distributed along the entire length of the connecting pipes, or, what would amount to nearly the same thing, let the pipe be an elastic hose requiring equal pressures to enlarge or diminish its cross-section.

This will at once entirely change the circumstances of the case, for the air chambers near the force pump will readily receive the water as it flows from the force pump and transmit it to those next along the line, and so on, so that a wave of pressure will pass along the pipe and at the same velocity a wave of current will pass, having its maximum flow at points where certain high-pressure air chambers are discharging into those next along the line. By these progressive pressure and current waves, energy will be transmitted to the working cylinder, which need not in this case be of the same cubic capacity as the force pump. Several complete waves may be in progress of transmission along the pipe at once. The frequency of oscillation in the working cylinder will be equal to that of the force pump to an amount which may be completed in any given case. But it will lag in phase behind that of the force pump to an amount due to the number of waves and fractions thereof in progress of transmission along the line, and to all the inertia of the working piston, etc.

It is evident that when the two cylinders are equal in every respect, except that the piston of the second cylinder is of such large mass that its inertia is great, and when, in addition, we may disregard fluid friction, and the flywheel of the second cylinder is running idle, that no work is expended in the system. In this case the second piston will originate transmission waves, precisely as does the first, but in opposite direction. The resultant of these equal and opposite progressive waves will be a system of stationary waves along the line. Whenever the amount of energy used at the working cylinder is small compared with the total energy, kinetic and potential, at and near the receiving apparatus, the waves originating there will approach the magnitude of those received by it. Any discontinuity of mass in the current-flowing pipe, as, for example, mercury in place of water, for some of the length of the bent pipe, will originate reflected or return waves. To insure good transmission, little or no discontinuity in the distribution of the inertia along the pipe should occur at any point of such as would be due to changes of size or otherwise.

All these results are equally true of alternating-current circuits. It may be shown from elementary considerations that the progressive velocity of the waves in the transmission pipe under consideration is constant for all frequencies of oscillation in cases of a pipe in which the friction may be disregarded, but that the velocity increases as the square root of the frequency in any case where the inertia of the current may be disregarded. The case of the unequal velocity of the waves propagating the harmonic components of sounds in telephone transmission by reason of their difference of pitch, which is one cause of the distortion of sound in long-distance telephone transmission, has been treated at length in the researches of Dr. Pupin, who has investigated very fully the inductive (or inertia) loading necessary in order to render lines practically distortionless. It is equally a hydrodynamic phenomenon. The one question remaining for elucidation is that of the attenuation or gradual diminution of amplitude of waves as they progress along the line.

It may be readily shown that in both of the two extreme cases already considered, viz., those in which either friction or inertia is disregarded, that the logarithm of the reciprocal of the amplitude, or intensity of the wave at any point, varies directly as the product of the distance of the point from the source of the wave by its velocity. Since this velocity has already been shown to be constant in case the fluid friction may be disregarded and to increase with frequency in case inertia is disregarded, it is evident that attenuation depends upon frequency in case of fluid friction without inertia, but is independent of frequency in case of inertia without fluid friction. Such unequal attenuation in the telephone obliterates to a greater or less extent tones of high pitch before it does those of lower pitch. It is therefore necessary to distinct transmission that the self-induction of the line should be large enough to store a large amount of kinetic and potential energy in the wave motion along the line, which in all its aspects, is strictly analogous to the wave motion propagated in the water in the apparatus just described.

1. Paper presented before the Mechanical Science section of the American Association for the Advancement of Science, at Pittsburg, June 25 to July 2, 1902. Professor Eddy is connected with the University of Minnesota.

D. & W. 250-volt Plug Fuse.

The D. & W. Fuse Company has recently placed upon the market an improved form of 250-volt plug fuse to fit the standard Edison cut-out. It is asserted that this company was the first to produce a plug fuse which would operate satisfactorily on 250 volts and which passed the requirements of the National Board of Fire Underwriters. A large number of these fuses were sold, but the new plug which the company is now turning out, is considered a decided improvement by all who have examined it. The accompanying illustrations show the plug assembled and its several parts, consisting of the casing, porcelain cap and the small cartridge which contains the fuse proper. All that is necessary to recharge one of these is to remove the burnt-out cartridge and insert a new one, an operation which is said to require not more than two minutes at the most. This company supplies cartridges which are all interchangeable, in capacities from three to 30 amperes. This little device was recently subjected to most severe trial, being directly short-circuited across a 250-volt circuit within 10 feet of the switchboard of a very large central station, having a capacity of between 4,000 and 5,000 kilowatts on the buses. It repeatedly operated with absolute freedom from flash, noise, or discharge of any kind, and later was short-circuited directly across a 440-volt circuit under the same conditions, where it operated with perfect success, the only difference being that there was a slight noise at the instant of rupture of the fuse.

D. & W. 250-VOLT PLUG FUSE

DEVELOPMENT OF THE TELEPHONE FIELD.

Michigan Telephone Company Defaults Interest on Bonds.

The Michigan Telephone Company (Bell) has defaulted the six months' interest due July 1st, on its five per cent. consolidated mortgage gold bonds running 30 years and amounting to $5,000,000. It is possible that proceedings will be begun to foreclose the mortgages which secure these bonds, after the 90 days has expired which is necessary to permit the default to become operative. The first-mortgage bonds amount to only $285,000. These, being first lien, will probably be fully protected in the event of a sale, and after this claim has been satisfied, the consolidated mortgage bonds, amounting to $4,715,000, will have preference.

H. W. Poor & Co. of Boston, one of the firms which placed the bonds, has issued a circular to the bondholders, from which the following extracts are taken:

"At the time of its acquisition by the Western Telephone and Telegraph Company [January, 1902] the Michigan company was confronted by exceedingly low revenue returns, due to severe competition. A large amount of money had been expended during 1900 and 1901 in new construction, resulting in the creation of a correspondingly large floating debt, so that the beginning of 1902 found the company with large physical resources, but with low rates for service and a heavy interest charge. In January, 1902, rentals were raised throughout the state, and earnings have increased during the first four months of the current year. The present management claims, however, that net earnings are still insufficient to meet the July coupons on Michigan consolidated mortgage bonds and that default is necessary.

"A committee, acting in the interest of the bondholders, consisting of members of the firms of N. W. Harris & Co., Blodgett, Merritt & Co. and H. W. Poor & Co., has had expert opinion as to existing conditions and future requirements and prospects in the Michigan territory, and believes that with prudent management and the maintenance of equitable rates for service the company should be able in the near future to meet its obligations permanently. This conclusion has been reached by careful deductions from official figures of earnings for the first four months of the current year furnished us by the American Telephone and Telegraph Company:

1902.	January.	February.	March.	April.
Gross revenue	$120,943	$117,203	$126,559	$129,611
Operating expense, including rentals and royalty	103,534	105,191	107,161	103,720
Net earnings	$ 17,409	$ 12,012	$ 19,398	$ 25,891

"Many interviews have been held with officials of the latter company, and several plans proposed seeking a solution of the difficulty without the necessity of default. Among the propositions made was one to purchase the Western Telephone and Telegraph Company holdings of Michigan stock and notes, pay the Michigan company July coupons and provide cash for necessary extensions to the plant. This was rejected.

"The mortgage securing your bonds provides for the sale of the property under foreclosure proceedings after default for 90 days in payment of interest. During this period we believe that either a satisfactory adjustment can be made with the American Telephone and Telegraph Company, or in the event that the Michigan property has to be sold in accordance with the terms of the mortgage, we feel that a satisfactory price can then be realized.

"The mortgage covers all present and future acquired property. The $2,200,000 floating debt was incurred for new construction subsequent to the consolidated mortgage bond issue and is subject to the lien thereof. The property is in good physical condition and its construction value is believed to be largely in excess of the bonded debt. Gross earnings are increasing, and economies properly inaugurated should materially add to the net revenue in the immediate future.

"We therefore advise you not to sacrifice your bonds, but to deposit them for your protection under a bondholders' agreement, a copy of which you can obtain by application to us."

A committee headed by N. W. Harris & Co. requests holders of these bonds to deposit them with the Old Colony Trust Company of Boston on or before July 21st, with the view of combining for the protection of all concerned. This committee, however, is hopeful that the company will in the near future be able to meet its obligations.

A Detroit stockholder says that during the last year the company has earned $220,000 less than enough to pay fixed charges and operating expenses. Of course, the cost of running the various plants must be paid first. It is possible that some plan of reorganization may be decided upon by which about 75 per cent. of the $5,000,000 in stock and 25 per cent. of the $5,000,000 in bonds would be cut out. Should such a "squeeze" be carried through the company might be placed on a solid basis.

Southern Telephone Developments.

The Bell Telephone Company has about completed all underground cables at Richmond, Va., and it is expected that the Grace Street exchange will be ready about August 1st. When all work is completed the city will have one of the best telephone systems in the country.

The Winchester (Va.) Telephone Company, covering five counties, has sold out to the United Telephone Company of Philadelphia. The local company was recently absorbed by a Hanover (Pa.) syndicate, which has now sold out to the United company. Extensive improvements in the way of long-distance connections will be made.

L. W. Floyd, Newberry, S. C., has bought the Home Telephone Company of Greenville for $10,200. The plant was sold to satisfy a $30,000 mortgage.

The Central Telephone Company of Ballinger, Texas, has filed an amendment to its charter with the secretary of state, increasing its capital stock from $50,000 to $75,000.

L. W. Floyd of Newberry, S. C., by recent purchase now owns telephone exchanges in 15 towns and cities of that state, including Newberry, Spartanburg, Greenville, Piedmont and Williamston. Mr. Floyd intends soon to connect all these towns together and with Columbia.

The Bell Telephone Company will lease a handsome new building at Wilmington, N. C., as an exchange. About $50,000 will be spent in rebuilding the local exchange and in other improvements. Long-distance connections are under construction.

The following-named telephone companies (previously mentioned) have been chartered in South Carolina: Blacksburg Telephone Company, $3,000; Bedford Telephone Company of Yorkville, $5,000; Lancaster Telephone Company, $5,000. W. B. Moore is interested in each of the above-named systems. L.

Telephone News from the Northwest.

The Lewis and Western Telephone Company of Lewis, Iowa, has elected S. H. Albright president and Charles Dolan secretary.

The Interior Telephone Company of Montezuma, Iowa, has increased its capital stock to $70,000.

The City Board of Equalization of Lincoln, Neb., has raised the valuation of the Nebraska Telephone Company's property to $153,000.

The New State Telephone and Telegraph Company has transferred its lines in Monona and Woodbury Counties, Iowa, to the Maple Valley Telephone Company.

Charles Bucher has sold the telephone system at Moulton, Iowa, to W. C. Stickney.

A franchise has been granted for an Independent telephone line at Fremont, Neb.

The People's Telephone Company of Madrid, Iowa, has elected T. R. Dresser president and F. A. Anderson secretary and general manager. The capital stock may be increased from $10,000 to $25,000.

A deed of trust securing an issue of $25,000 in bonds has been executed by the Minnesota Mutual Telephone Company of Minneapolis. The trustee is the Minnesota Loan and Trust Company.

The Consolidated Telephone and Telegraph Company is endeavoring to secure a franchise to build a line into Stillwater, Minn.

The new telephone company of Davenport, Iowa, will put in an extended conduit system.

The City Council of Omaha, Neb., will serve an injunction against the South Omaha Independent Telephone Company, which is doing business without having first procured a franchise. R.

Indiana Telephone Items.

The Pierceton Telephone Company was incorporated on July 1st. The capital stock authorized is $20,000. The company purposes to establish and operate telephone exchanges in Kosciusko, Whitley, Noble and Wabash Counties. The incorporators are J. T. Brosnahan, D. W. Straus and Harry Humrichoser. The Brick Chapel Telephone Company was incorporated on July 2d to establish and operate a telephone system in Putnam County. The Whiteland Telephone Company of Whiteland, Johnson County, increased its capital stock to the amount of $10,000, and the Eastern Indiana Telephone Company of Winchester increased its capital from $5,000 to $15,000 on the 1st inst.

The New Long-distance Telephone Company of Indianapolis made great headway last week. G. H. Hendren and J. F. Slinkard of Bloomfield, D. A. Yoder of Vincennes, J. H. Klinger and M. J. Murphey of Brazil, Guy Bush of Clay City and C. P. East of Worthington held a conference with President Sheerin Saturday, resulting in the signing of a contract by which an additional large territory is connected with the New Telephone Company's system. Most of these Independent lines will connect with the New company's Indianapolis line at Spencer. F.

The Eureka (Texas) Telephone Company has been incorporated with $4,000 capital stock by J. A. Bonner and others.

The Des Moines Telephone Strike.

As a result of the strike of the telephone operators at Des Moines, Iowa, the Des Moines Mutual Telephone Company, an Independent mutual concern having nearly 2,000 subscribers, has been sold to a group of well-known Independent telephone men, including George N. Bandy of Perry, E. H. Martin of Webster City, and Brenton Brothers of Dallas Center, Iowa. Heretofore each subscriber was a stockholder, the company having been organized to compete with the Bell system. The new management has issued an ultimatum to the strikers, and the latter announce that the fight will be waged with greater determination than before. The labor unions say they will tie up business in general unless the union girls are recognized.

Originally the contest was over wages. The girls received an average of 80 cents a day. They demanded $1. The Mutual and Bell companies after a few days offered to pay the scale demanded, but declined to recognize the girls' union. Meanwhile the companies have secured the services of operators from various exchanges in the state, and assure subscribers the service will soon be restored to its former excellence.

GENERAL TELEPHONE NEWS.

The South Berkshire (Mass.) Independent Telephone and Telegraph Company, with a capital of $20,000, has been incorporated. R. C. Taft is president, and C. E. Fuller is treasurer.

A large construction gang of the American Telephone and Telegraph Company is at work installing five metallic circuits between Detroit and Chicago for through business. At present all through telephone communication between Chicago and the East goes via Maumee, Ohio, and very often this delays connections, especially in the busy hours of the day.

A dispatch from Frankfort-on-Main states that the German government has decided to dispatch an official commission to investigate the postal, telegraph and telephone methods and devices of the United States. The commission consists of Postal Advisers Wernicke of Leipsic and Braun of Hamburg and Telegraph Engineer Feyerabend of Berlin. Emperor William is said to have expressed his determination to copy America in every particular that promises advancement for Germany.

J. T. Reynolds of Myrtle, Miss., is building a telephone toll line from New Albany, Miss., to Holly Springs, Miss., a distance of 30 miles. Pay stations will be established at New Albany, Myrtle, Hickory Flat, Potts Camp, Waits Siding and Holly Springs, Miss. This is an Independent system and Mr. Reynolds expects to extend it on to Memphis, at which place it will connect with the new Memphis telephone exchange. The line connects with the Alabama, Mississippi and Tennessee Telephone Company at New Albany, Miss.

TELEPHONE MEN.

Frederick L. Martin, the popular and enterprising advertising manager of the Kellogg Switchboard and Supply Company of Chicago, was married on June 17th to Miss Lillian May Kane, daughter of Captain John W. Kane of Bluehill, Maine.

Albert C. White, general manager of the Providence (R. I.) Telephone Company (Bell), died in Providence on June 27th, after a short illness. He was 61 years old and was prominent in secret societies and in politics. He was at one time manager of the Western Union telegraph office at Newport, R. I.

Professor Alexander Graham Bell of Washington, D. C., the well-known telephone inventor, passed through Chicago last week on his way to Minneapolis to attend the convention of the National Educational Society. He is president of the special education department which deals with the instruction of children having defective hearing, sight or mentality. Professor Bell intends to devote the remainder of his life to such special education. He has just been awarded the 1902 Prince Albert medal by the London Society of Fine Arts.

MANUFACTURERS AND DEALERS.

It is reported that the Stromberg-Carlson Telephone Manufacturing Company of Chicago has asked for a special election to grant it a franchise to install a modern telephone system at Sioux City, Iowa.

The De Veau Telephone Manufacturing Company of New York city has been incorporated with a capital stock of $50,000, with A. S. De Veau and William Hoffman of New York and Charles Auth of Brooklyn as directors.

The Kellogg Switchboard and Supply Company of Chicago has just received a contract calling for an additional 1,080-line equipment for the Los Angeles (Independent) exchange. This will bring the present equipment up to 7,080 lines to start with.

Use of the Telephone in Operating Railroad Trains.

PART II.

A. R. Swift, Chicago, Rock Island and Pacific, Chicago: I would like to have Mr. Annett explain what the necessity was for this large expenditure of money; for instance, the line from Chicago to Dubuque. As I understand, they have nothing except ordinary stations, and what was the purpose, not particularly the running of trains by telephone, but any purpose, that the telegraph will not serve now?

Mr. Annett: That is a part that our department did not enter into. They found the necessity. You have probably had that experience that your telegraph wires were heavily loaded with business; there is a class of business, to illustrate, between Chicago and Kankakee; there is a trainmaster at Kankakee, and superintendent of the Chicago division at Chicago; there are matters that but for the telephone it would be necessary to call the trainmaster in to Chicago.

Mr. Swift: Could not that be done by the telegraph?

Mr. Annett: It would not be as satisfactory. There is an exchange of ideas required. The superintendent may want to instruct the trainmaster during the excursion season to ride a certain train going out of there.

Mr. Swift: The reason I asked was because it is unusual for a railroad company to be so liberal in any one department, when it has something that will answer the purpose.

Mr. Annett: It seems to me that so far as Dubuque is concerned, it is not an ordinary station; it is a competitive point. We have an assistant general passenger agent there, and there are matters of excursions that will come up, in order to agree upon which that assistant general passenger agent wants to come in touch with the general passenger agent. You can get communication ordinarily in less than a minute; and he can place certain matters before him and have a decision reached, when perhaps at that very time the telegraph wires might be grounded. We had a case a few days ago when we had trouble this side of Dubuque, and everything was cut out but the telephone, and all the business at the time had to be handled over it.

H. C. Hope, Chicago, St. Paul, Minneapolis and Omaha. St. Paul: I would like to ask if those wires are kept very busy?

Mr. Annett: At this present time they are only in short lengths, not through, as I stated, from Chicago to Dubuque; and they are kept very busy between the superintendent's and trainmaster's offices; also, between Fulton, Ky., and Memphis, Tenn.

H. T. Simpson, Chesapeake and Ohio, Richmond, Va.: Have you figured out any limit to the number of offices that you are going to put on a line?

Mr. Annett: Well, take 308 miles, Chicago to Carbondale: The first station south of here is Kankakee, 56 miles; the next will be Champaign, and then Mattoon, Centralia, Carbondale; there are only five offices there so far provided for on that one circuit. Then there is a branch exchange at Carbondale, which will be in operation in a very few days. And from there to Memphis the first station south of that is Mounds Yard, north of Cairo. The next are Fulton, Napoleon, Covington, Tenn.; then Memphis. Of course, all the different points in Memphis are reached through the branch exchange over that line.

Every lineman is furnished with test sets, the same as a telephone lineman, and he makes tests; and we utilize the telegraph a good deal to get the linemen out to remove the trouble; but we have not had any cases of bad trouble.

Mr. Foley: It just occurred to me when Mr. Swift made inquiry in regard to the financial end of the construction of long-distance lines over railroads, that he was looking to earn something on the expenditure. Down our way we have spent about $60,000 on our line, and we are getting back about five per cent. of that from pay stations. I do not know whether western roads operate pay stations or not; but that is a large revenue to us. Our lines are about 250 miles long, and are working very satisfactorily. I do not know but we have had some trouble, as Mr. Annett and all other railroads have.

Mr. Pardington, New York and New Jersey Telephone Company: One question I would like to ask of both Mr. Annett and Mr. Foley: How much use have their respective companies made of the long-distance telephone service prior to their taking up the extension of this line; whether there had been a demand, and how active a one prior to this time?

Mr. Foley: We have used the long-distance telephone for the last five years in connection with the private-branch exchanges at various points. We would get as far as we could over our line, then use the long-distance. Now we are building a long-distance line over our own road the entire distance to obviate paying long-distance tolls, which we found very expensive; but we are able to reach every point on our line from every other point by telephone; have been doing so for the last five years. We were not able to go into the long-distance business till we made this recent contract with the Bell company, that allows us to go from the territory of one company into the territory of another. I believe they do not generally allow that unless you have an exclusive contract. We find that our traffic department saves a good deal of money by the use of the telephone; but it is a question whether if all our competitors have the same service, whether we will benefit by it or not. There is no doubt but that the railroad companies have got to use the telephone; and I think that they are finally going to operate the roads by telephone; that is our intention. We intend to run trains by telephone when we get everything in good shape. I believe that is the ultimate aim. I do not know whether that is the ultimate aim of the Illinois Central, or not. It looks to me as if the roads will have to do something of the sort in order to protect themselves against men that understand their particular branch of the business that nobody else can handle without them.

H. V. Miller: This subject, it seems to me, has taken a very roseate hue. The Alton has had 126 miles of copper metallic circuit in use for about two years. We were very much pleased with it at the start, and our officers were highly commendatory as to its operation. Now, take into consideration that you are operating a telephone with two wires, whereas only one gives you communication with the telegraph circuit. If one of the telephone wires goes down, both are useless until the trouble is rectified. You cannot even patch a wire in order to restore communication, because you will make a very noisy line. Any boy throwing a stone at your insulators, at your transpositions, will cross your line. It works very nicely when it works; but there are a great many times when it does not work, and you cannot keep it up at all. We have one of the best lines in the United States. I believe the telegraph company says we have the very best one; very heavy poles; strong arms; well pinned; the telephone line is in the midst of all the wires; yet we are constantly troubled, constantly interrupted by telephone troubles; and when the trouble comes on a wire, then you are out of the telephone business; you cannot use it in any way at all, cannot restore telephonic communication until that trouble is found and remedied. I rather think that the question of railroad telephony is yet in its infancy, and must be greatly improved to be of any practical use along a railroad line.

Our line started off very well, but we have run into just those troubles, loose connections, broken insulators, wires broken or fallen down, etc. We have had cases where the wires crossed and neither end touched the ground. We cut it out for a distance possibly of 30 or 40 miles between test stations, and the inductive influence we would get on that would unbalance the line, and then you have a noisy line. Now that is our experience. I think our friends will run into the same things exactly. I am not so enthusiastic over long-distance telephony as I was a year ago.

Mr. Annett: I want to answer the gentleman as to the time the line has been in use. In Memphis we have an arrangement with the Cumberland Telephone and Telegraph Company whereby it locates troubles for us with a galvanometer right close up.

Mr. Miller: We do the same thing; and our wire men have located a cross-connection in the telephone line exactly at the pole. We can measure it out to a fraction of an ohm; but a great many times that cannot be done on any test, because the slack resistance in that cross will throw you clear off. When a line falls on the ground your test becomes very unreliable. If it is wet weather it will appear very close to you, and if dry, a long ways off, according to the test. We make all those tests in every conceivable way it can be done by any testing instrument. We do not do it ourselves; we have all the instruments, but our instrument has not been as satisfactory as we expected, although we use it a great deal.

Mr. Annett: That case you mentioned of a broken insulator is only one chance in 15. We have had one case of trouble of that kind with the transposition insulators.

Mr. Miller: We have had a great many.

Mr. Annett: We expect to get over that difficulty about the line being interrupted. Mr. Ferguson informed me yesterday that they have a scheme whereby you can use a single wire, a telegraph wire and two wires. We expect to do that on telegraph wires. In an emergency, when the regular copper-metallic circuit is in trouble, we expect to overcome all those difficulties by utilizing telegraph circuits. I am thoroughly satisfied we are going to do that. We talked with Fulton, 406 miles, and got the conversation first rate on two telegraph wires. But we want a perfect working telephone system in operation first; and after that we will develop the other. Probably the next question that will come up will be that of trunk lines, to jump over a section.

Mr. Miller: You will come up then to the two-wire railroad system. Now you must understand that we are so continually accustomed to having lots of wires that we never lose our telegraphic communication. There is not once in a year, perhaps a good many years, that we lose our telegraphic communication for any length of time; but if you have but one telephone circuit, you will lose that every time there is a storm; if it goes down you have lost all telephonic communication. That is the argument I make, that we are back to the one-wire system of running railroads. We cannot use telegraph wires for telephoning; there is no successful system yet.

Mr. Annett: We have been using our telegraph wires for the last three months, 56 miles. There is some noise, but the operators have got accustomed to it, and do not mind it.

Mr. Bidwell: I have been corresponding with a firm in Berlin, Germany, who are making what they call loud-talking telephones, first devised for use on warships, whereby they can talk when the guns are being used in practice, in which case with an ordinary telephone you could hear nothing. My idea is that we should use them on our car telephone, and possibly this gentleman will use them on telegraph wires for talking, to overcome that noise that was spoken of.

Mr. Selden: I beg leave to say in that connection that an English company has a loud-talking telephone; I have one at Baltimore which does identically the same thing; you do not even have to have call bells in a room of this size; you can hear the conversation through them from one end of the room to the other. It is due to the peculiar form of receiver employed partly, but largely to the transmitter that they use, which has a solid back peculiarly constructed. I have worked with them very successfully. The receiver, I might say, in this instance, is owned by the Bell Telephone Company.

President Jacoby: I cannot allow this opportunity to pass without offering a word of testimony as to long-distance telephony. We have had quite a complete discussion of this matter, and some very important points brought out, pertinent points, especially by Mr. Miller. We are always liable to have trouble on wires, and what we want is as far as possible to anticipate these so as to provide against them wherever practicable in construction. Some of you may remember that at our Wilmington meeting, three years ago, I stated that the company I represented was planning a long-distance telephone, and that we were about erecting a line between South Bethlehem and New York, or the Jersey City side of the river, a distance of about 90 miles. I said we proposed to use that not exactly as a telephone line, but a second telegraph line composed of copper; and in constructing it we proposed to anticipate telephony and transpose the wires while we were at it, at a little additional cost; then we would have a telephone wire. We did that. We have been working that two years as a composite circuit; and, as far as troubles go, they have been readily removed. Now, we may be differently situated from railroads in general, but we have stations about every five miles. We have telegraph offices not any further apart than every 10 miles; and we put our wires into these stations, suitable switches being provided. We have a means of testing by which troubles are quickly located; our maximum time is about two hours for locating a trouble.

This telephone line of 90 miles we have had in use for almost two years, and it has given us excellent results in service; the service has been so good that we have been warranted in going ahead with our long-distance line, and have extended our lines over 100 miles farther; and with the possibility of building all the way through over our whole system from New York to Buffalo; furthermore, we have had for some little time worked very successfully a line between New York and Wilkesbarre, about 187 miles.

We are using two wires that were originally constructed as telegraph lines, and on those two wires we constructed a telephone circuit and use it as such—have so used it for the last two years, as stated. Now, then, the long line that we have just built of 187 miles is additional over that particular territory of 87 miles; so that we have there two telephone lines. We have suitable switching arrangements between various stations, so that we can supplement one by the other; they are perfectly interchangeable. We have our men posted, and that can be done in a moment's time; so that if one line gives out we use the other. If but one wire of the two is in trouble we use the remaining telegraph wire for a telegraph circuit. We only use one telegraph circuit for operation; so what we want to do is to anticipate conditions and build accordingly. After awhile we can have all our telegraph wires erected by that method as well as by the present method, and then we will have enough telephone wires to replace any that might get in trouble. If we use four of those for telegraph and one for telephone, and if that particular telephone line gets in trouble, we simply put one of the others in its place, having suitable switching arrangements at the stations. That can be done readily, and I think we can have our service continuous.

That is a very pertinent point which Mr. Miller made, that our general managers will bring us to account if we have defective service, even if it is interrupted for five minutes for one day out of 30; and the chances are that if the interruption comes at a critical time they will complain that the line is always in trouble. We have all had that sort of an experience, and we must be prepared to meet that. It is a somewhat new condition that we have in telephony; and it seems to me that what we should do is to build along these lines, and we will make no mistake.

Mr. Greene, Northern Pacific railroad: In our work on the Northern Pacific railroad we found it necessary to get up some device for using telegraph and telephone instruments on the same wires, which may be of interest. I did not bring with me one of the devices mentioned, but can explain it to you so that you will all understand its construction.

We use a copper-metallic circuit for telephone lines, which is strung midway from the present line. I took a couple of antediluvian relays, long coil, and had them wound up with an equal number of convolutions on each coil, something over 14,000 convolutions, to get an equal magnetic effect, and we found that the ohmic resistance was quite different in the two coils; so we made some coils of german-silver wire, not inductive, wound them back, and just attached those in series, one with each of those coils, so as to equalize the ohmic resistance through the two, so as to get the same quantity of battery through each arm of the telephone circuit. We did that very accurately. Then from the middle of the windings of the electromagnetic coils we ran off a wire to the battery and ground through the instruments. We could put those on at any point that we chose. We have not gone into it so far as to put any intermediate offices yet on the telegraphic circuit, though we did on the telephonic; but I think they will work alright; theoretically, they are alright. Those coils are wound so as to avoid lightning effects. The coils act as choke coils, or regulating coils, for the telephonic circuit, and the ohmic resistance being higher than the resistance of the bell, 1,600-ohm ringer, none of the telephonic current apparently goes through. At least, the talking circuit is perfect, and the telegraphic current going through the two seems to wipe out any effect from the telegraphic circuit on the talking circuit.

We started in to use a small condenser on the key, but have taken it off, and we barely hear a slight click. I have advised using condensers to remove that click. The line is perfectly silent, so far as any telegraphic disturbance is concerned. This device was gotten up by Mr. Gaunt and myself, because we knew of nothing of the kind that was accessible to use. It was experimental from the start, but we found it went off perfectly. The coils are wound in such a manner that they soften the impulses of the telegrapher's current; but, at the same time, they put in the circuit very little resistance, as the circuit is divided—the current is divided—between the two, and the total ohmic resistance in each coil is about 750 ohms only. I think that if those were wound still lower that they would work perfectly. That was experimental, and just to try it; I am having some wound now, and I think I shall have some wound with lower resistance.

Secretary P. W. Drew, Wisconsin Central, Milwaukee: How long is that line?

Mr. Greene: One wire working now is only 44 miles long; but it is on telegraph poles with some three or four quadruplex circuits, and the only disturbance we get is from the high-tension, 30,000-volt power circuits of a power company, which are some 15 or 20 feet away from us for about six miles. They bought right-of-way alongside of us, so we cannot get away from them without moving outside of our right-of-way; so we have to put up with the little bit of buzz that we get from them. It affects the quadruplex more than it does the telephone. We are now about to put these devices on a line from St. Paul to Duluth, 152 miles, and also from Missoula to Helena, 126 miles. The gauge of the wires we are using is No. 11, American gauge. They are transposed every tenth pole, except along this power line; there we thought we could remove more of the inductive influence we got from them by transposing oftener, and we divided that every fifth pole; that did help it. They think it a fine telephone circuit; they use it continually. It connects some important offices.

President Jacoby: I understand that this was a specially constructed telephone circuit composed of two copper wires properly transposed, and then utilized for telegraph circuit in addition?

Mr. Greene: Yes, sir. We have in view an arrangement for putting in intermediate telegraph instruments. In that case I think I would make the batteries all of one polarity, and use a biased polar relay, and have the batteries at each point, and key when closed that would be to ground, not through battery—an open-circuit arrangement. That, I think, is perfectly feasible, and I intend using it when we have occasion to cut in between the terminals.

We have two arrangements in view for intermediate offices; one, to split the cores of the relay magnet and let half of the current go through each, and bridging around the entire telegraphic side; but the other arrangement, I think, will be simpler and easier, simply connecting on the telephone and telegraphic apparatus, and going to the ground. That high resistance in the coils appears to present a complete barrier to the passage of the telephonic current either to the ground or through the coils at all.

Secretary Drew: Are your telephones inside of your telegraph instruments as relates to the ends of the lines?

Mr Greene: Yes, they are all bridged across. The magnetic inductance coils are so wound that they do not present to the telephonic current that magnetic resistance that they do to the telegraphic, which softens the telegraphic impulses so that they go onto the line with the same as with any ordinary choke coil, but they do not present the same effect to the telephonic circuit; the high resistance keeps all the telephonic current on the two wires across the shunts of the coils. The resistance to the telephonic circuit is about twice as high as it is through the bells; but I think that can be reduced, as I said.

[*To be continued.*]

CORRESPONDENCE.

New York Notes.

New York, July 5.—A bold and original plan for eliminating the congestion at the Brooklyn bridge terminal was submitted to the Rapid Transit Commission on July 1st by Chief Engineer William Barclay Parsons. Briefly this is the plan: Depress the elevated and trolley tracks beginning on the bridge at Rose Street, run them underground at the terminal, send the trains from the elevated tracks north underground to the Williamsburg bridge, send the trolley cars south underground to the foot of Maiden Lane and thence by tunnel back to Brooklyn, tear down the present terminal structures, and build on city property over this end of the bridge the proposed new municipal building with an enormous ornamental archway through its first story by which foot traffic and wagon traffic will reach the bridge. Mr. Parsons computes the cost of the underground construction between the two bridges at $2,750,000. The plan met with the unanimous approval of the commission, and has been endorsed by Mayor Low, Bridge Commissioner Lindenthal, President Jacob A. Cantor of the Borough of Manhattan and others. Mr. Parsons' plan is regarded as fully practical and expedient and has the merit of keeping the streets free and clear of elevated structures. The proposed station will be contiguous to the rapid-transit subway and on a level with it.

The Rapid Transit Commission has approved the franchise sought by the New York and New Jersey Railroad Company to build a tunnel under the North River, with a terminal in this city. The company proposes to construct and operate a road for the transportation of passengers and property with two tracks between New Jersey and New York. The tunnel under the Hudson River will stretch from Morton Street, running easterly under the river, dock, and bulkhead property to West Street, at a point nearly opposite or at the foot of Morton Street. Under that street to Greenwich Street, and thence northerly to a terminal in the westerly half of the block bounded by Christopher, West Tenth, Greenwich and Hudson Streets. The property necessary for the terminal is to be purchased at the expense of the company, which has agreed to begin construction within three months after obtaining the necessary consents and to have the railroad in working order within three years. The road will be operated by electricity. The agreement is said to be as advantageous to the city as that with the Pennsylvania Railroad Company. It is estimated that the receipts to the city for the franchise will be about $300,000 a year for the next 25 years.

The New York Central and Hudson River Railroad Company has awarded a contract to the Hall Signal Company for the equipment of its Putnam Division from One-hundred-and-fifty-fifth Street to Yonkers, with the Hall system of automatic electro-gas block signals, to be operated on the normal danger plan. This application of signals is said to represent the latest system of railroad protection in the automatic block-signaling art. The semaphore arms are held by gravity to a horizontal position to indicate to the engineer danger ahead, or are drawn down to indicate safety, by carbonic acid-gas pressure in a cylinder in each signal post. The gas is stored in liquid form in a tank underground beside the post. The valve controlling the flow of gas from the tank to the cylinder is closed or released by an electric current passing through the rails, and this is done automatically by the presence, or otherwise, of a train in the block ahead, and the approach of a train from behind.

During a thunderstorm which passed over Jersey City to-day the tracks of the North Jersey Street Railway Company's line were struck by lightning and the rails were torn up for a distance of about 25 feet, disabling the Newark line for a short time.

A peculiar death by electric shock is reported as occurring at Croton, N. Y. Mrs. J. D. Anderson was walking through her husband's store, carrying a pan of cherries, when she stopped and raised her hand to turn on an electric lamp, and to steady herself is supposed to have rested the pan against an iron railing about the counter. The light current was accidentally grounded and the accident resulted.

It is stated that the salaries of many of the employes of the Western Union Telegraph Company in this city have been materially increased. When Colonel Clowry was made president of the company and other western men were put in control of the executive positions, many positions which had grown to be sinecures were abolished. Vague talk of a prospective strike among the operators and the strengthening of their secret organization started at this idea, but nothing definite resulted. It has now been learned that in New York city alone more than 200 men have been given an increase of salary since May 1st last. In several cases old employes have been relieved from work on a life pension.

M. L. G.

Southern Developments.

Charlotte, N. C., July 5.—The dynamo and part of the fixtures of the town lighting plant at Big Stone Gap, Va., have been destroyed by lightning; loss, $2,500. The plant was only recently purchased by E. J. Patterson.

W. T. Goffe, who has successfully promoted the organization of the Knoxville-Seviersville, Tenn., electric railway, has sold out his interest to J. B. Clothier of Philadelphia.

The governor of Mississippi has approved an amendment to the charter of the Meridian Light and Railway Company, increasing its capital stock to $450,000.

Three companies are seeking electric-railway franchises at Donaldsonville, La. Dr. Armond Mary is one of the promoters. The matter will likely come before the Town Council on July 16th.

The Nashville (Tenn.) and Gallatin and the Nashville and Columbus electric-railway measures have passed the City Council of Nashville.

L.

New England News.

Boston, July 5.—H. Parsons of New York, who bought the plant, equity and assets of the Eddy Electric Manufacturing Company of Windsor, Conn., is connected with the law department of the General Electric Company, and it is believed that the property was purchased in the interest of that company. Mr. Parsons says that the business will be continued and that the plant will probably be enlarged.

The Engineering Company of America, organized at Trenton, N. J., with an authorized capital of $5,000,000, will continue the business of the Cunningham Engineering Company of Boston, but its charter will allow it also to manufacture heavy steam vehicles for commercial purposes, develop transportation companies in cities, and construct apparatus for electric cars. Marshall D. Barr of the Stanley Electric Manufacturing Company is a director in the new company.

Hon. George G. Crocker and Hon. Horace G. Allen have been reappointed as the state's representatives on the Boston Transit Commission. The life of the commission expired July 1st, but the new Boston subway bill extends it until July 1, 1904, if the bill is not accepted by the people of Boston, and until July 1, 1906, if the people accept the bill at the next municipal election. Mr. Crocker is chairman of the commission. Charles H. Dalton, Thomas J. Gargan and George F. Swain have been named by the Mayor to succeed themselves as commissioners for the city of Boston.

The Washington Street subway bill passed both branches of the Legislature and was signed by the governor on June 27th. It contained a referendum clause, and the matter will be voted on by the people of Boston at the municipal election, December 9th. As the bill passed it provides that the Boston Transit Commission shall have charge of the work; that it shall consist of a tunnel containing two tracks for elevated trains and a subway containing two tracks for surface cars, the tunnel to be begun immediately after the acceptance of the act by the people and the subway to be begun after the expiration of one year after the completion of the tunnel, at such time as the commission and the Boston Elevated Railway Company shall agree upon; that the tunnels and subways shall extend from Broadway under Washington Street, to Adams Square, Haymarket Square, or Causeway Street, distances approximating three-quarters of a mile to 1¼ miles; that they shall connect with the present subway and the East Boston tunnel; and that they shall be leased to the Boston Elevated Railway Company for 25 years from the beginning of the use of the tunnel, at an annual rental of 4½ per cent. of the cost, the cost to include 3¼ per cent. interest on the debt incurred by the city in the construction of the subway and tunnel. The city is to construct and own the subway and tunnel, and upon completion of construction thereof the company must remove its elevated-line trains from the Tremont Street subway, leaving that to the exclusive use of ordinary cars entering the subway from the surface lines.

Simon Vorenberg, a prominent clothier of Boston, and Wolf Brothers of New York have taken the title to the Van Choate Electric Company's plant at Foxboro, Mass., and contemplate continuing an electrical factory therein.

The Massachusetts Legislature passed the bill authorizing the Rockingham County (N. H.) Light and Power Company to furnish electricity to any street-railway company operating in Newburyport, Haverhill, Lawrence, Lowell, Salisbury, Amesbury, Newbury, Groveland, West Newbury, Georgetown, Merrimac, Methuen, or Dracut, Mass. This bill is in the interest of the so-called Lovell companies which have organized as the New Hampshire Traction Company, with a capital of $1,000,000 and an issue of bonds amounting to $7,500,000, expiring July 1, 1942. Bonds amounting to $375,000 are held in escrow to retire underlying bonds, and bonds amounting to $500,000 are held for future expansions and improvements. The following-named gentlemen are officers of the company: President, Charles S. Fairchild, president of the New York Security and Trust Company; secretary, F. P. Royce of Springfield, Mass.; treasurer, Henry A. Tenny; general manager, Howard Abel, formerly president of the Lake Street Elevated Railway Company of Chicago. The properties consist of about 135 miles of electric railway, pleasure resorts, fully equipped power plants, electric-lighting plants in Exeter and Portsmouth, N. H., and a gas plant in the latter city.

Approximately 900 persons have taken this year's

entrance examinations for the Massachusetts Institute of Technology.

A syndicate of stockholders of the Pittsfield (Mass.) Electric Street Railway Company has purchased a controlling interest in the Hoosac Valley Electric Railway Company of North Adams, Mass. The companies will be consolidated, thus making a continuous electric railway between Pittsfield and Williamstown via Adams and North Adams.

The Mutual District Telegraph Company has released the basement of the Old State House for a period of five years from January 1, 1902, at an annual rental of $3,000, the company to vacate with 90 days' notice in case the premises are required for the subway system. The company's principal office has been located in the Old State House since the company was formed in 1882.

B.

Canadian Intelligence.

Ottawa, Ont., July 5.—The Town Council of Cookshire, Que., has decided to purchase the water-power on the St. Francis River and to establish an electric-light and power plant. The Town Council of Sherbrooke, Que., also contemplates the purchase of a waterpower with a view to establishing an electric-light system of its own.

As soon as the cable steamer Tyrian leaves dry-dock, where she is being overhauled, Mr. Keeley, superintendent of government telegraphs in Canada, will proceed to arrange for stretching 5½ knots of cable over the sandbars at the Magdalen Islands, and the repairing of the break in the 20-mile section of cable between Anticosti and the north shore of the St. Lawrence. The 116-mile cable between the Magdalen Islands and Anticosti is expected out from England early next month.

At the annual meeting of the shareholders of the Ottawa Electric Company it was decided to declare a dividend of not less than four per cent. for the current year commencing May 1st last. Owing to the heavy loss sustained in the great Ottawa-Hull fire of April 26, 1900, necessitating a large expenditure for the restoration and enlargement of the plant, no dividend has been paid in the last two years. The report presented at the annual meeting was a very gratifying one, showing, as it did, an earning capacity of 8½ per cent. The old board of directors and list of officers were re-elected.

W.

From the Buckeye State.

Cleveland, Ohio, July 5.—The United Trades and Labor Council of Cleveland seems to have taken Senator Hanna and President Andrews at their word in regard to the low-fare proposition in this city, as a committee has been appointed to go over the books and ascertain at what fare passengers can be carried in order to allow the stockholders a fair percentage on their money and fair wages to the employes.

Quite a little surprise was caused a few days ago when the list of stockholders of the Big Consolidated Railway Company of Cleveland was filed with the city clerk and the name of Senator Hanna did not appear among the others. It has been supposed by the public that he was at least interested in the Andrews syndicate that purchased the road, but it would seem from this that he is not. H. A. Everett and others of the Everett-Moore syndicate still hold some stock. There are about 400 stockholders altogether.

Senator Camden of West Virginia has sold to a Philadelphia syndicate his electric roads in Huntington, W. Va., Kenova and Ceredo, and Ashland, Ky., and Ironton, Ohio, the entire transaction amounting to about $2,000,000, which includes the electric-light plants at Ironton, Ashland and Huntington. It is said that the syndicate will build lines in other Ohio Valley towns and that the ultimate aim is to connect Pittsburg and Cincinnati with a continuous line. John Graham of Newville has been made president of the new company. Senator Camden did a great work in building the roads owned by the Camden Interstate Railway Company.

The movable machinery of the large furnaces now being built at Sandusky by Pickands, Mather & Co. of Cleveland will be under the control of electrical apparatus, and probably other electrical devices may be put in use about the plant.

The contract for rewiring the federal building at Columbus and furnishing electroliers has been awarded to the McMaster & Fletcher Company at $2,200.

The Columbus, Newark and Zanesville Electric Railway Company of Columbus has been incorporated with a capital stock of $1,500,000 by J. R. Harrigan, A. C. Ralph, C. A. Alderaman, H. A. Fisher and J. A. Godown. It is the intention to build an electric line from Newark to Zanesville, which will be operated in connection with the Columbus, Buckeye Lake and Newark line.

Lightning struck the stack of the electric-light plant at Sandusky a few nights ago and the plant was so badly damaged that everything was in darkness for several nights.

It is now stated upon good authority that the work of reorganizing the Lake Shore Electric Railway Company and the Detroit and Toledo Shore Line Company will be taken up without delay. Other matters have now been so nearly cleared away that the bankers' committee has ceased to take an active part in the matter. The reorganization work will be done by Henry A. Everett, and it is said that all arrangements have been made to finance the two companies in Cleveland, and that only the legal formalities remain to be gone through with. Receiver Lang is still in charge of the Lake Shore and will continue in that capacity until the new company is ready to take it off his hands. A number of Cleveland capitalists made a trip over the road a few days ago and made a thorough inspection of it. They are well satisfied with it and also with the other road from Detroit to Toledo. There may yet be a through line from Cleveland to Toledo.

O. M. C.

Information from Indiana.

Indianapolis, July 7.—The Leavensworth Electric Railway Company has been incorporated to construct and operate a street-railway system in Leavensworth. The capital is $100,000. T. P. Elsworth and S. A. Beale are directors. The Winona, Warsau, Elkhart and South Bend Traction Company has been incorporated to build an interurban line to connect Warsaw, Winona Park, Elkhart and South Bend. The capital is $400,000. S. P. George is president and S. A. Collins secretary and general manager. The proposed new line will connect with lines at Elkhart, running to Michigan towns and resorts. Work will begin between Elkhart and Nappanee at once. The Decatur Council has granted a franchise to the Ft. Wayne, Cincinnati and Dayton Traction Company. Work on the Evansville-Princeton traction line, the first line in southern Indiana, was begun last week at Ft. Branch. The road will be 25 miles in length and is expected to be in operation before Christmas.

The Indianapolis Street Railway Company has granted an increase of one cent an hour to all motormen and conductors. The increase was unexpected and was gratifying to the employes. It will affect over 600 men and calls for an increased expenditure in wages of $25,000 for the year.

The first real freight cars on the Union Traction lines began running between Indianapolis, Marion and Muncie by way of Anderson on the 1st inst. The cars resemble a regular passenger coach. The schedule fixes a rate of 20 cents for all parcels under 25 pounds and graduates others according to weight and distance. The rates are very unsatisfactory to Indianapolis merchants and a new schedule is promised by August 1st.

The Chicago and South Shore Railway Company, which is building an interurban line between La Porte and Michigan City, ran its first cars into La Porte on the 1st inst. This action was made necessary in order to save a forfeit of $2,500 previously posted. The people came out in mass and welcomed the initial car. The whole line will be in operation by September, the managers say.

The labor unions are keeping up the boycott of the Terre Haute street and interurban railway lines and also of all who patronize them. A merchant who recently rode on a car was tried by the union and fined $10, which he paid, promising not to ride any more if the boycott is withheld against him. The money was sent to the strike fund.

The City Council at Marion has taken radical action and declared the Marion Traction Company's franchise, owned by the Union Traction Company, forfeited, and instructed the city attorney to enter suit for $50,000 damages. This step is said to be due to the action of the Union Traction Company tearing up Thirty-eighth Street in the nighttime in order to put in a connection where permission had been denied.

Greenwood celebrated the Fourth by turning on the new electric-light plant's current for the first time. The effect was satisfactory. The opening was delayed some time by an injunction restraining the company from turning on the current because the light wires interfered with telephone and trolley wires. This required necessary changes of the light wires.

The city of Indianapolis will, on July 15th, advertise for bids for a 10-year contract for public lighting for the city. The specifications provide that the successful bidder shall assume all liability for the legal stability of the contract, there being some contention that the city charter provides for only one-year light contracts. The Legislature will be asked to amend the charter, as no outside company will bid on a one-year contract.

The Merchants' Heat and Light Company of Indianapolis has been incorporated, with $150,000 capital stock. F. M. Ayers is one of the principal directors. The franchise which this company agrees to accept provides for a rate of 10 cents a kilowatt for incandescent electric lighting, 25 cents a square foot radiating surface for steam heating and 17 cents a foot for hot-water heating.

Suit has been brought to set aside a 50-year franchise granted the Boonville Electric Light and Power Company, and to restrain the town trustees of Boonville from paying for any more lights. Irregularity and illegality is charged in the complaint. A franchise has been granted to a new light and heat company, and it promises to furnish cheaper lights. The old company's plant is valued at $30,000, and it is believed the company will not give up the field without a struggle.

A bitter fight is on at Hartford City, where the Council has repealed the franchise of the Hartford City Lighting Company. The latter offered to sell to the city, but the offer was rejected. The Council now threatens to remove the company's poles and wires from the streets. The company proposes to hold the city to its contract for 120 lights at $80 a light per year. Citizens have subscribed a fund to pay for litigation in the matter. It is a matter of sincere regret that so much dissatisfaction and litigation is growing out of the electric lighting of streets in Indiana.

F.

Northwestern Notations.

Minneapolis, July 5.—The street-railway company of Superior, Wis., will spend about $300,000 in improvements. The broad-guage track is nearly completed and work will be begun at once on the East End line and on the new car barns.

The Citizens' Electric Light and Gas Company of Centerville, Iowa, has purchased the rights and franchises of the People's street railway and will begin the construction of its new line at once.

The ordinance providing for an annual tax of $500 on the franchise recently granted to the La-Crosse and Eastern Railway Company will be repealed as the company has refused to build its line otherwise.

The LaCrosse and Black River Falls (Wis.) Railway Company will build a large power dam at the latter city and will construct a line between the two cities.

A. E. Boone of Zanesville, Ohio, proposes to establish several interurban lines with Fargo, N. D., as the pivot.

Decorah, Iowa, will be the terminus of two electric railroads, one from Chatfield, Minn., and the other from Lansing, Iowa. Articles of incorporation for the latter line have already been filed.

The Burlington, Iowa, street-railway and light property has been transferred to the People's Gas and Electric Company.

R.

Among the Rockies.

Salt Lake City, July 5.—R. S. Marson, an electrical engineer, with a party of surveyors, is establishing the line for the long transmission line for the power plant to be built on Fossil Creek, Ariz. Work will be commenced on pole line and power plant as soon as a permit has been obtained from the Interior Department to pass through the forest reserve. About 500 men will be employed on the ditch and about 50 men clearing the right-of-way for pole line.

The Mammoth Mining Company's new electric plant in Idaho is now complete. A 32-kilowatt generator has been installed, which furnishes power to a 50-horsepower locomotive which hauls ore from mine to mill.

The new Highland Power Company has received a large shipment of machinery for its plant on which work has begun near Boise, Idaho. O. B. Williams of New York is supervising the work.

The City Council of Pueblo, Colo., has granted a franchise to the Pueblo Traction Company, to build and maintain an electric street railroad in that city. Work will at once commence on a line to the steel works, also to Mineral Park. The franchise runs for 38 years.

The Emerson Electric Company of Emerson, Wyo., has been bought by the North American Copper Company, which has formed a company to control a number of mines in the state.

F. E. Nimrod of New York, who is interested in the Cascade Power Company of Idaho Springs, Colo., has purchased the controlling interest in the Clear Water Light and Power Company of Georgetown, Colo. The company will now make a number of extensive improvements in the plant. Another 300-horsepower generator will be installed and a pole line built to Idaho Springs. A line is now under construction to Black Hawk and Central City to supply those cities and surrounding mines with light and power. It is also understood that the company will build a power plant in Grand County and run wires 70 miles to the east side of the divide at Georgetown.

The O. K. Mining Company of Flathead County, Mont., will install a large power plant at its mines. A transmission line will be run a distance of 2,000 feet in the company's tunnels.

The proposition to bond the city of Weiser, Idaho, for $15,000, for the building of an electric-light plant, has been abandoned.

Fountain Grove and Moroni, Utah, are to be lighted by electricity in a short time, the two towns using the same plant.

The Belcher Mining Company at Reno, Nev., has installed a double electric hoist of 75 horsepower, 30-horsepower motor in its saw mill and five-horsepower motor in the blacksmith shop of the mine. The entire mine is lighted by electricity.

The street-railway company of Helena, Mont., is making a number of extensions in its lines as well as building two new loops.

The citizens of Georgetown, Utah, will vote on bonding the city for $25,000, to build a municipal electric-light plant.

The Missoula (Mont.) Electric Light Company has completed the erection of an electric plant at Sand Point.

Bozeman, Mont., is to have another electric light and power plant. For some time past George C.

Dier, E. Myron Ferris and others have been examining the waters of Hell Roaring Creek, and have taken up 5,500 inches. Here the new company will build a plant. Power will be transmitted to Bozeman and Belgrade, competing with the present electric-light company. The company has also planned to build an electric railway from Bozeman to Salesville and up the West Gallatin Canyon to the Yellowstone Park. Since the new company's plans have been made public the old company has filed claims to waters on Middle Creek and will enlarge its present plant.

The taxpayers of Cripple Creek, Colo., have voted unanimously to grant two electric-light franchises recently passed by the City Council—the Kerin franchise of the Colorado Electric Power Company and the franchise asked for by the People's Electric Light Company, a local corporation. It is now certain that there will be competition in the furnishing of electric light in that city. With the granting of these there have been three franchises granted within the last month.

Raton, N. M., is to make a number of extensions to its electric-light plant. The present capacity of the plant is 3,000 lights. This will be increased to 5,000. A 200-horsepower engine will be added to the 150 and 50-horsepower engines now in use, and a new building, 100 by 40 feet, will be erected. In all about $25,000 will be expended.

The branch power house of the Denver (Colo.) Gas and Electric Company at Montclair, a short distance from Denver, was entirely destroyed by fire on June 27th.

The Salt Lake Electric Company has secured the contract to light the streets during the reunion of the Grand Lodge of Elks in August. About 500 incandescent lamps will be used, besides many special and unique designs, among which is an elk 20 feet high, which will have 300 lights upon it; also an American flag with 300 lamps. C.

On the Pacific Slope.

The Santa Clara Valley Electric Railroad Company has disposed of its holdings and privileges to John Burson, who is thought to be backed by Douglass, Lacey & Co., large landholders near Bakersfield, Cal. Part of the consideration of the purchase is that the purchasers must commence building operations inside of 60 days, and to complete them within six months. It is the intention of the new holders to make this line a continuation of the Bakersfield-Sespe line to tidewater at Hueneme. The company will build a large power house at Oxnard, Cal., to operate the new road.

J. N. Gillett, who represents eastern capital, has applied for a franchise to build and maintain an electric railroad in Eureka, Cal.

The Pacific Electrical Company, Portland, Ore., is installing a 1,000-light plant at Burns, Ore.

Richard Popkiss of London, England, who represents English capitalists, is looking over the works of the new Cascade Power and Light Company of Cascade, B. C. The machinery for the new plant has arrived and work is being rapidly pushed. The transmission line to Phœnix is completed, and it is expected that the company will be in a position to supply power to all the surrounding mines early in the fall.

Mahoney Bros. of Tekoa, Wash., have purchased from the Tekoa Cold Storage and Power Company the electric-light and water plant. The new owners will add many improvements to the plant, and Tekoa will have one of the most modern plants in the state.

J. F. McNaught, representing the capitalists who will build the electric road through North Yakima Valley, Wash., has filed papers appropriating 1,000 cubic feet of water per second to be taken out of the Natchez River, about 20 miles from North Yakima. This step is preliminary to building the electric railroad from North Yakima to Sunnyside.

A number of Durkee electric drills are being installed in the Copperapolis Copper Company in Eastern Oregon.

R. E. Brinker, who purchased an electric street-railway franchise some time ago in Los Angeles, has purchased another in that city for $886, bidding against the Campbell-Johnsons syndicate

A petition is being circulated by H. C. Foster among the citizens of Corona, Cal., asking the City Council to bond the city for $20,000, to build a municipal electric-light plant. The petition is meeting with no opposition, and it is thought the plant will be built. C.

PERSONAL.

George Nial Eastman, superintendent of the testing department of the Chicago Edison Company, was married on July 2d to Miss Fay Wheeler of Lansing, Mich.

Charles Proteus Steinmetz, very recently president of the American Institute of Electrical Engineers and electrician of the General Electric Company, has received the honorary degree of A. M. from Harvard University.

Col. Allan C. Bakewell, second vice-president and general manager of the Sprague Electric Company, was recently elected department commander at the New York state encampment of the Grand Army of the Republic, held at Saratoga Springs. There was a strong opposition ticket in the field, but Colonel Bakewell, in recognition of his services in both the state and national work of the organization, was elected by a handsome majority.

Richard J. Bloxham, who for 17 years has managed the Baltimore, Md., branch of the Western Union Telegraph Company, has resigned his position and will take a prolonged and well-earned rest as soon as his successor is appointed.

George H. Gibson of the Westinghouse Companies' Publishing Department, read a paper on "The Electrical Industries of Pittsburg and Their Economic Influence" before the economic and social-science section of the American Association for the Advancement of Science at Pittsburg last week.

W. R. Mason, well known to the electrical fraternity in the West, has resigned his position with the Sprague Electric Company and accepted the position of western manager for Coe, Smith & Co. of Boston, selling agents for the Mechanical Boiler Cleaner Company, with offices at 413 Western Union Building, Chicago.

Thomas R. Mercein, the esteemed secretary of the Northwestern Electrical Association, has returned from his European journey. Mr. Mercein managed to get over a large portion of Great Britain and the Continent in the comparatively short time at his disposal and comes back greatly refreshed and much pleased with his trip. In Venice Mr. Mercein ran across Colonel F. A. Copeland, president of the La Crosse (Wis.) Edison Light and Power Company, who is spending the year abroad.

R. T. Lozier, who has had charge of the New York sales office of the Bullock Electric Manufacturing Company, has gone to Cincinnati to take charge of the general selling organization of the Bullock company. He is succeeded in New York by E. W. Goldschmidt of the Chicago office of the company. Mr. Goldschmidt is a well-known Chicago electrical-engineering salesman, having been connected with the Western Electric Company for several years. About a year and a half ago he went with the Bullock company.

Friends of Mr. Louis A. Ferguson—and they are numerous in number and warm in attachment—will be delighted to learn that on July 9th he was chosen second vice-president of the Chicago Edison and Commonwealth Electric companies by the directors of those corporations. The office of general superintendent, heretofore held by Mr. Ferguson, was abolished, although the new vice-president will continue to discharge the duties of that position. Mr. Ferguson is president of the National Electric Light Association and of the Association of Edison Illuminating Companies, and has well earned this official recognition.

Robert T. Todd, vice-president of the Cincinnati Traction Company has been made general manager of the properties of the United Gas Improvement Company, which owns many miles of electric-railway lines. Mr. Todd is only 32 years of age, and has been in the service of the Whitney-Widener-Elkins syndicate for the last 10 years, having been called from the Johns Hopkins University to take a position with it. He has demonstrated such ability that his employers are willing at his age to place him in one of the most responsible positions they have. It is said that his salary will be about the same as that of the president of the Cincinnati Traction Company.

ELECTRIC LIGHTING.

The stockholders of the Union Electric Light and Power Company of St. Louis will, on August 4th, hold a special meeting, to consider and vote upon a proposition to increase the bonded indebtedness of the company from nothing to $10,000,000. Julius S. Walsh is president of this company.

The Chicago Yaryan Company has been granted the right by the Chicago City Council to operate a lighting and heating system in the territory bounded by North Avenue, Fifty-second Avenue, Twelfth Street and Austin Avenue. The franchise is to run 20 years, the city to receive as compensation three per cent. of the gross receipts yearly and five per cent. after the first seven years.

A feature of a reception to the Indian princes in London given by the Prince of Wales, in behalf of King Edward, on July 4th at the Indian office, was the electrical illumination in which 3,000 incandescent lamps were used. An immense ceiling cover was painted to represent the Indian firmament, in which the stars and constellations were accurately depicted, the light of the stars being furnished by electric lamps.

An electric fountain in commemoration of Independence Day was dedicated at Douglas Park, Chicago, on July 4th. It represents three children, two boys and a girl, each waving a roman candle, and grouped around the upright figure of a boy, waving the Stars and Stripes. By an electrical device, alternating red, white and blue lights are displayed at the ends of the roman candles and elsewhere about the statue.

ELECTRIC RAILWAYS.

The Chicago Tribune has adopted the rather novel expedient of utilizing a specially constructed electric car for the delivery of its papers to points on the far south side in Chicago. Along the route of the car, in the early morning, wagons are supplied with papers which they distribute to the newsdealers in the adjacent territory.

The railroad commissioners at Concord, N. H., have authorized the issue of $100,000 worth of stock and $25,000 worth of bonds for the building of the Claremont electric road. The new road is to be about eight miles in length.

The Wolf Lake Railway and Resort Company, organized for the purpose of building an electric railway to Wolf Lake to connect with the Jackson (Mich.) and Suburban Traction Company, has bonded its property to the extent of $30,000.

The American Transportation Company of Augusta, Me., and Battle Creek, Mich., has been incorporated, with $500,000 capital stock, to build and operate steam and electric railroads. G. W. Meechem of Battle Creek, Mich., is the company's agent.

The People's Transportation and Power Company of High Point, N. C., has been organized to construct the proposed new electric railway from Thomasville via Highpoint to Greenboro, from High Point to Kernersville, and thence to Winston and Salem. D. A. Waters is president of the company.

Consul F. D. Hill writes from Amsterdam (Holland) that the City Council has voted a loan of $2,613,000 and a second one of $1,165,800 for building a plant to furnish electricity for lighting and motive power and for changing the present street-railway system to electric traction. The contract for the building of the plant has as yet not been made, but the steam engines, dynamos, and the installation will be furnished by German and Dutch manufacturers.

Messrs. Park and Hamilton of Youngstown, Ohio, have secured a franchise authorizing them to construct and operate electric street-railway lines through and about the city of Havana. The concessions are estimated to be worth upward of $20,000,000. Association with Messrs. Park and Hamilton in this enterprise are Devitt, Tremble & Co. of Chicago, G. F. Penhale & Co. of New York, H. W. Whipple of New York, H. W. McDonald & Co. of Chicago, W. J. Hayes & Sons of Cleveland.

The New Orleans (La.) Railway Company has increased its capital stock from $5,000,000 to $40,000,000. The company was incorporated in January of this year for the purpose of constructing and operating railways by electric and other motive power. The consenting stockholders include the names of Charles S. Fairchild, E. Clarence Jones and J. Ledie Hees, who jointly own 49,996 shares of the stock of the company. Henry H. Pearson, Jr., is president and Theodore F. Lozier is secretary.

The Aurora, De Kalb and Rockford Traction Company, formed by R. S. Vivian of Chicago and associates, is preparing to build an electric road from Aurora, Ill., where connection will be made with the Aurora, Elgin and Chicago road, northwesterly through De Kalb to Rockford, a distance of 58 miles. At Rockford connection will be made with electric lines, already partly built, running to Madison and Janesville, Wis., so that a through route from the latter cities to the heart of Chicago will be given, by use of the Aurora, Elgin and Chicago and its connection over the Metropolitan elevated. The greater part of the line will be built over private right-of-way, and the construction will be of the best pattern, so that the 58 miles from Rockford to Aurora can be covered in an hour and a half. There will be no grade crossings of steam roads; 70 to 80-pound rails will be used. The road will use the overhead-trolley system.

PUBLICATIONS.

The Fort Wayne Electric Works of Fort Wayne, Ind., describe with several illustrations their type MPL direct-connected generators in a recent bulletin.

The Safety Electric Switch Company of Providence, R. I., has issued a catalogue descriptive of its quick-make and quick-break switches, transfer knife switches, arc cut-outs, mast arms, pole steps, etc.

The installation of Chloride accumulators in a small central-station plant owned and operated by W. P. Lamkin, Milan, Mich., is described in a bulletin distributed by the Electric Storage Battery Company of Philadelphia.

An attractive catalogue issued by the Wagner-Hatch Motor Company of Chicago describes its Hartley Type-C direct-current multipolar dynamos and motors, which it builds in sizes from one-fourth to 7½ horsepower.

James S. Barron & Co., manufacturers and wholesale dealers in general electrical specialties, West Broadway and Franklin Street, New York, call attention in a circular to their Harloe self-tying porcelain insulators.

A recent catalogue of the Crocker-Wheeler Company, Ampere, N. J., is entitled "Motor-driven Tools," and contains a large number of illustrations, showing applications of the company's motors

in the distribution of power. A unique feature of the publication is the cover, which consists of burlap, and is bound with wrapping twine.

A 70-page publication issued by the Gregory Electric Company of Chicago contains a list of its "Installations To Date." The list is very complete and shows the great amount of apparatus the company has sold to leading firms in the country during the last few years. Views are also shown of different departments in the company's works.

The S. K. C. bulletin No. 127, entitled "Switches," of the Stanley Electric Manufacturing Company, is being distributed. Besides the well-known type of S. K. C. slide switches, carbon-break switches, etc., many specialties are included, among which are a combined oil switch and circuit-breaker for great capacities at high voltage and a line of knife switches, the blades of which are made up of units, providing a range in capacity from 50 to 3,000 amperes, single or double-throw, with or without fuses and with or without quick-break. Copies of the bulletin, which contains 32 pages, may be obtained from Ray D. Lillibridge, 170 Broadway, New York.

MISCELLANEOUS.

Thomas A. Edison was granted two patents on July 1st, one for apparatus to be used in making briquettes out of pulverized material and the other for a reproducing device for phonographs.

Flour is loaded on ships at Tacoma, Wash., by electric power. Sacks are placed on a revolving belt which passes over 12 rollers. The belt is propelled by a two-horsepower motor. With this system 2,500 tons of flour is loaded every 24 hours.

The motion for an injunction brought by the Westinghouse Electric and Manufacturing Company against the Stanley Electric Manufacturing Company in a suit for infringement of a patent on transformers has been denied by Judge Colt in an opinion handed down in Boston on July 1st, in the United States Circuit Court, District of Massachusetts.

TRADE NEWS.

The Standard Vitrified Conduit Company of New York city has been incorporated with a capital stock of $100,000. Directors of the company are R. W. Lyle, B. S. Barnard and W. H. Barnard of New York.

Sealed proposals will be received at the office of the supervising architect of the Treasury Department, Washington, D. C., until two p. m. on August 6th, and then opened, for the installation of a conduit and electric-wiring system for the Postoffice Building at Freeport, Ill., in accordance with the drawings and specification, copies of which may be obtained at that office or at the office of the superintendent of construction at Freeport, Ill.

BUSINESS.

William C. Banks, the well-known electrician of the Gordon Battery Company, New York, was in Chicago this week. Mr. Banks is making a combined business and pleasure trip through the West, and states that the battery business was never as good as at present.

In the distribution of a catalogue it is manifestly impossible to reach everyone in the trade. The Electric Appliance Company of Chicago will be glad to have the name and address of those interested in wattmeters who have failed to receive a copy of its new Gutmann alternating-current wattmeter catalogue, which will be mailed promptly upon application.

As the result of its purchase of the Citizens' Light and Power Company, the Rochester (N. Y.) Gas and Electric Company has a 1,500 horsepower vertical cross-compound engine, now nearly completed at the McIntosh & Seymour shops in Auburn, N. Y., which it wishes to dispose of.

R. G. Wilson, an electrical engineer of many years' experience, has recently organized the Scientific Exchange in Chicago to provide an introduction between the buyer and seller of the best scientific service. The exchange proposes to maintain filed records of engineers, draftsmen and specialists in all scientific branches, these records to be open to the inspection of employers.

Among recent orders of the Crocker-Wheeler Company of Ampere, N. J., manufacturer of direct-current machinery, are the following: Standard Steel Works, Burnham, Pa., two 200-kilowatt generators; Buda Foundry and Manufacturing Company, Harvey, Ill., 240-kilowatt generator; Woodward & Lothrop, Washington, D. C., one 200-kilowatt, two 150-kilowatt and one 75-kilowatt generator; Minot Light and Telephone Company, Minot N. D., 90-kilowatt generator; Armour & Co., East St. Louis, Ill., four 50-horsepower motors and one 75-horsepower motor; Green Engine and Machine Company, Harrison, N. J., four 35-horsepower motors; Descubridora Mining and Smelting Company, Mexico, four 20-horsepower motors; Moline Malleable Iron Company, St. Charles, Ill., 90-kilowatt generator and 11 motors, aggregating 125 horsepower; Fretz Umbrella Works Philadelphia, Pa., 80 motors in small sizes; Lake Shore and Michigan Southern shops, Collinwood, Ohio, 11 motors, aggregating 200 horsepower.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 1, 1902.

703,369. Electric Instrument for Cautery. Walter B. Batcheller, Chicago, Ill., assignor to George G. Hunter, Des Moines, Iowa. Application filed March 8, 1902.

The ends of two pieces of a wire conductor extend into a chamber and a trigger pivoted to the handle extends into the chamber for pressing one of the ends of the wire into contact with the end of the other wire.

703,372. Door-operating Device. Peter J. Beisel, Allentown, Pa., assignor of one-half to Harry F. Smith, Allentown, Pa. Application filed November 4, 1901.

An electric alarm circuit is used to actuate mechanism for operating a rod to release a spring-opening door.

703,374. Mechanism for Electric Propulsion of Road Vehicles. Daniel S. Bergin, Chicago, Ill. Application filed September 28, 1901.

The mechanism consists of positive and negative line conductors, a motor and a folding or jointed trolley pole having insulated contact sections, one being electrically connected with one and the other with the other terminal of the motor, and means for bringing the sections into sliding contact with the line conductors respectively.

703,420. Process of Making Electric Accumulator Plates. Rudolph M. Hunter, Philadelphia, Pa. Application filed August 1, 1899.

The process consists in first forming a series of elementary parts with a large number of thin lead walls, and then placing the parts in a mold and clamping their outer edges tightly, in then passing a cooling medium through the central or interior portions of the elementary parts, in then forcing molten lead into the mold so as to cast it around the segments under pressure, and in finally transforming the surfaces of the thin walls of the segments into peroxide of lead.

703,425. Electric Alarm Clock. Zareh H. Kevorkian, Philadelphia, Pa. Application filed February 12, 1901.

An electric alarm and normally broken circuit therefor are connected with a contact-spring and with the clock movement.

703,439. Apparatus for the Manufacture of Sugar. James A. Morrell, Lansdale, Pa., assignor of two-thirds to Henry C. Stuart, Denver, Colo., and Samuel B. Allison, New Orleans, La.; C. A. Dorrestein, administrator of Allison, deceased. Application filed January 29, 1896.

Combined with means for supplying cane-juice are a sieve for separating the coarser solid matter from the juice, a wire-cloth basket, and electric-circuit wires attached to the basket whereby cane-juice may be screened and an electric current passed conjointly through the liquid and wire-cloth to precipitate solid matter preparatory to filtering.

703,467. Electric Incandescent-lamp Socket. Guy H. Proctor, Somerville, Mass., assignor to New England Electric Manufacturing Company, Boston, Mass. Application filed February 28, 1902.

An insulating cap-lining for the cap of incandescent-lamp sockets is formed to follow the concavity of the cap, with retaining catches adapted to fit a bead in the cap, and with depending holding-ears having their thickened extensions perforated to receive the holding-screws which connect the cap, shell and base.

703,468. Brake for Administering Prescribed Resistance to the Starting Movements of Hand-operated Controllers. William E. Quimby, New York, N. Y. Application filed December 7, 1900. Renewed December 13, 1901.

One claim reads: In electric starting mechanism the combination of the controller-operating shaft with a vacuum cylinder, a piston traversing the cylinder and connections between the operating shaft and the piston, whereby the starting movements of the controller are opposed by atmospheric pressure acting upon the piston.

703,472. Electric Low-water Alarm. Ebenezer W. Rider, Detroit, Mich. Application filed July 24, 1901.

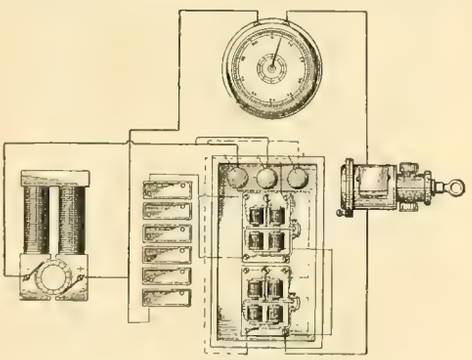
An expansible tube through which the boiler contents can flow has a number of connections with the boiler at different levels thereof, and means are operated by the expansion of the tube to actuate an electric signal.

703,476. Overhead Trolley. George H. Russell, Pittsfield, Mass. Application filed January 27, 1902.

A trolley-wheel support combines the harp, plates slidably held therein, an axle journaled in the plates and having a wheel held thereon, and means carried by the plates for locking them to the harp.

703,490. Storage Battery. Malcon O. Smith, Depew, N. Y., assignor of one-half to Thomas J. Coster, Depew, N. Y. Application filed July 13, 1901.

An element for storage batteries is composed of a metallic plate forming a tray with outwardly sloping sides and ends, deepest in the center along a central longitudinal line. The plate is provided upon its upper and lower sides with electrodes of opposing polarity, in conductive connection with the plate by means of a retaining grid of vertically disposed thin laminæ, formed from the body of the plate on opposite sides of its central core to which the laminæ remain united.



NO. 703,691.—ELECTRIC LOG REGISTER.

703,515. Electric Switch. Andrew P. Anderson, New York, N. Y., assignor of one-half to John Dahlgren, New York, N. Y. Application filed June 6, 1901.

In the switch are combined a contact knife, a standard upon which the knife is pivotally mounted upon a bolt passing through the standard, an inwardly extending flange upon the head of the bolt, and a spring located in the recess formed by the flange and adapted to hold the knife yieldingly to its standard.

703,541. Water Purifier. Chauncey C. Clark, Philadelphia, Pa., assignor of one-half to James G. Carson, Philadelphia, Pa. Application filed January 22, 1901.

Parts of the purifier are a closed receptacle, a vertical cylindrical insulated inlet chamber partly within and partly without the receptacle, a series of perforated disk electrodes arranged across and within the chamber, insulated and liquid-retaining stuffing boxes for the inlet chamber, and means therethrough for positive and negative electric connection to alternate electrodes.

703,563. Guard for Third-rail Systems. Sterling Elliott, Boston, Mass. Application filed April 3, 1902.

The guards rest on the rail flanges, and extend above the rail and means are provided for holding the guards in place.

703,575. Stitch-separating Machine. John B. Hadaway, Brockton, Mass. Application filed November 4, 1901.

Electromechanical means are controlled by the stitch intervals for actuating the indenting tool to indent the stitch intervals.

703,589. Trolley for Electric Cars. Charles J. Johnson and Charles W. Benedict, St. Louis, Mo. Application filed September 23, 1901.

A stop mounted on a support is adapted to receive the impingement of a detent, and a rope is connected at one end to the swinging member and loosely positioned on the lever.

703,623. Electroplating Apparatus. Theodore F. Taylor, Camden, N. J. Application filed June 26, 1901.

The apparatus comprises a tank, an axle suitably supported over the tank, a receptacle on the axle, the receptacle having openings in its ends, wire rings on the interior surface of the receptacle, the rings being electrically connected with the negative pole of a generator, an anode secured within the receptacle, and a binding post secured to the axle, electrically connected with the anode through the axle.

703,673. Electric Battery and Mounting Same. Elmer A. Sperry, Cleveland, Ohio, assignor to the National Battery Company. Application filed September 13, 1899.

A metallic case for a battery forms part of an electric circuit, and active material forming the negative electrode is applied directly to the wall of the case. An electrolyte within the case, in combination with an electrode or electrodes is introduced into such case and made integral therewith at a plurality of points on the perimeter of the electrode or electrodes for affording better electrical distribution as between the electrode and the case.

703,674. Connection for Batteries. Elmer A. Sperry, Cleveland, Ohio, assignor to the National Battery Company. Original application filed September 13, 1899. Divided and this application filed November 6, 1899.

The case of the battery has its walls formed of thin conducting material and an electrolyte is placed within the case, the case being provided with an extension projecting above the electrolyte. The extension is thicker than the walls of the case and is provided with a terminal having a broad contacting surface, and an insulating support for the walls of the case.

703,691. Electric Log Register. William B. Armstrong, San Francisco, Cal. Application filed September 15, 1900.

The electrical log comprises a primary source of electrical energy and a secondary source connected therewith, electrical circuits connected with the sources, one of which is provided with an indicator and the other with a log and a register, and electrically controlled means for automatically passing a current from either source through the second-mentioned circuit. (See cut.)

703,692. Manufacture of Carbons for Arc Lamps. Conrad R. Boehm, Charlottenburg, Berlin, Germany. Application filed April 12, 1902.

The process consists in incorporating with the carbon besides other metallic salts an addition of magnesium fluoride not less in proportion to the salts than is defined by equal or equivalent molecular weights.

703,700. Trolley Wheel. William F. Hall, Boston, Mass. Application filed April 29, 1902.

A central sleeve or hub of the wheel has at its end an annular groove, and a fastening device consisting of a divided ring or key inserted within the annular groove an bearing against the outer face of the adjacent side disk.

703,701. Trolley Wheel. William F. Hall, Boston, Mass. Application filed April 30, 1902.

The sectional hub is composed of a series of concavo-convex keys provided at their opposite ends with outwardly extending flanges adapted to overlap and bear against the side disks to hold the latter in place against the central portion.

703,712. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring, Philadelphia, Pa. Application filed February 12, 1901.

The system comprises a transmitting apparatus and receiving apparatus. The receiving apparatus consists of air and ground plates, a wave-responsive device connected therewith, a choking relay in circuit with the wave-responsive device, another relay having two windings and circuit-controlled by the choking relay, a condenser circuit connected with one of the windings of the relay, a permanent magnet connected with the cores of the relay, an independent circuit operated by the relay and a sounder in the circuit.

703,717. Incandescent Electric Lamp and Socket. Jesse C. M. Brown, Philadelphia, Pa. Application filed February 28, 1902.

The socket comprises a flat ring-shaped base of insulating material, a series of independent spring fingers supported at their base upon and insulated from each other by the upper face of the insulating base and projecting upward therefrom to form in series a tubular socket to receive the lamp neck and suitable terminals.

703,759. Electrical Sparking Device. Alfred C. Brown, London, England. Application filed December 21, 1901.

The sparking plug has a metallic body through which one of the electrodes passes. A tubular condenser for the plug comprises two metallic tubes one of which is in immediate metallic union with the body of the plug while the other is contained within the first and is in direct connection with the wire or conductor terminating in the other electrodes of the device.

703,769. Motor Vehicle. George E. De Long, New York, N. Y., assignor to the Industrial Machine Company, Phœnix, N. Y. Application filed February 25, 1901.

The igniting devices for the motor comprise one or more battery cells and a sparking coil located in the hollow section of the frame.

703,777. Cable-testing Apparatus. Henry W. Fisher, Pittsburg, Pa. Application filed July 15, 1901.

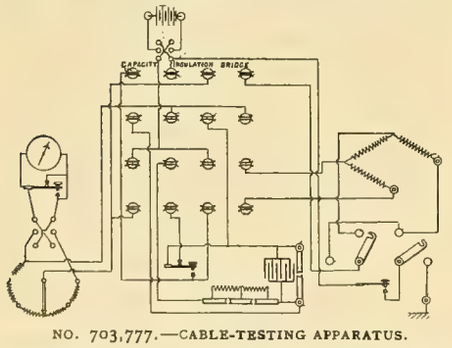
Combined with a number of instruments of a cable-testing set are a series of different circuits leading to and from the instruments and adapted to be connected up in different ways with the instruments for making various tests, and contacts arranged in pairs in the circuits. A switch comprising a rotary shaft carries a plurality of contact arms arranged to bridge the circuits between the different pairs of contacts in such manner that when the switch is in one position all the proper connections will be made with the instruments through some of the contacts for one test and when in another position all the proper connections will be made with the instruments through other contacts for another test. (See cut.)

703,779. Electric-railway Rail Bond. Edward P. Frederick, St. Louis, Mo., assignor of one-half to James D. Houseman, St. Louis, Mo. Application filed March 20, 1902.

The bond consists of a conductor, and chambered terminal couplings having pockets in the wall thereof adapted to receive a filling introduced to fill the chambers of the couplings.

703,782. Trolley Fork. Ernest L. Gentis, Newport, News, Va. Application filed February 21, 1902.

Circular ends are provided upon the members or prongs of the fork, the ends being provided with circular openings, which support the ends of the trolley-wheel axle. Springs are so arranged as normally to center the wheel and also act as a conductor for the electric current.



NO. 703,777.—CABLE-TESTING APPARATUS.

703,786. Apparatus for Preventing Trolley Wheels from Leaving the Feed Wire. George W. Hammond, Philadelphia, Pa., assignor of one-half to Samuel S. Wiener, Philadelphia, Pa. Application filed March 3, 1902.

The invention consists of projecting arms which serve the purpose indicated in the title.

703,791. Incandescent Lamp. Herman J. Jager, New York, N. Y. Application filed August 13, 1901.

A telephone lamp comprises a tubular glass vacuum chamber and a thick half-globular translucent top joined thereto by the fusion of the glass and integral therewith.

703,810. Telegraphically Operated Signal System. Joseph N. Newsom, St. Louis, Mo. Application filed March 11, 1901. Renewed May 28, 1902.

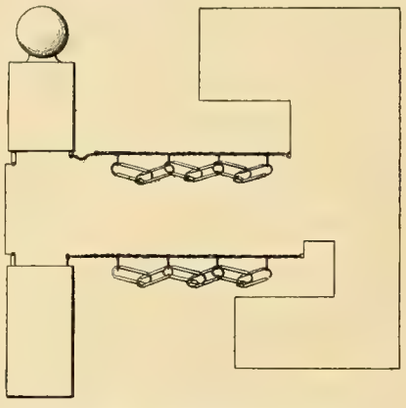
The system comprises a main wire, a key, a relay and a local circuit-sounder at the train-dispatcher's office and also at a signal station, a semaphore-controlled repeat-back mechanism and a relay in series at the signal station, a local magnet on the station relay circuit, a double-pointed contact on the local-magnet armature, actuating mechanism for a semaphore, a semaphore, and electrical connections for the semaphore by which the local-magnet armature controls the semaphore.

703,826. Electric Bath Apparatus. James D. Randall, Memphis, Tenn., assignor of one-half to Joseph W. Buchanan, Memphis, Tenn.; Josephine E. Randall, administratrix of James Dennison Randall, deceased. Application filed February 5, 1901.

The apparatus comprises a cabinet open at the bottom and having a top closure provided with an opening, a number of electroheating helices arranged around the cabinet concentrically and insulated one from another, the several conductors having each one terminal connected to a wire adapted for connection with an electric line-wire, and switches for closing the other line wire with the other terminals of the conductors.

703,837. Manufacture of Braided Cords or Cables for Electric Lighting or Like Purposes. Carl Schürmann, Dusseldorf, Germany. Application filed December 24, 1900.

The method of covering a number of conductors and a central core for electric-light cords consists in braiding a system of covering threads around each conductor and the central core, and simultaneously interlooping the threads of the several systems.



NO. 703,909.—AUTOMATIC FIRE ALARM.

703,842. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring, Philadelphia, Pa. Application filed February 1, 1901.

The receiving apparatus of the system consists of air and ground plates, a coherer connected therewith, decohering means surrounding the coherer, a circuit connected with the decohering means, a sounder having two windings, another circuit operated before the decohering circuit is made to energize both windings, and a condenser circuit energized when the last-mentioned circuit is made and adapted to discharge when the decohering circuit is made, to energize one winding of the sounder.

703,854. Electric Alarm Clock. William E. Throop and William S. Ingraham, Bristol, Conn., assignors to the E. Ingraham Company, Bristol, Conn. Application filed February 25, 1902.

An electric circuit, of which the clock frame constitutes a part, controls a pair of electromagnets, and a switch is connected to a bolt for establishing a circuit through the clock frame when the rider of a resilient arm enters a notch of the cam disk and engages the arbor of the clock.

703,857. Electrometallurgical Treatment of Zinc Ores, and Especially Blende. Constantin J. Tossizza, Paris, France. Application filed August 6, 1901.

For the electrolysis of the sulphate and other salts of zinc, the process described is one whereby a practical reduction of the voltage below two and three-tenths volts is obtained by the aid of sulfurous acid as a depolarizer. The process is divided into two parts to avoid the decomposition of the sulfurous acid and consists as to one part in the electrolysis of the zinc salt with corresponding solution of copper anodes and formation of copper salt, and as to the second part in the electrolytic reconstitution of the copper anodes by decomposition of the so-formed copper salt in a solution preliminarily charged with sulfurous acid.

703,861. Electrolytic Cell and Electrode Therefor. August A. Vogelsang, Dresden, Germany, assignor to William Lewin, Nottingham, England. Application filed March 5, 1901.

In the electrode are combined a series of supporting bars, electrode strips covering the sides thereof, and conducting strips integral with such electrode strips and passing through the electrode between the bars.

703,875. Active Material for Storage Batteries and Process of Making Same. Walter E. Winship, San Francisco, Cal. Application filed March 14, 1901.

The process of forming an active material for storage batteries consists of suitably binding a mass of lead salt which will retain its conformation after immersion, and reducing it by electrolysis to spongy lead in an electrolyte which is a solvent for the lead salt, and from which solution lead trees essentially parallel to each other are plated out within the mass.

703,880. Socket Cover and Globe Holder. John F. Wride, Brooklyn, N. Y., assignor of one-half to Oliver R. Bonner, Brooklyn, N. Y. Application filed September 20, 1901.

An electric-light fixture is described which comprises a cap adapted to serve as a support and provided with a screw, a socket cover provided with a bayonet slot for engaging the screw and other parts.

703,892. Electric Telegraphy. Sidney G. Brown, London, England. Application filed November 5, 1900.

In the system combined with the line or cable are a number of transmitting instruments, a corresponding number of batteries adapted to be worked in series by the transmitting instrument, a corresponding number of recording instruments actuated by the combined effect of positive and negative impulses simultaneously transmitted by the transmitting instruments and adapted simultaneously to register signals on one or other side of their zero lines in accordance with the polarity or direction of the currents having their respective transmitting instruments.

703,895. Separator Plate for Secondary Batteries. Absolam F. Clark, Philadelphia, Pa., assignor to J. Horace Harding, Philadelphia, Pa. Application filed October 18, 1900.

A separator for use in connection with secondary-battery grid plates is described. It comprises a frame, a series of cross-bars secured to the frame and a series of supporting bars at the back of and embedded in the cross-bars, each of the cross-bars forming, with the grates of the grid, a series of pockets.

703,902. Protecting Device for Induction Motors. John H. Diggle, LaSalle, Ill. Application filed October 21, 1901.

The device comprises fuses connected with the terminals of the switchboard, and pivoted independent fuses and a handle carrying the same to bring them in line with and over the first-mentioned fuses.

703,909. Automatic Fire Alarm. Mason K. Fred, Bandera, Texas. Application filed March 22, 1902.

The system comprises two line-wires arranged in a circuit including a source of electrical energy and alarm, loops formed on such line-wires, links carried by the loops and normally held from electrical contact, the links having uninsulated portions adapted to make contact and close the circuit by gravity when subjected to an abnormal increase in temperature. (See cut.)

703,921. Trolley Pole. John D. Hickman, Anderson, Ind. Application filed October 11, 1901.

Combined with a trolley pole are a head pivoted thereto, the plate spring carried by the pole, and having the bracing roller at its upper end engaging the head, and preventing lateral displacement thereof, and stops for limiting the swing of the head in both directions.

703,942. Electric Motor Power-transmitting Device. Herbert S. Miller and Gustave C. Marx, Elizabeth, N. J., assignors to the Diehl Manufacturing Company. Application filed November 30, 1901.

Combined with a sewing or other machine to be driven are an electric motor the shaft of which is separate from the machine and which motor shaft is provided with a brake wheel, a brake to engage the wheel and which is mounted on the motor frame, and a switch, to make and break the electric circuit, connected with the brake so that when the circuit is broken the brake will be applied to the brake-wheel, and when the circuit is closed the brake will be removed from the wheel.

703,952. Electromagnetic Capping Machine. Louis J. Borie, San Francisco, Cal. Application filed October 8, 1901.

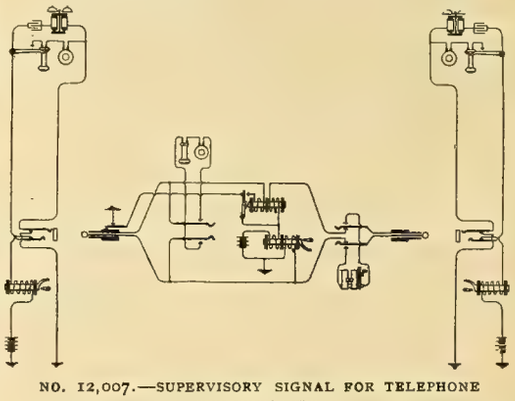
The machine comprises a stationary head supporting a jaw or die, and a movable head carrying a similar jaw or die. Electromagnetic means are provided for adjusting one jaw relatively to the other to vary the degree of pressure exerted on the piece of work introduced between the jaws.

703,953. Self-winding Electric Clock. Charles M. Crook, Bristol, Conn., assignor to the National Self Winding Clock Company, Elgin, Ill. Application filed March 9, 1901.

The invention comprises an electromagnet and the circuit in which it is energized, a striking train and its motor and winding device and mechanism by which the electromagnet operates the winding device.

703,957. Semaphore Indicator for Electric Signaling. Harry Gulliver, South Yarra, near Melbourne, Victoria, Australia, assignor of one-half to Henry Greer Robinson, Melbourne, Victoria, Australia. Application filed April 23, 1902.

A semaphore indicator for electric signaling on railways, tramways, and the like is described. It consists of an electromagnet, an oscillating horseshoe magnetic armature, a rocking bar carrying the armature, an upwardly extending lever arm on the rocking bar, a rod or spindle having a crank arm thereon, a semaphore carried thereby, and a link connecting the crank arm on the rod or spindle with the lever arm.



NO. 12,007.—SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS.

703,970. Electrical Heating Apparatus. John R. Quain, Middlesex County, England. Application filed March 10, 1902.

In the apparatus are combined a vessel provided with an inlet and an outlet, substantially parallel diaphragms mounted in the vessel, a block provided with vertical perforations between the diaphragms, heating tubes passing through the perforations in the block, and means for heating the tubes by a current of electricity.

REISSUE.

12,007. Supervisory Signal for Telephone Switchboards. Charles F. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed February 25, 1901. Original No. 638,426, dated December 5, 1899.

Combined with united telephone lines each provided at its station with means for determining the flow of current in the line in the use of the telephone, a bridge of the united lines and a supervisory signal and a source of current included therein, are a relay with two windings, one included in the line to each station between the station and the bridge, the switch contacts of the relay being adapted to break the circuit of the lines between the bridge and the calling station when the magnet is inert; whereby the supervisory signal is rendered responsive to current in both telephone lines. (See cut.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, JULY 19, 1902. No. 3

Light, Heat and Power at the University of Chicago.

A combined heating, lighting and power plant has recently been installed at the University of Chicago which, on account of the several peculiar conditions that had to be considered in its construction, possesses features of considerable interest. The plant supplies all of the university buildings on the campus, some 25 in number, through a series of tunnels branching from the power house and aggregating over a mile in length. The buildings are located on eight city blocks, just north of Fifty-ninth Street, and the main campus lies between Fifty-ninth and Fifty-seventh Streets and Ellis and Lexington Avenues. The power house is located at the west end of the grounds, near the corner of Ellis Avenue and Fifty-seventh Street. The farthest building connected with the power plant is the new school of education now being erected, which is supplied through a tunnel over 3,000 feet long. Low-pressure steam is furnished by the power plant to heat the buildings and the water used for bathing purposes, and high-pressure steam is used in the various cooking departments. Electric current is used for lighting the buildings and grounds and for operating motors driving elevators, ventilating fans and experimental machinery. Compressed air is also provided for automatic heat regulation and experimental work, and high-pressure water is distributed for fire protection and for house service in the various buildings.

The power house, illustrated in Fig. 2, is a long, single-story, brick building. Its length at present is 297 feet, but a 122-foot extension is being added to provide for additional boiler capacity. The building is 43 feet wide and about 30 feet high from the boiler-room floor to the bottom of the roof trusses. It is divided by three transverse brick walls into a machine shop at the south end, which is 50 feet long, an engine room, 75 feet long, the boiler room, 254 feet in length, and at the extreme north end a coal-storage room, 40 feet in length. Running the entire length of the building and over all the rooms is a Shaw electric crane (Fig. 4) of 21 tons' lifting capacity and provided with two hoisting drums. In order that the crane may pass from one room to another the brick partition walls, are only carried up to the level of the crane tracks and above swinging doors are provided, which are raised when the crane is run through.

Engine Room.

The engine-room equipment comprises three direct-connected generating units of 60, 250 and 350 kilowatts' capacity, a compensator and the station switchboard. A general view of this equipment is shown in Fig. 1. The smallest generator, seen in the foreground, is driven by a single-cylinder Ideal engine at 275 revolutions a minute. Each of the other generators is connected between the cylinders of a double-cylinder simple engine, built by the Ball Engine Company of Erie, Pa., and so arranged that either cylinder can be disconnected and repaired without shutting down the generator. The generators are 250-volt machines and operate in multiple to supply a three-wire lighting service and a two-wire power service. A 20-kilowatt compensator, consisting of two 125-volt motors, is installed for balancing the load on the three-wire circuits, and provision is made for the installation of another compensator of 100 kilowatts' capacity. Provision is also made for the addition of a 450-kilowatt generator in the engine room, and this unit, which will be installed shortly, will bring the generating capacity up to over 1,100 kilowatts.

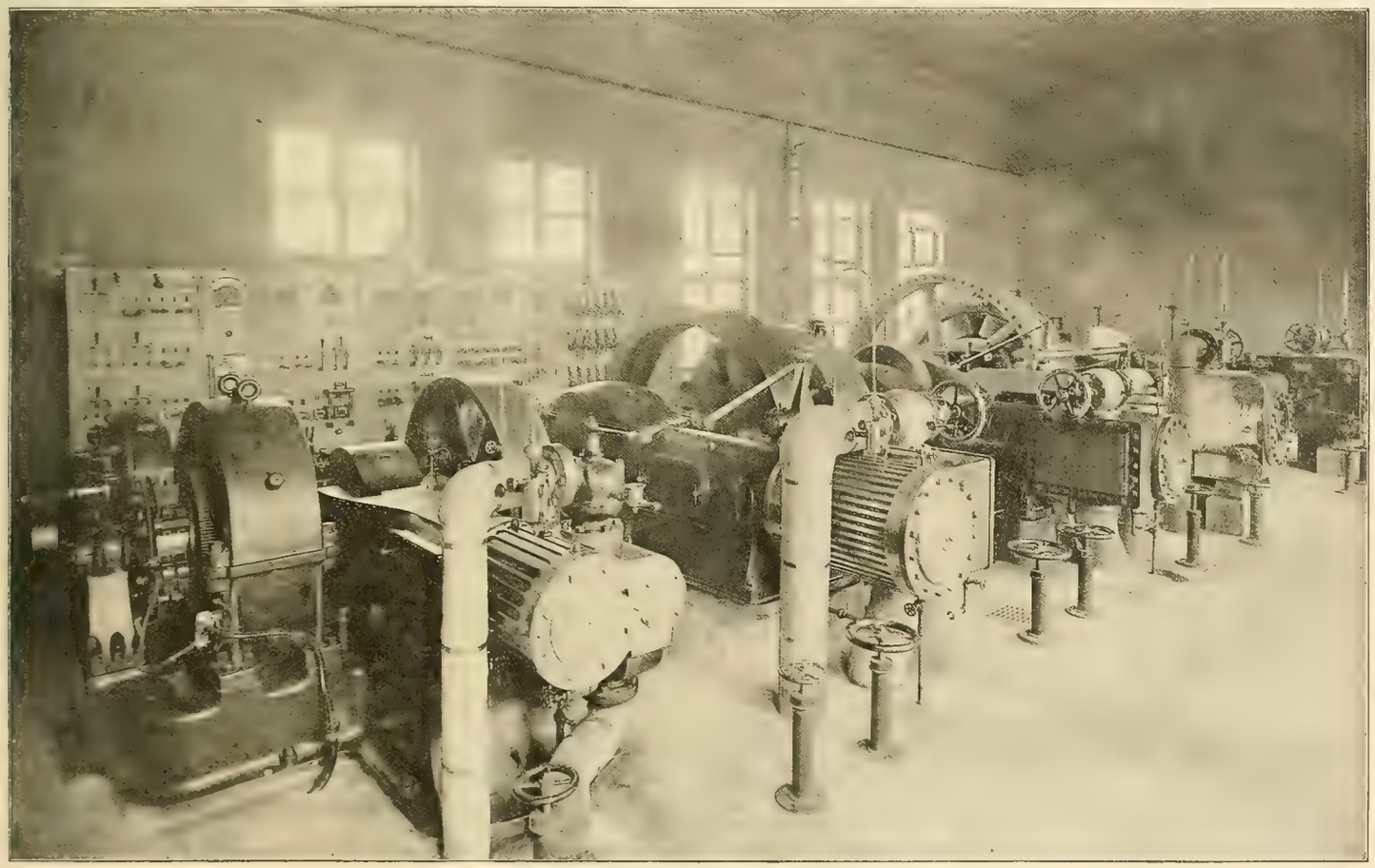


FIG. 1. LIGHT, HEAT AND POWER AT THE UNIVERSITY OF CHICAGO.—ENGINES, GENERATORS AND SWITCHBOARD.

Switchboard and Electric Distribution.

The switchboard of the station is illustrated in Fig. 3. This board has been made a model of its class, all the engineering details having been very carefully and accurately laid out. The panels are of blue Vermont marble, two inches in thickness, polished on faces and edges and supported in angle-steel framework upon ornamental pedestals. The panel at the left end when facing the board is the feeder panel for lighting. It is equipped with 12 three-pole, single-break switches, which connect from the upper bus-bars on the back of the board to the various feeders. At the extreme right-hand end of the board is another feeder panel, used for power, and equipped with 12 three-pole, single-break switches, connected to the lower bus-bars.

Adjoining the lighting and feeder panels are the totalizing panels, containing voltmeters, voltmeter switches and indicating wattmeters. The remaining panels are the two generator panels and the compensator panel. The former are equipped with two three-pole switches for each generator, making eight switches for the four generators. These switches are so arranged that either generator may be thrown on the power or light buses, or on both. At the lower end of each of the generator panels are Western Electric single-pole laminated-type automatic circuit-breakers, one for each generator. At the upper end of the panels are the ammeters and rheostat controllers. All the instruments are of the Weston illuminated-dial type and are set flush with the front of the board.

Upon a panel adjoining the generator panels is the compensator panel, equipped for two compensators, the equipment comprising a multiple-type Cutler-Hammer starting box for the large compensator and an ordinary starting box for the small one. This panel also contains the equalizer and neutral switches and a special automatic release switch, which protects the compensators by automatically short-circuiting the series coils in case the series field should at any time overpower the shunt field, as might be the case were the system at any time thrown considerably out of balance.

The fuse panels are on the back of the board and arranged in banks gradually projecting beyond each other, so that the upper bank projects the most. This prevents molten metal falling onto any of the lower fuses in case of fuses blowing, besides considerably facilitating the operation of replacing fuses. Open-link fuses are used. The bus-bars are of the laminated type, and are supported independently of the marble or framework directly from the floor. The upper bus-bars are used solely for power and the lower bus-bars for lighting.

The lighting service of the plant supplies 14,000

16-candlepower, 115-volt incandescent lamps used for interior illumination of the buildings and 23 2.5-ampere, 240-volt enclosed-arc lamps for lighting the campus. Seven arc lamps are also installed in the power house. The power circuits at present supply about 500 horsepower in motors in various buildings. These motors are used for different purposes, such as driving ventilating fans and operating electric pumps in the basements of some of the buildings to raise the drainage water from sumps to the level of the sewer system. Motors are also used to drive printing machinery in the Press Building, to operate electric elevators in that building and the dormitories for women, to drive experimental machinery and fans for a blast furnace in the physics laboratories and also to operate some exhaust fans. An interesting use of electric current is also made in the Zoology Building, where 12 electric heaters are employed to maintain even temperatures in the incubators. These heaters are of the Leitz type and take from two to four amperes of current. They are placed beneath the incubators and are regulated by an ingenious method of thermostatic control.

Fig. 2. Power House, Showing Extension.

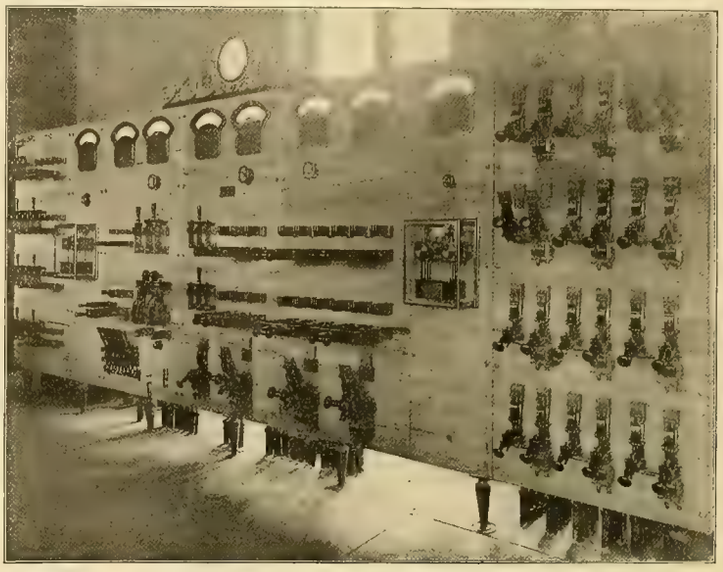


Fig. 3. Light and Power Switchboard.

LIGHT, HEAT AND POWER AT THE UNIVERSITY OF CHICAGO.

Machine Shop.

A very complete machine shop for the making of repairs and alterations to the power-house equipment is located at the south end of the building. The tools are all motor driven and are equipped with Cutler-Hammer starting boxes. A 2¾-horsepower motor, mounted on the wall, drives a machine lathe and in the center of the room is a 4½-horsepower motor that drives an emery wheel, a grindstone and a drill press. A pipe-fitting machine, with a range from one-eighth to four-inch pipe, is operated by a 3½-horsepower motor and a larger machine, taking four to 12-inch pipe, is driven by a 4½-horsepower motor. One of the assistants at the plant has ingeniously reconstructed a small direct-current motor and made it into an alternating-current generator for testing purposes. The alternator is driven by the 4½-horsepower motor used to run the emery wheel and drill press, and is excited from the direct-current mains. A general view of the machine shop is shown in Fig. 4. In the foreground of the picture are shown two electric-fan outfits on hand trucks that will be mentioned later in connection with the tunnels.

Boiler Equipment.

Ten horizontal tubular boilers comprise the present boiler equipment and an additional installation of 10 boilers is now being made. Each boiler is 72 inches in diameter and 16 feet long and has a capacity of 125 horsepower, thus making a boiler equipment of 2,500 horsepower. They are set in batteries of two each and are suspended in a simple manner, so that a shell may be easily withdrawn at any time, by means of the overhead crane, for purposes of cleaning, inspection or repair. A view of the present boiler plant is given in Fig. 5. It shows the 10 existing boilers, the mechanical and induced-draft fan equipment and a portion of the foundations for the new boilers.

Jones underfeed stokers are used to feed the coal into the fireboxes, and the air supply is furnished hot to improve combustion and thus obtain the greatest amount of heat and minimum amount of smoke. This last provision is so well arranged for that practically no smoke is discharged from the stack. The heating of this air supply and the economizer for heating the feed water are original features which have been especially adapted to the needs of this plant. The products of combustion are carried from the boilers through a tunnel extending the entire length of the boiler settings and under their rear end. In this tunnel is installed the economizer, consisting of 15,000 linear feet of two-inch wrought-iron pipe. From these pipes the gases pass into another tunnel immediately in front and containing 6,000 feet of six-inch pipe, in which the air for combustion is heated to about 300 degrees before it is delivered to the fires. The gases are then drawn into the stack by an American induced-draft fan directly connected to a steam engine. A forced-draft apparatus, consisting of an American blower fan driven by a 50-horsepower electric motor, is used to force the air of combustion through the hot-air pipes and into the boilers. Natural draft is also provided for by means of a separate tunnel which can be connected directly between the stack and boilers. In regular operation the products of combustion are reduced to 250 to 275 degrees before they are delivered to the stack, and the amount of heat represented between this temperature and that of the gases leaving the boilers, about 550 degrees, is absorbed by the water and the air for combustion to be delivered again to the boilers.

The stack of the power house, shown in Fig. 2, has a capacity to take care of the full equipment of boilers. It is octagonal in shape and 150 feet high, with an internal diameter of nine feet. It is built with a concrete base on 100 piles driven 40 feet into the ground on hard pan.

The boiler-plant equipment includes a continuous-reading econometer and other testing instruments used in determining analyses of the products of combustion and of the coal used. It is the intention soon to carry on complete and thorough tests with a great variety of coals to determine which is the best suited for use in the boilers. To aid in this work daily records are kept of the performance of the boilers.

In the engine room is located an air pump which maintains an air pressure of 80 pounds per square inch in a central reservoir. Receiver lines are run to the different buildings for use in experimental work and in the thermostatic heat regulation. Compressed air is also used to clean the boiler and economizer tubes and for lubricating all the machinery.

Tunnels.

All the heating mains, electric conductors and air pipes necessary to connect the buildings are carried from the power house in two tunnels, one leading from the engine room and the other from the new boiler room. Branches are carried to the various buildings as is needed. These tunnels vary in width from 10 to six feet and in depth from six to four feet. It was necessary to build them comparatively shallow and just below the surface, as the permanent water line is only 6½ feet below the average level of the campus. The tunnels are built with concrete bottoms, brick walls and I-beam and brick-arch tops, covered with cinders. Steam for heating purposes is carried from the power house in seven

FIG. 4. LIGHT, HEAT AND POWER AT THE UNIVERSITY OF CHICAGO.—MACHINE SHOP.

12-inch mains, and three eight-inch mains carry high-pressure steam. Two eight-inch pipes are used for the heating returns and two two-inch pipes carry the air supply. The electric conductors consist of paper-insulated cables, encased in lead, and are carried in ducts in the bottom of the tunnel and covered with wooden planking.

The construction of the tunnels has an experimental feature, in that the steam mains are not covered with heat-insulating materials. The tunnels have been made so as to insulate against the escape of the heat as much as possible, and it is estimated that by this means the extra cost of fuel necessary to supply the increased radiation will be less than the interest on the considerable investment that would be entailed to cover the pipes. As there would be poor chance for vegetation to grow above the tunnels, they have been built under the stone walks and roadways and although the heat given off is not great, it was found sufficient last winter to melt a light fall of snow on the walks above.

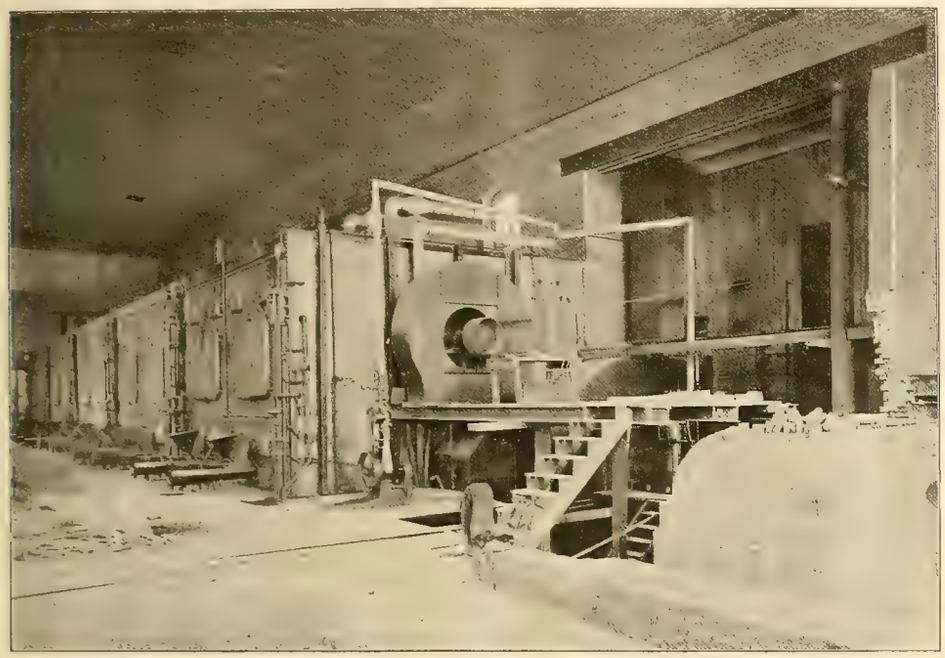


FIG. 5. LIGHT, HEAT AND POWER AT THE UNIVERSITY OF CHICAGO.—BOILER ROOM.

As the inside of the tunnels are of about the same temperature as the steam pipes, it was necessary to devise some means of cooling them in order to make repairs. This is easily accomplished by the two outfits illustrated in the foreground of Fig. 4 and spoken of above. Each of the outfits consists of a 1¼-horsepower electric motor mounted vertically above and on the same axis with a disk exhaust fan. The fan is supported on a truck over a circular hole and about 200 feet of electric cable is provided on a reel, so that connection may be made with an electric circuit at an arc-lamp post. The fans are placed over adjacent manholes in the tunnel and one forces fresh air into the tunnel and the other exhausts from the tunnel, so that a current of cool air is maintained and the workmen are enabled to make their repairs.

CONCLUSION.

The power plant was designed by A. D. Houghton of New York city, and Goble Brothers of New York have the contract for the installation. John Wright, formerly chief engineer at the Northwestern Elevated power house in Chicago, is chief engineer of the plant. All the electrical machinery, including motors, generators and switchboard, was furnished and installed by the Western Electric Company of Chicago. The boilers were placed by the Titusville Iron Company of Titusville, Pa.

Radion, a New Element.

Professor Marckwald of the University of Berlin is said to have announced that he has discovered a new element. The element is called radion. It is active and of extraordinary energy. Professor Marckwald has separated it from radio-active bismuth, so-called polonium, found in uranium ore, which consists, as Professor Marckwald discovered, substantially of ordinary bismuth and the new metal in the proportion of a thousand to one. The new metal can be separated by the electrolytic process. The rays it emits are something like those of the metal radium, but differ in being almost completely absorbed by paper as well as by glass. Professor Marckwald is said to have proved that a porcelain tube heavily charged with electricity by rubbing, immediately lowers its charge when a morsel of this metal weighing hardly a milligram is brought within a distance of one decimeter.

The Progress of Electric Space Telegrapy.

By G. Marconi.

PART II.

Another successful system of tuning or syntonizing the apparatus was the outcome of a series of experiments carried out with the discharge of condenser or Leyden-jar circuits. I tried by means of associating with the radiating wire, or capacity, a condenser circuit, which is known to be a persistent oscillator, to set up the required number of oscillations in the radiator. An arrangement consisting of a circuit containing a condenser and a spark gap constitutes a very persistent oscillator. Professor Lodge has shown us how, by placing it near another similar circuit, it is possible to demonstrate interesting effects of resonance by the experiment usually referred to as that of Lodge's syntonic jars. But, as Lodge points out, "a closed circuit such as this is a feeble radiator and a feeble absorber, so that it is not adapted for action at a distance." I very much doubt if it would be possible to affect an ordinary receiver even at a few hundred yards. It is, however, interesting to notice how easy it is to cause the energy contained in the circuit of this arrangement to radiate into space. It is sufficient to place near one of its sides a straight metal rod or good electrical radiator, the only other condition necessary for long-distance transmission being that the period of oscillation of the wire or rod should be equal to that of the nearly closed circuit. Stronger effects of radiation are obtained if the radiating conductor is partly bent round the circuit containing the condenser (so as to resemble the circuits of a transformer).

My first trials with this system were not successful, in consequence of the fact that I had not recognized the necessity of attempting to tune to the same period of electrical oscillations (or octaves) the two electrical circuits of the transmitting arrangement (these circuits being the circuit consisting of the condenser and primary of the transformer and the aerial or radiating conductor and secondary of the transformer). Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonized transmitter is shown in Fig. 1. The period of oscillation of the vertical conductor A can be increased by introducing turns of wire, or decreased by diminishing their number, or by introducing a condenser in series with it. The condenser in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity.

The receiving-station arrangements are shown in Fig. 2. Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, I place an adjustable condenser across the coherer in Fig. 3. Now, in order to obtain best results, it is necessary that the free period of electrical oscillation of the vertical-wire primary of transformer and earth connection should be in electical resonance with the second circuit of the transformer, which includes the condenser. I stated that in order to make the tuning more marked a condenser is placed across the coherer. This condenser increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble but properly tuned electrical oscillations being received, the effect of the same is summed up until the electromotive force at the terminals of the coherer is sufficient to break down its insulation and cause a signal to be recorded. In order that the two systems, transmitter and receiver, should be in tune it is necessary (if we assume the resistance to be very small or negligible) that the product of the capacity and inductance in all four circuits should be equal.

It is easy to understand that if we have several stations, each tuned to a different period of electrical vibration, and of which the corresponding inductance and capacity at the transmitting station are known, it will not be difficult to transmit to any one of them, without danger of the message being picked up by the other stations for which it is not intended. But, better than this, we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers. Different messages can be sent by each transmitter connected to the same radiating wire simultaneously and received equally simultaneously by the vertical wire connected to differently tuned receivers. This result, which I believe was quite novel at the time, I showed to several friends of mine, including Dr. J. A. Fleming, F. R. S., nearly two years ago. Dr. Fleming made mention of the results he had seen in a letter to the London Times, dated October 4, 1900. I have further noticed that the tuning can be further improved by the combination of the two systems described. In this case, the cylinders are connected to the secondary of the transmitting transformer, and the receiver to a properly tuned induction coil, and all circuits must be tuned to the same period as already described. This arrangement is going to be further tested in long-distance experiments shortly to be undertaken between England and Canada.

The syntonic systems have not been applied generally to ships, as it has always been considered an advantage that each ship should be able, especially in case of distress, to call up any other ship or ships which may happen to be at the time within the range of its transmitter, but in the case of land stations the syntonic method has been applied in several instances where necessity demanded it. Thus, at the testing stations which maintain communication between St. Catherine's, Isle of Wight, and Poole, in Dorset, when electric waves of a certain frequency are used, no interference whatever can be caused by the working of the Admiralty installations in the vicinity. The long-distance station at Poldhu, Cornwall, is able to transmit signals decipherable on a tuned receiver on a ship at over 1,000 miles distance, while the Lloyd's wireless station at the Lizard, only seven miles away, is not affected by the powerful waves radiated from Poldhu, if tuned to a different frequency.

I am not at all prepared to say that under no possible circumstances could a wireless message transmitted between syntonic instruments be tapped or

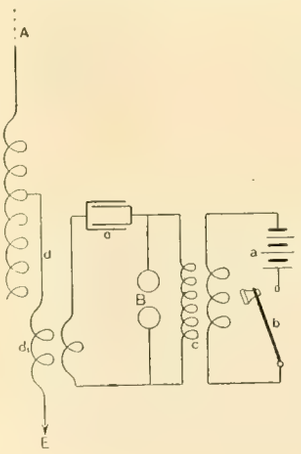


Fig. 1.

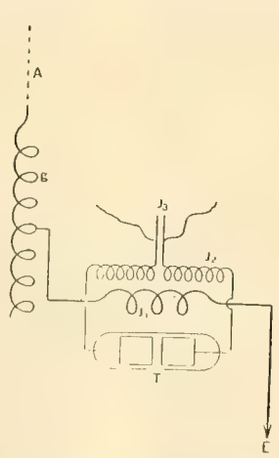


Fig. 2.

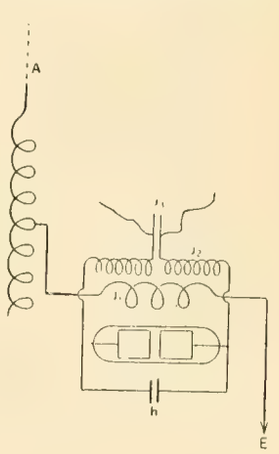


Fig. 3.

ELECTRIC SPACE TELEGRAPHY.

interfered with, but I wish to point out that it is now possible to work a considerable number of wireless-telegraph stations simultaneously in the vicinity of each other without the messages suffering from any interference. Of course, if a powerful transmitter, giving off waves of different frequencies, is actuated near one of the receiving stations, it may prevent the reception of messages, but the ordinary systems of communication through wires may be likewise affected. Professor O. J. Lodge, in a report of his experiments in magnetic space telegraphy, mentions that he was able to interfere with the working of the ordinary wire-telephone system in the city of Liverpool. Sir W. H. Preece has also published results which go to show that it is possible to pick up at a distance on another circuit the conversation which may be passing through a telephone wire. About two years ago, at Cape Town, it was found impossible to work the cables landing there during certain hours when the electric tramways of the town were running, and the matter became subsequently the subject of litigation between the companies concerned. Professor Fleming, who has witnessed the working of a great number of syntonic wireless-telegraph stations, was sufficiently impressed by what he saw to make the following statement in his Cantor lectures on "Electrical Oscillations and Electric Waves," delivered before the Society of Arts in December, 1900: "The objections as to interference of stations which imperfectly informed persons are in the habit of raising with regard to Mr. Marconi's system of wireless telegraphy, as a matter of fact, no longer exist."

I shall now say a few words on the subject of the detector of the electric waves, called sometimes "the electric eye," which consists of that essential part of the receiving apparatus especially affected by the electrical oscillations. In all wireless-telegraph apparatus used up to quite a recent date, a detector, now called a coherer, has been employed. This detector is based on discoveries and observations made by S. A. Varley, Professor Hughes, Colzecchi, Onesti and especially Professor Branly. Professor O. J. Lodge has made large use of this apparatus, which he first named "coherer," in the very numerous experiments and studies he has carried out on the effects produced by Hertzian waves. The form of coherer I have found most trustworthy and reliable for long-distance work consists of a small glass tube, about four centimeters long, into which two metal pole pieces are tightly fitted. They are separated from each other by a small gap, which is partly filled with a mixture of nickel and silver filings. Provided such a coherer is properly constructed, and the tapper and relay in good adjustment, it proves to be quite reliable when within the range of the transmitting station. Experiments with syntonic systems have, however, shown that certain kinds of coherers can be far more advantageously employed than others. One apparently all-important condition is that the resistance of the coherer in its sensitive state, or after being tapped, should appear to be infinite when measured with an electromotive force of about one volt. If the tapping does not entirely do away with the conductivity of the filings very poor results are obtained, which can be explained as follows: According to the systems I have described, electrical syntony between the transmitter and receiver is dependent on the proper electrical resonance of the various circuits of the transformers used in the receivers. The condenser and secondary of the transformer must not be partially short-circuited by the coherer, otherwise the oscillations cannot mount up or sum up their effect, as is essential in order to produce the difference of potential at the ends of the coherer necessary for breaking down its resistance; but the electrical oscillations will leak across the conductive coherer without causing it to record any signal. Of course, the condenser is short-circuited when the filings cohere under the influence of the received oscillations; but in this case the signal is already recorded, and the tapper at once restores the coherer to its non-conducting condition, and in this way restores its sensitiveness.

By using coherers containing very fine filings the necessary condition of non-conductivity when in a sensitive state is obtained. Coherers have lately been tried which will work to a certain extent satisfactorily without the necessity of employing any tapper or decoherer in connection with them. Nearly all are dependent on the use of a carbon microphonic contact or contacts which possess the curious quality of partially reacquiring spontaneously their high-resistance condition after the effect of the electrical oscillations has ceased. This enables one to obtain a far greater speed of reception than is possible by means of a mechanically tapped coherer, the inertia of the relay and tapper which are used in connection with it being necessarily sluggish in their action. In all these self-decohering coherers a telephone which is affected by the variations of the electric current, caused by the changes in conductivity of the coherer is used in place of the recording instrument. It has not yet been found possible, so far as I am aware, to actuate a recording instrument or a relay by means of a self-restoring coherer. The late Professor Hughes was the first, I believe, to experiment with and receive signals on one of these coherers associated with a telephone. His experiments were carried out as early as 1879, and I regret that this pioneer work of his is not more generally known. Other self-restoring coherers were proposed by Professors Tommasina, Popoff, and others, but one which has given good results when syntonic effects were not aimed at was (according to official information communicated to me) designed by the technical personnel of the Italian navy. This coherer, at the request of the Italian government, I tested during numerous experiments. It consists of a glass tube containing plugs of carbon or iron with between them a globule of mercury. Lieutenant Solari, who brought me this coherer, asked me to call it the "Italian Navy Coherer." Recently, however, a technical paper gave out that a signalman in the Italian navy was the inventor of the improved coherer, and I was at once accused in certain quarters of suppressing the alleged inventor's name. I therefore wrote to the Italian minister of marine, Admiral Morin, asking him to make an authoritative statement, to which I could refer in the course of this address, of the views of the Italian Admiralty on the matter. The head of the Italian navy was good enough to reply to me by a letter, dated the 4th inst., in which he makes the following statement, which I have translated from the original Italian: "The coherer has been with good reason baptized with the name of 'Italian Navy Coherer,' as it must be considered fruit of the work of various individuals in the royal navy, and not that of one." These non-tapped coherers have not been found to be sufficiently reliable for regular or commercial work. They have a way of cohering permanently when subjected to the action of strong electrical waves or atmospheric electrical disturbances, and have also an unpleasant tendency toward suspending action in the middle of a message. The fact that their electrical resistance is low and always varying, when in a sensitive state, causes them to be unsatisfactory for the reasons I have already enumerated when worked in connection with my system of syntonic wireless telegraphy.

These coherers are, however, useful if employed for temporary tests in which the complete accuracy of messages is not all-important, and when the attainment of syntonic effects is not aimed at. They are especially useful when using receiving vertical wires supported by kites or balloons, the variations of the height of the wires (and, therefore, of their capacity) caused by the wind making it extremely difficult to obtain good results on a syntonic receiver.

Coherers have long been considered as constituting almost the essential basis of electric space telegraphy, and although many other detectors of electric waves existed, none of them possessed a sensitiveness which even approached that of a coherer, and most of them were also unsuitable for the reception of telegraphic messages. With a view to producing a receiver which could be worked at a much higher speed than a coherer, I was fortunate enough to succeed in constructing a magnetic detector of electric waves, based on a principle essentially different from that of the coherer, and which I think leaves all coherers far behind in speed, facility of adjustment and efficiency when worked in tuned circuits. This detector, which I had the honor of describing in detail before the Royal Society yesterday, possesses, I believe, a sensitiveness which surpasses that of the best coherers. The magnetization and demagnetization of steel needles by the effect of electrical oscillations has long been known, and was noted especially by Professor T. Henry, Aloria, Lord Rayleigh and others. Mr. E. Rutherford, also, has described a magnetic detector of electric waves based on the partial demagnetization of a small core composed of fine steel needles previously magnetized to saturation. By means of a magnetometer, Mr. Rutherford succeeded in 1895 in tracing the effects of his electrical radiator up to a distance of three-quarters of a mile across Cambridge. But Mr. Rutherford's arrangement is not suitable for the reception of telegraphic messages in consequence of the fact that a careful process of remagnetization which requires some time to effect, is necessary in order to restore its sensitiveness after the receipt of each impulse. Mr. Rutherford's arrangement is also considerably less sensitive than a coherer.

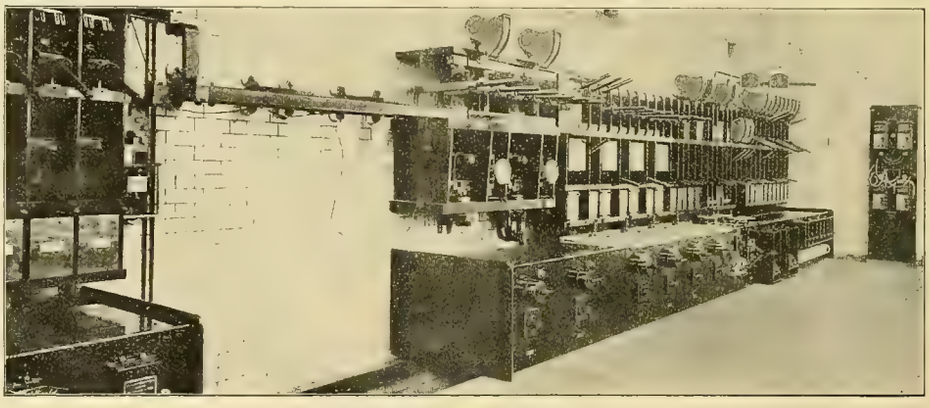
[*To be continued.*]

The Central Power and Equipment Company of Beaumont, Texas, has been incorporated with a capital of $10,000. The company will electrically pump and store oil in the oil districts of the state.

A Recent British Railway Switchboard.

The corporation of Cardiff, Wales, has recently placed in operation a system of electric railways that is entirely new, including tracks, power plant and most of its equipment. The power plant consists of four inverted vertical cross-compound condensing engines, direct-connected to 300-kilowatt, 550-volt, direct-current generators. Two more units of 1,600 horsepower have been ordered. A 56-cell storage battery, with a capacity of 2,100 ampere-hours, is also installed.

The main switchboard, shown in the accompanying illustration, possesses some features that differ from standard American practice. According to the Tramway World of London, it is built direct into the main wall at one end of the engine room, and stands back in a recess, taking up 42 feet of the total width of the room. Immediately in front of the board there is a clear space 10 feet in width. The gallery is carried right through into the boiler house and to the coal bunkers beyond, so that the engineer in charge can control the whole station with the smallest amount of trouble. The switchboard, which is of the standard Ferranti pattern, consists of 10 feeder panels, each of 600 amperes' capacity; two return feeder panels, each of 1,500 amperes' capacity; one positive booster panel; one negative booster panel; three panels for motor-generator and battery; one Board of Trade panel; four 300-kilowatt generator panels; two 900-kilowatt generator panels; four panels for controlling the supply of current for private and public lighting and power purposes, each of these panels having a capacity of 1,000 amperes. On the front of the board there is a table standing out from the board two feet six inches, upon which the field-regulating and motor-starting switches are placed, the resistances being below the board. There



A RECENT BRITISH RAILWAY SWITCHBOARD.

are also four panels on the front of the table for controlling the works, motors, battery and regulating cells, etc.

There are two independent sets of main bus-bars for controlling the traction and lighting loads, each having a section of six square inches. All the switches are designed for a current density of 60 amperes per square inch of contact area. Each panel is fitted with an automatic circuit-breaker of the Ferranti pattern, and the various instruments are of the edgewise type. The recording instruments were supplied by Elliott Brothers, and the wattmeters are of the Thomson type. There are three Weston type illuminated-dial voltmeters at each end of the board for lighting and traction purposes. An independent switchboard controls the works' lighting.

New Edison Storage-battery Patents.

Of four patents issued to Thomas A. Edison on July 8th three have the same title, "Reversible Galvanic Battery," and cover different compositions of active materials. No. 704,303 describes a battery with an alkaline zincate as the electrolyte, and an "oxygen-storing" element, which comprises an intimate mixture of finely divided oxide of mercury and flake graphite. A magnesium plate receives the deposited zinc.

The parts of the battery described in patent No. 704,304 comprise an alkaline electrolyte and two conducting supports, one of which carries finely divided oxidizable iron and the other an oxide of cobalt intimately mixed with flake graphite. This oxide of cobalt, it is explained, should have more oxygen than the black oxide of cobalt (Co_3O_8).

Finely divided copper mixed with flake graphite forms the material carried by one conducting support in the battery described in patent No. 704,306 and an electrolytically oxide of nickel or suitable magnetic material other than iron is carried on the second support.

No. 704,305. relates to an "Electrode for Batteries," consisting of a support carrying a number of pockets or receptacles in which the active material is placed. These pockets are arranged in substantially the same plane, each pocket being made of elastic material with corrugated walls.

Static Interrupter for High-tension Circuits.

Ever since the first introduction of lightning arresters on power circuits, choke coils have been used to some extent as auxiliaries. These choke coils are the type of apparatus which is adapted to protection against static waves, for in passing through a choke coil, a static wave is smoothed or flattened out and its abruptness reduced. As the choke coils frequently used have not always been designed with the definite object in view of protecting particular apparatus from the local concentration of potential, they have often been inadequate. A sufficiently powerful choke coil in the path of a

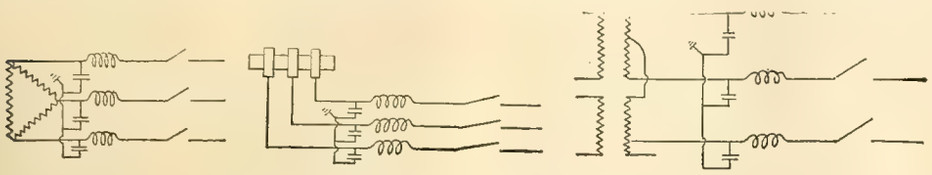


Fig 1. Fig. 2. Fig. 3.

STATIC INTERRUPTER FOR HIGH-TENSION CIRCUITS.

static wave will render the wave practically harmless, but if a less powerful choke coil be used, it may not reduce the severity of the wave materially, and little benefit may be derived. Another important point—different designs of apparatus require different choking power in the coils which protect them, for the static wave must be much more completely smoothed out to relieve from strain a transformer coil of many turns than one of few. This follows, for charge can penetrate into a coil of few turns much more quickly than into one of many.

For moderately high voltages, effective choke coils can be constructed and should always be used, but the choking power of these coils should be at least approximately proportional to the apparatus to be protected. But it will be found in most cases in very high-tension circuits that if a choke coil powerful enough to prevent dangerous strains be placed in the line, this coil will seriously interfere with the normal operation of the circuit, or that it will get hot when carrying full load, or have an excessive cost. In other words, such a coil will be found impracticable.

It becomes, therefore, very desirable to find some other way of accomplishing the same purpose without

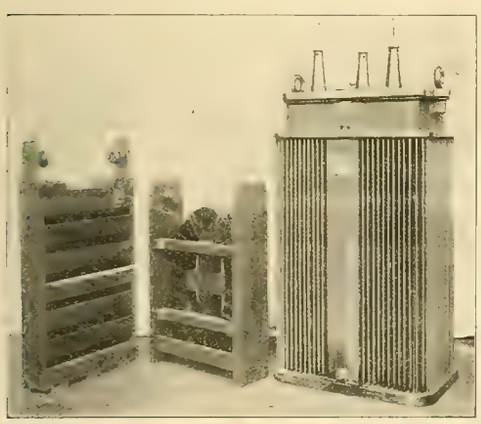


FIG. 4 STATIC INTERRUPTER.—COIL, CONDENSER AND CASE.

excessive cost or interference, with the normal operation of the line. The "static interrupter" is such an arrangement. This apparatus has been designed by Percy H. Thomas of Pittsburg, Pa., and was described recently by him in a paper read before the Canadian Electrical Association.

The device consists of a condenser, in connection with a comparatively small choke coil, the condenser being connected between line and ground. The line connection is made between the apparatus to be protected and choke coil. With this arrangement, a comparatively small coil may be used, for the condenser, by absorbing a large part of the charge which passes the coil, multiplies its choking effect. It is possible by increasing the size of the condenser to get almost any desired degree of protection.

To summarize, the static interrupter consists of a choke coil and a condenser, forming together a device for effectively rendering harmless the abrupt waves resulting from lightning and similar causes. The protective power of the interrupter must be proportionate to the design of the apparatus to be protected. This adjustment need not, however, be very close. As the interrupter has a choke coil in series with the line, it must be suited to carry a certain current, and as it contains a condenser, must also be adapted to a definite voltage and frequency. As both coil and condenser experience an energy loss when in use, the case of the interrupter must be so designed as to dissipate this heat properly.

Since switching is one of the prominent causes of static strains in such high-tension circuits as require the use of static interrupters, the apparatus should be so placed that no switching shall occur between the interrupters and the transformer or generator to be protected, usually in their leads. In some cases, however, such an arrangement leads to an unnecessarily large number of interrupters. For instance, when two or three, or more, transformers are operated in a group on polyphase circuits, interrupters may usually be placed in the leads of the groups, instead of in the leads of the individual transformers. In this case no switching is permissible within the interrupters except under the following conditions:

(1) Circuit-breakers or fuses may be open under heavy loads or short-circuits, since the arc formed prevents any change of potential at the terminal sufficiently abrupt to cause serious local concentration.

(2) High-tension windings of transformers may be thrown in and out of service at will, provided their low-tension windings are excited from the same source as the high-tension bus-bars. Such switching causes no change of potential at the terminal. For example, if it is desired to cut off one transformer from the group of three connected in delta, cut out the high-tension winding of the one to be removed from circuit. Though this causes the transformer to drop its load, no material change is made in the potential of its terminals, since the low-tension winding is still in parallel with the other transformers. The low-tension switchings may now be opened.

In connecting back this transformer to the delta, the low tension should first be connected to the other transformers, which will magnetize the iron and cause the high tension to assume line potential, though it will not, of course, be carrying any load. The high-tension switchings may then be closed without causing any change of potential, and the transformer will pick up its share of the load. On the other hand, if the high-tension winding be connected to the bus-bars first, we have a violent raising of the potential of the terminals. The general arrangement for static interrupters in commercial circuits protecting generators and groups of transformers are shown in Figs. 1, 2 and 3.

Fig. 1 shows three static interrupters protecting three transformers connected in delta. In Fig. 2 are shown the connections for three single-pole static interrupters protecting a three-phase generator. Single-phase and two-phase generators are protected by two and four single-pole static interrupters, respectively, connected in a similar manner. Fig. 3 shows three static interrupters protecting two transformers connected for three-phase high-tension and two-phase low-tension circuits.

The static interrupter provides protection against local concentration, but is not expected to provide protection against strains to ground. Of course, as an interrupter (and, in fact, a lightning-arrester choke coil as well) delays as well as smooths out static waves, it will give an arrester properly placed on the line side of the coil more time to discharge, and will thus indirectly help to prevent strains to ground; but, in general, the static interrupter performs an entirely different function from the lightning arrester. It is supplementary, not a substitute.

Some of the characteristics of actual interrupters designed by Mr. Thomas for commercial service may now be considered. In these interrupters, which are illustrated in Figs. 4, 5 and 6, choke coils are

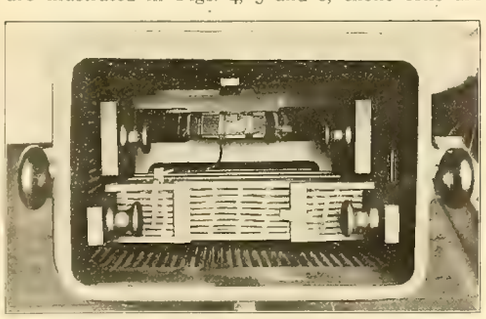


FIG. 5. STATIC INTERRUPTER.—INTERIOR VIEW.

wound of several turns per layer and are very heavily insulated; they are wound without iron core.

Condensers are built up with thin copper plates and sheets of insulating material, consisting of special treated fullerboard, the whole being immersed in oil. There are ventilating spaces provided for oil circulation, to prevent dangerous rise of potential in the interior of the condenser. Three leads are brought from the interrupter, one for the line, one for the apparatus and one for the ground connection. The cases are provided with the oil-level indicators, by which the depth of oil in the case may be determined without removing the top. The relative location of coil and condenser and the connection between them, are shown in Fig. 5, which gives an internal view of an interrupter without oil. Fig. 4 shows the coil, condenser and case of an interrupter, and Fig. 6 illustrates a case for a triple-pole static interrupter.

As comparatively little has been published of the characteristics of high-tension condensers, Mr. Thomas presents some of their most important peculiarities.

(1) The charging current, temperature being constant, is proportional to the voltage and to the frequency and to the capacity of the condenser. The capacity (or, more accurately, specific inductive capacity) in condensers for interrupters, increases with temperature, though not very fast. Ordinarily, an increase of from 10 to 20 per cent. may be expected for a rise from 20° C. to 70° C.

(2) The electric energy stored in the condenser measured in watt-seconds or joules, is one-half the product of the capacity in farads, and the square of the voltage. One watt-second equals 11-15 foot-pounds. The maximum energy actually stored in the condenser of an interrupter for protecting a modern-sized 30,000-volt transformer would be something like three joules = three watt-seconds = 2.2 foot-pounds.

The statements following refer to condensers of the type used in the static interrupters referred to; other types may have different characteristics.

(3) There is a very considerable heat loss in the dielectric of condensers when subjected to alternating voltages somewhere near the safe limit of the insulating strength. These losses may be made greatly to exceed one watt per cubic inch without attaining a voltage high enough to break down the condenser.

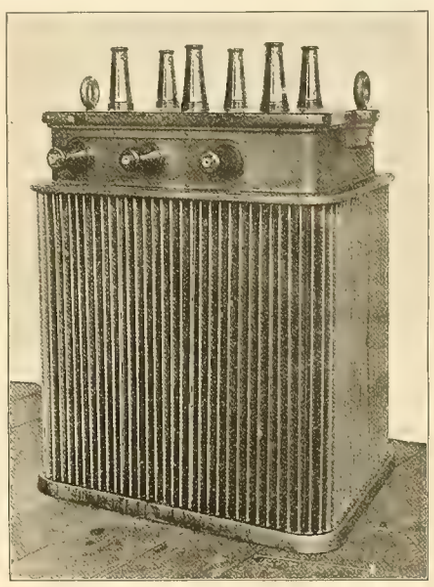


FIG. 6. STATIC INTERRUPTER.—TRIPLE-POLE TYPE.

The loss is approximately proportional to the square of the voltage, and increases very fast with the temperature. If the loss in the condenser is one watt per cubic inch at 20° C., it may be three or four watts or more, at 80° C. This is at once a very surprising and important result that must be carefully noted in the use of condensers, for a condenser which has a comparatively small loss when running in a cool place, may, if transferred to a hot atmosphere, have its loss so increased by the higher temperature as to heat up rapidly and break down. On the other hand, as noted above, the specific inductive capacity, which determines the charging current, not the loss, of the condenser, does not vary nearly as rapidly with the temperature, although increasing somewhat.

Condenser losses are very greatly increased by the presence of moisture in the insulating material. A very small amount will cause a dangerous increase. It is consequently very important not to expose high-tension condensers to the atmosphere, unless they are thoroughly moisture-proof.

In a concluding paragraph of his paper Mr. Thomas says: "The subject of static disturbances is most fascinating, and destined to be of considerable importance on high-voltage plants. Much can be gained in relieving the apparatus of static strains without sacrificing the quality of the commercial service, by the careful planning and operation of the plant. In this connection, it will be well to caution engineers against the danger of improperly conducted over-potential tests on apparatus. The specifications of the American Institute of Electrical Engineers for testing the insulation of apparatus provide for the use of a spark gap in connection with the apparatus to be tested, which is expected to break down and prevent any increase in voltage above the testing limit. It is readily seen that such a breakdown of the gap causes the worst condition for producing static strains between turns of coils in the apparatus, as not only is the change of voltage extremely abrupt, but the amount of the strain is much beyond the voltage of normal operation. In all cases where such a spark gap is used, a very high resistance or powerful choke coil should be placed in the connections of the gap to prevent its breaking down and causing a sudden change in the potential of the terminal of the apparatus. In fact, any sparking which may occur in temporary wiring when special high-voltage tests are being made upon apparatus may cause injury to insulation."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Light, Heat and Power at the University of Chicago. Illustrated	33, 34, 35
Radion, A New Element	35
The Progress of Electric Space Telegraphy. By G. Marconi. Illustrated. Part II	35, 36
A Recent British Railway Switchboard. Illustrated	36
New Edison Storage-battery Patents	36
Static Interrupter for High-tension Circuits. Illustrated	37
Editorial	38
The De Forest-Smythe Wireless Telegraph. Illustrated	39
Mrs. Tutt's Proposed Arizona Power Plant	39
The Situation in Denver	39
Long-distance Wireless Test Over Land by Marconi	39
Development of the Telephone Field	40, 41
Ohio Telephone Notes	40
Telephone News from the Northwest	40
Indiana Telephone Items	40
Southern Telephone Developments	40
Recent Telephone-patent Suits	40
Pole Question in Jamestown, N. Y. By T. S. Lane. (Communication.)	40
American Bell Output	41
Telephone Men	41
General Telephone News	41
Manufacturers and Dealers	41
Use of the Telephone in Operating Railroad Trains. Part III	41, 42
Stanley Company's Affairs	42
Garrigus Mechanical Boiler Cleaner. Illustrated	42
Meston Patent for Lubricated Bearing for Electric Ceiling Fans Sustained	42
St. Louis World's Fair Notes	42
Besly Badger Grease Cup. Illustrated	42
Traveler's Electric Stove. Illustrated	42
New Weston Direct-current Instruments. Illustrated	43
Waterpower Development on Drainage Canal Below Joliet	43
Electrical Development at Portland, Oregon	43
The Ideal Electrical Engineering Course. By Charles P. Steinmetz. (American Institute of Electrical Engineers.)	44
The Late Professor Rowland	44
Boat and Electric-railway Connection Between Chicago and Cincinnati	44
Selection of Street-railway Motor Equipment. By Fred A. Jones. (Southwestern Gas, Electric and Street Railway Association.)	45

DEPARTMENTS.

Correspondence	45, 46, 47
New York Notes	45, 46
New England News	46
Southern Developments	46
Niagara Falls	46
Canadian Intelligence	46
From the Buckeye State	46, 47
Information from Indiana	47
Northwestern Notations	47
On the Pacific Slope	47
Personal	47
Electric Lighting	47, 48
Electric Railways	48
Automobiles	48
Power Transmission	48
Societies and Schools	48
Publications	48
Electrical Securities	48
Telegraph	48
Space Telegraphy	48
Miscellaneous	48, 49
Trade News	49
Business	49
Illustrated Electrical Patent Record	49, 50

CONVENTIONS AND EXPOSITIONS.

New York State Independent telephone men, Rochester, July 23d and 24th.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, White Mountains, September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

IT is to be regretted that there is almost a complete absence of electrical apparatus on display in the American Exhibition in London. When the idea of such an exhibition was first suggested it had the support of several electrical concerns, but in the execution electrical exhibits seem to be entirely lacking. At this distance, although the fact is known, the reason for this strange omission is veiled in obscurity. As the Western Electrician has several times pointed out, the great bulk of the foreign electrical trade of the United States is with Great Britain and its dependencies. It would seem, therefore, that an American Exhibition in London would be a particularly appropriate theater for a compact display of the latest electrical machinery and apparatus that this country has to offer; but the opportunity has been neglected.

"ELECTRIC" is a word having the amplitude and elasticity of the very mantle of charity. It is applied to many contrivances which are shrewdly supposed to have very little connection with "the thing called electricity." A man can get an "electric" belt for his waist, "electric" insoles for his feet, and now an inventive genius announces an "electric headache cure" for the head. This simple device is made to be attached to the hatband, inside of the hat, or bound to the head by an elastic band. It "produces a strong galvano-electric current which not only cures headache, but is a great stimulus to the roots of the hair." And thus the march of invention goes on. But we fear that the new appliance may come into direct competition with the electric hairbrush, in which event there might ensue grievous and unseemly strife even in the very camp of the benevolent alleviators of human ills.

MICA continues in steady demand at increased prices. The government statistics show the total amount of plate mica produced in the United States during 1901, as reported to the United States Geological Survey, was 360,060 pounds, valued at $98,859, as compared with 456,283 pounds, valued at $92,758, in 1900. Thus the average price of this product in 1900 was about 20 1-3 cents a pound and in 1901 27½ cents a pound. In addition, there was a large falling off in the amount of scrap mica produced in the United States in 1901, estimated at 2,165 short tons, valued at $19,719, as compared with 5,497 tons, valued at $55,502, in 1900. The importation of mica from Canada and India tends to curtail the production in the United States, especially the Indian mica, which can be imported at a cost lower than that for which it can be mined in this country. There was an increase in the production of plate mica in North Carolina, which furnishes by far the greater part of the mica mined in the United States, but a large falling off in the production of scrap mica. The imports of mica in 1901 were valued at $335,054, as compared with $319,560 in 1900 and with $275,984 in 1899. The use of mica in sheets for stoves, chimneys, etc., has increased greatly, but still more the use of small circular disks and rectangular pieces of mica for insulation purposes, especially for electrical apparatus. Ground scrap mica is used in the manufacture of wall papers, lubricants, etc. Scrap mica, also, arranged on a wire net coil, and then pressed into proper shape, is used satisfactorily as a steam-pipe covering, mica being a non-conductor of heat. It is interesting to note that a great American electrical manufacturing company—the General Electric Company, in fact—is establishing a plant for the manufacture of mica in Ottawa, Ont. This Canadian factory will employ 150 hands at once and perhaps 400 when fully established. This fact is of some significance. It indicates the trend of American manufacturing concerns in establishing plants in Canada and also shows that mica, the almost indispensable insulating material, enters to a greater extent into the manufacture of dynamos, motors and other electrical apparatus than one would at first thought imagine.

CENTRAL-STATION men will be pleased with the news that the disastrous rate war in Denver is about over. A correspondent sends us a brief history of the wild competition in the electric-lighting business that has been waged in that city during the last two years. It is freely asserted that the new company was organized for the purpose of forcing its purchase by the old company at an inflated price. If this was the case, little sympathy will be wasted on it because it failed in its object, for such a design is hardly to be included in the purview of legitimate competition. The fight has excited widespread attention, owing to the prominence of Mr. Henry L. Doherty, the former president and present receiver of the Denver Gas and Electric Company. Mr. Doherty has just retired from the presidency of the National Electric Light Association and is one of the most progressive and intelligent central-station managers in the country. His friends will congratulate him on the fact that his company—the older one of the two—although somewhat battered, is "still in the ring," after what appears to have been an exceptionally bitter contest.

AFTER lasting much longer than it should have done, or, indeed, than would have been believed possible two weeks ago, the strike of the Chicago freight handlers has been settled, to the great relief of the electrical manufacturers and dealers of this city, in common with all other business men having other than purely local connections. Chicago distributes electrical apparatus over a large territory, and, as may be readily understood, a ten-day interruption of freight traffic was a very serious inconvenience. Some shipments were made by express, and the railroads succeeded in moving a few by freight, but, in general terms, the rail-borne commerce of the city, outgoing and incoming, was stopped. Such a drastic interference with freight traffic was bewildering. It is a truism, of course, to say that it should not have occurred, but nevertheless it did occur, and it is much easier to deplore the fact than to point out the remedy, unless it be compulsory arbitration in all labor troubles affecting common carriers. Great credit is due Mr. F. W. Job and his associates on the Illinois State Board of Arbitration for their unwearied efforts to bring about a settlement of the difficulty. The mediation of these gentlemen was partly successful in bringing the strike to an end, as it was; and that the settlement was a tardy one is no fault of theirs, as they have no powers beyond those of moral suasion.

AN exceedingly interesting announcement is made by the St. Louis Exposition authorities to the effect that they will award a prize of $3,000 (which might better have been ten times as great) to any person who shall transmit, without wires, energy amounting to one-tenth of a horsepower for a distance of 1,000 feet, presumably on the exposition grounds and during the period of the show. Of course, literally taken, the conditions named for the feat would offer no great difficulty to those familiar with the transmission of power by mechanical means; but undoubtedly the idea is not only to exclude wires, but all other hitherto-used agents, as ropes, belts, or air or water in pipes, the plan being, seemingly, to encourage the possibility of power transmission by propagating electrical waves in the ether. This is a most fascinating subject, and Tesla and others have conducted experiments to determine the manner in which the prospect may be succeeded by actuality. If the comparatively small reward offered should stimulate the experimenters to solve the problem of transmitting energy through the ether, the achievement would undoubtedly be the greatest with which the name of the exposition could be connected—far greater than the historic Frankfort-Lauffen experiment of 1891, which, to electrical men, has made the Frankfort Exposition of that year famous.

The De Forest-Smythe Wireless Telegraph.

A year ago appeared in the columns of this journal the first printed description of a new American system of space telegraphy—one invented and up to that time developed in Chicago by Lee De Forest and Edwin H. Smythe, assisted by Professor C. E. Freeman. During the twelvemonth that has since elapsed much labor and capital have been expended upon the system, and satisfactory progress has been achieved. The De Forest Wireless Telegraph Company has been incorporated under the laws of the state of Maine; laboratories and work shop have been opened in Jersey City; two regular stations have been equipped on opposite shores of New York Bay, between which messages have been exchanged daily for some months; another station for long-distance communication with ocean-going and coast-wise vessels has been opened at Coney Island, and others are now in progress of erection.

The new receiver, or "responder," as it has been named, depends on an electrolytic principle for its action. During the last year the sensitiveness of this device has been greatly increased. It is now asserted that the receiver will respond with absolute certainty and regularity to a spark of one sixty-fourth-inch length from a small coil 40 feet distant, driven by one cell of storage battery, with a two-foot antenna at receiver and coil, and without ground connection at either end.

The transmitter does away with induction coils, all interrupters and make-and-break devices, as it has been found that a large percentage of the uncertainties and failures in wireless messages is due to the imperfections and irregularities of these devices.

A special key, very like the ordinary Morse key, has been devised, with a view especially to high-speed work. The make-and-break is under oil, and the operator is fully protected from contact with high-voltage wires. The key also automatically switches the upright conductor, or antenna, from receiver to sender, so that the operator is enabled instantly to "listen in" after sending, and at the same time it is impossible to close the primary circuit while the receiver is connected to the antenna.

By virtue of the automatic quality of the responder it is possible to use a telephone in circuit with the device, and the employment of a relay is rendered unnecessary. By this means a speed of 40 words the minute can be obtained, it is said, and, under ordinary circumstances, a speed of 25 to 30 words is regularly accomplished. One hears in the telephone, as it were, the sound of the sending spark, be this a high or low frequency, in dots and dashes.

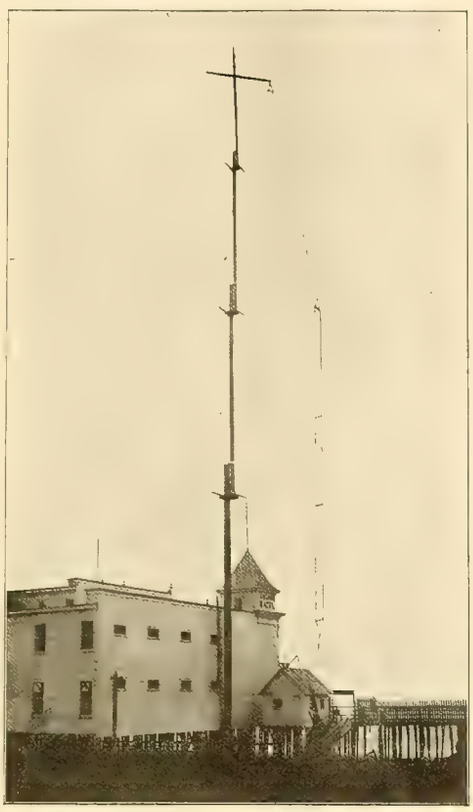
In proof of the sensitiveness of the responder when the operator is equipped with head telephone, it is stated that on February 22d signals from the Etruria were heard at the Jersey City station, from a mast but 30 feet above the roof, when the steamer was fully 90 miles distant. This was without any "jigger" or transforming device whatever at the receiving end.

By virtue of the automatic quality of the receiver, whereby the sound impulses as heard are identical in frequency with that of the transmitter spark, the relay or "call" in use employs a reed attuned to a certain frequency per second. Thus only when the calling station uses a frequency of spark in tune with this reed will the "call" respond and summon the listening operator. The opportunity this feature gives to the system for a mechanical or acoustic syntony, in distinction from and in addition to the electrical syntony, is pointed out.

During the last month a regular station and school for operators has been opened by the De Forest company on the roof of the Cheeseborough Building, 17 State Street, New York. Here is a house built of glass over an iron frame, and fully equipped with sending and receiving apparatus. The antenna here is 60 feet in height. The companion station is located at Hotel Castleton, Staten Island—the first hotel in the world, by the way, to be equipped with a wireless plant.

The most important land station yet established by the De Forest company is that at Steeplechase Park, Coney Island. This enjoys the distinction of having the tallest mast in America, a fine stick of four pieces, standing 210 feet high. This station, which is illustrated herewith, is supplied with 60-cycle alternating current at 110 volts from the Edison mains. This is stepped up in two transformations to 25,000 or 50,000 volts, as desired, and applied direct to the spark terminals. These latter are of special construction and connected with the condensers give a spark of exceptional clearness and power.

On June 14th, the first day the Coney Island station was operated, the first communication with a vessel equipped with the De Forest-Smythe system was also established. On the Ward liner Morro Castle, bound for Havana, a moderately high (60-foot) antenna had been rigged, and transmitter and receiver installed. Messages to and from ship and shore were exchanged, until the vessel was 50 miles from port. Previous to this test the Staten Island station had maintained communication with the Hamburg-American liner Deutschland on her last trip East, up to a distance of 70 miles. The Deutschland was



DE FOREST-SMYTHE WIRELESS TELEGRAPH.—210-FOOT MAST AT CONEY ISLAND STATION.

equipped with the Slaby-Arco system, but there was little trouble in intercommunication between the two systems save that the German operator sent so slowly that his signals were difficult to read by ear. The De Forest company has secured desirable land near the government lighthouse at Montauk Point, and proposes erecting a station there at once, as well as others at important points along the coast.

Mrs. Tutt's Proposed Arizona Power Plant.

Mrs. I. E. Tutt, manager of the Arizona Power Construction Company, and R. S. Masson, consulting engineer of the same company, have made a journey to Fossil Creek, where they have located a large water right and power-house site. This company proposes to build a plant to transmit power to Prescott, Jerome, Big Bug, Lynx Creek and the many mines around those districts. Several large substations will be located at the centers of the various mining districts.

Fossil Creek is 52 miles from Prescott. Fourteen miles from the head of this creek 2,250 cubic inches of water has been taken up by the company, but at its outlet into the Verde River evaporation and seepage reduce it to about 1,800 inches. By tunnels and flumes the company will reduce this loss of water greatly, so there will be a saving of several hundred inches. There is a 1,500-foot fall to the stream and over 5,000 horsepower will be generated.

Mrs. Tutt, who conceived and now manages the enterprise, is, as the readers of the Western Electrician are aware, one of the prominent electrical personages of the Southwest. She has constructed various electrical plants now being successfully operated on the coast. Last March she secured from the original owners the present water rights, and shortly afterward the Arizona Power Company was incorporated. H. C. Cutler and J. H. Quinton are the engineers in the field, with O. H. Newman of Los Angeles as consulting hydraulic engineer. The company expects to have the plant in full operation in about a year.

This will be the first long-distance transmission plant in Arizona, except the 25-mile line of the Phœnix Light and Power Company; but it will be but the beginning of a series of like developments, as Mrs. Tutt has already plans for several more, ranging in size from 2,500 to 12,000 horsepower.

The Situation in Denver.

Denver, July 11.—It is believed that the war between the Lacombe Electric Company and the Denver Gas and Electric Company is at an end, and that prices will soon be restored and the properties consolidated. The closing chapters of this bitter fight are not without interest.

In the latter part of April the Court of Appeals reversed the decision of the District Court holding that the 10-year contract with the Lacombe company was valid. On May 1st the Denver Gas and Electric Company passed into the hands of a receiver, and in the latter part of June the Lacombe company was purchased by people supposed to represent the Denver Gas and Electric Company. On July 2d General Irving Hale was announced as manager of the Lacombe company, and on July 3d Charles F. Lacombe made an unsuccessful effort to commit suicide.

For nearly two years the most bitter warfare has been in vogue. Every known and previously unknown method has been used. It was a fight to a finish for supremacy of the Denver lighting business. The policy of the old company seemed to be one of "rule or ruin." The appointment of the president of that company as receiver on May 1st was unexpected. It is now asserted that this movement did not result from financial embarrassment, but was taken to prevent a dissatisfied element of the stockholders from obtaining control of the company and changing its policy.

The change of control of the Lacombe company was a surprise, coming at a time when it had apparently overcome every obstacle. It was at first supposed that the Lacombe company had sold out at a handsome profit, but it is now stated that the two years of warfare had so involved it that it was forced to sell out at a figure fixed by the purchaser and that this figure meant a heavy loss to all the investors.

One of the former owners of the Lacombe company said: "Lacombe and some others of us attempted to exploit this scheme on its merits, but our heaviest financial backers were in for a quick profit by selling out. The old company is capitalized for nearly $8,000,000, and our backers were playing for a million-dollar profit from the old company's money. We had a 10-year contract with the city for 1,000 arc lamps at $90,000 and a contract for steam coal at $1.30 a ton, and we did not see how we could lose, but the determined policy of the old company showed that it had equal confidence in its position, and this, coupled with all manner of attacks on our property, gradually weakened our financial backers.

"From a million dollars' profit they dropped to a half million, and for the past few months it has been a play to get back our money and make any profit we could. Just prior to the appointment of a receiver for the old company we offered to sell out at a very small profit, but the offer was rejected by their president, who is the present receiver, with a counter proposition, which practically amounted to a demand for our unconditional surrender. The policy of the old company was ruinous, and we tried to arouse their investors to take action to save their property as well as ours, but just before the annual stockholders' meeting we found the officers of the company had anticipated our movement by throwing the property into the hands of a receiver.

"The situation then looked hopeless, and as a last move we commenced to buy up their stock to give us a standing in court to oust the receiver or to compel him to advance the ruinous rates he had established, but in the meantime we had become hopelessly involved in debt and had internal troubles, and were forced to sell out at what we could get."

Mr. Doherty, the receiver for the Denver Gas and Electric Company, was approached, but would not even admit that his people now controlled the Lacombe company. He said he did not know when the receivership would end and denied that there was now any dissatisfaction with his management of the company, but admitted there had been some dissatisfaction shown a few weeks back. G. W. T.

Long-distance Wireless Test Over Land by Marconi.

William Marconi recently installed a wireless-telegraph apparatus on board the Italian flagship Carlo Alberto, which was en route to Cronstadt. On July 15th he telegraphed the Marconi company at London that he had received messages from Poldhu, the station on the Cornwall coast, at Cape Skagen and Cronstadt. The distances are respectively 850 and 1,400 miles from Poldhu, crossing England at its widest point and a part of Denmark. Mr. Marconi added that his new magnetic receivers beat all others in sensitiveness.

The people of Ballard, Wash., have voted in favor of bonding the city to the amount of $25,000 for an electric-light plant.

DEVELOPMENT OF THE TELEPHONE FIELD.

Ohio Telephone Notes.

Good progress is being made toward refinancing the United States Telephone Company, through plans outlined in the Western Electrician last week. It is stated that the greater part of the stock has been disposed of by the heads of the new syndicate that has taken it up. The increase of capital stock of $1,000,000 has been authorized by the directors, although but $200,000 of it will be disposed of now, the remainder to be kept in the treasury for future improvements and extensions. For the month of May the company made a phenomenal showing, the gross earnings being $24,491.76, as compared with $11,926.39 for the same month in 1901. Deducting interest charges and expenses, the net balance for the month was $3,871.96, as compared with $472.37 last year. A meeting will probably be held within the next 60 days, when all the directors will resign and new ones will be elected. However, it is expected that there will be no radical change in the operating management, since it has been very satisfactory in the past. That the company will be put in good, sound financial condition again seems certain now, but until it is there will be little development in the lines or improvement in those already in operation.

The Home Telephone Company of Toledo is now going into service with 6,000 telephones. This will give the long-distance lines a good outlet to the northwest.

The Dayton plant will be ready for operation early in January, it is thought, and the Springfield exchange will also be ready within a reasonable time, as will that at Hamilton. This will almost complete the development of the large cities and towns of the southwestern portion of the state outside of Cincinnati. It is said that the Independent lines and exchanges have had such an effect in a business way that the jobbers in cities that have them have won away a large amount of trade from those which do not have the service. This influence is being so strongly felt in Cincinnati that the business men are being won over to the idea of having an Independent system installed there. It is the only large city in this section of the country that does not either have the system in operation or where a plant is not in process of construction. West to Indianapolis and south along the Mississippi Valley all the large cities are equipped or will be, and even in New Orleans a new company has been organized and a plant will be built by it.

The trouble between the City and Suburban Telephone Association and the officials of Covington, Ky., has been settled by the company agreeing to furnish several free telephones to the town offices, in return for the privilege of erecting certain lines through the streets. The temporary injunction secured some time ago has been dissolved.

The People's Telephone Company of Mount Blanchard has been incorporated with a capital stock of $25,000, to build and operate exchanges in Mount Blanchard, Arlington, Jenera, Marten and Forest. The officers of the company are as follows: President, J. M. Crawford, Columbus Grove; vice-president, Milton May, Mount Blanchard; secretary-treasurer, Nora Samson; manager, Oscar Wise.

The Chardon Telephone Company, Chardon, has filed notice with the secretary of state of an increase of capital stock from $10,000 to $25,000.

Plans have been completed for the new building the Bell Telephone Company will erect for its Cumminsville branch. The building will be 35 by 53 feet in dimensions and two stories high above the basement. The second story will contain the switchboard, of 3,000 capacity. The branch will serve all subscribers within a radius of four miles northwest of Cincinnati.

It is stated that the Citizens' Telephone Company of Columbus has practically completed a deal with the Automatic Switchboard Company for a board of its make for the exchange. The officers of the company have been making a very thorough investigation of the automatic devices, and are well pleased with them. The improvement will cost about $200,000, as new telephones will have to be furnished subscribers.

The Stark County Telephone Company, with plants at Canton and Alliance, has been disposed of to a local syndicate by the Everett-Moore people, and the proceeds have been distributed through the Savings and Trust Company of Cleveland. The company was capitalized at $500,000, with half of the amount issued. The authorized bond issue was also $500,000, but only half the amount had been sold. The Federal Telephone Company owns 85 per cent. of the securities.

Judge J. M. Thomas, formerly manager of the United States Telephone Company, with a number of other gentlemen, has purchased the Everett-Moore holdings in the Portsmouth Telephone Company of Portsmouth. The capital stock is $100,000, and there is a bond issue of $70,000. The plant has 1,000 telephones in operation. The company will be reorganized.

The plant of the Willoughby Telephone Company, owned by the Federal company, has been formally turned over to Fred Storm, who purchased it some time ago for $70,000.

William Hussey, manager of the Independent plant at Bowling Green, has completed his work there and gone to Toledo to give his entire attention to that plant.

W. E. Steinmetz, A. G. McBane and others have incorporated the Bergholtz Telephone Company with a capital stock of $5,000, to build lines in Columbiana, Jefferson, Harrison and other counties in that section.

The Wapakoneta Telephone Company, Wapakoneta, has increased its capital stock from $25,000 to $40,000 and added a number of new telephones. The plant will soon reach the 500 mark.

The Marion County Telephone Company has applied to the Probate Court to grant it a franchise to use the streets and alleys of the village of LaRue for telephone purposes. O. M. C.

Telephone News from the Northwest.

The Winona (Minn.) Telephone Company will shortly secure extended connection at Plainview through the Greenwood Prairie Telephone Company.

The council of Yankton, S. D., has passed a franchise for 20 years, running to the Yankton Telephone Company.

The Farmers and Merchants' Mutual Telephone Company of Le Sueur, Minn., will construct a rural system, running in a number of directions, as soon as possible.

Mayor Smith of St. Paul complains of the way the council grants privileges to the Twin City Telephone Company, without the city getting anything in return.

Charles F. Sise, Jr., superintendent of toll lines of the Bell Telephone Company, in Canada, has been in Minneapolis inspecting the lines of the Northwestern Telephone Exchange Company. He states that the line from Winnipeg to the international boundary will be completed in August. This line will be met by a line from the Northwestern, and will give connection from the Twin Cities to Winnipeg.

W. H. Walker has been granted a franchise at Alden, Minn., for a local and toll system. He will put in a toll system at once and will let the local exchange wait until later.

The Wisconsin Telephone Company will expend $8,000 in improvements to its system at Sturgeon Bay, Wis.

The Mutual Telephone Exchange Company of Des Moines has settled with the strikers.

The Iowa Telephone Company will rebuild the entire toll line between Davenport and Clinton, Iowa.

The local telephone company at Correctionville, Iowa, has found it necessary to abandon an underground cable, owing to dampness impairing the service. Wires have been placed on poles in its place.

The Union Telephone and Telegraph Company has adopted plans for exchange buildings to be erected at Moline and Rock Island, Ill., and Davenport, Iowa.

The central office of the Cedar Valley Telephone Company in Waterloo, Iowa, is located on the bank of the river, and the force of the current has been undermining the foundations of the building to such an extent that the building was regarded as unsafe. Investigation showed that the building was safe unless the river rose considerably, and the telephone service, which had been stopped, was resumed.

The Bismarck Telephone and Electric Company has secured permission from the Northern Pacific railway to string a cable line across the Missouri River bridge at Bismarck, N. D., and will connect with Mandan at once.

The Mitchellville (Iowa) Telephone Company has been incorporated with $10,000 capital stock.

The council of Perry, Iowa, has served notice upon the Hawkeye Telephone Company that its prices must be reduced to $12 on residence connections and $18 on business houses, in accordance with the franchise. R.

Indiana Telephone Items.

The Akron Telephone Company has been incorporated with a capital stock of $5,000. The company proposes to establish, maintain and operate an exchange and telephone system in Akron, Fulton County. Andrew A. Gast is president and C. T. Howe, secretary.

The Knox County Home Telephone Company filed articles of incorporation last week. The capital stock is $125,000. The company will operate telephone exchanges in Vincennes, Monroe City, Bruceville, Bicknell and Oaktown. George Reiter, W. H. Volmer, W. H. Morrison, D. A. Yoder and I. E. Gardner are the incorporators.

Fifty telephone linemen employed in construction work by the United Telephone Company near Marion quit work on Friday. The strikers are union men and the union asserted that the company had discharged union men with the intention of filling their places with non-union men. It is thought a settlement will be reached and the strikers will resume work.

The new South Side branch of the New Telephone Company in Indianapolis has been opened for business. Over 800 subscribers in the district south of the Union tracks will be connected directly with this exchange, which is situated in a new two-story building, fitted up with the latest conveniences for the operators and having many recently patented and improved equipments. The switchboard has a capacity of 1,800 subscribers. Five desk operators, one switching operator, a manager and a trouble clerk, besides a repairing force, will be stationed at the new exchange. The New company will soon install a similar branch on Talbott Avenue, on the north side of the city. F.

Southern Telephone Developments.

The Boyds (Md.) Telephone Company has been merged with a new company known as the Cumberland Valley Telephone Company. The merger with the Maryland Telephone Company of Baltimore, the Westminster company and the Western Maryland is now complete.

The Clovermont (Va.) Telephone Company has been chartered to build a line to Surry Courthouse, Waverly and Petersburg. Its capital is $5,000 and George H. Woods is president.

The Bell Telephone Company has decided upon an entirely new equipment in Augusta, Ga., including new apparatus, machinery, wires and the latest telephone apparatus. A supervisory common-battery switchboard will be installed.

The Cumberland Telephone and Telegraph Company will establish a creosoting plant in Nashville, Tenn., to furnish means of preparing all kinds of timber for use, as poles for wires, on account of the scarcity of cedar poles.

The City Council of Charleston, S. C., has voted that the Bell Telephone Company shall place all wires underground.

Two new Independent telephone companies have been chartered by Kentucky capitalists under the laws of Delaware, to put in telephone exchanges at Paris and Nicholasville, Tenn. Desha Breckenridge of the Lexington (Ky.) Home company is interested. L.

Recent Telephone-patent Suits.

The Western Electric Company has recently brought two suits against Independent telephone concerns. One of the defendants is the Akron (Ohio) People's Telephone Company, which operates an exchange at Barberton, near Akron. It is asserted that apparatus used in this exchange infringes the patent for "Signaling Apparatus for Telephone Switchboards" issued to C. E. Scribner on February 5, 1901, and numbered 667,463. The invention covered in this patent is designed to cause the supervisory signals of two united lines to act independently at certain stages during the connection between the lines and jointly at other times. Barton & Tanner of Chicago are the attorneys for the complainant and Charles A. Brown & Cragg of Chicago, counsel for the Stromberg-Carlson Telephone Manufacturing Company, for the defendant. The bill was filed in the United States Circuit Court at Cleveland on July 12th.

The second suit is brought by the Western Electric Company against the Keystone Telephone Company of Philadelphia. It is based on patent No. 488,038, issued to C. E. Scribner on December 13, 1892, for a "Multiple Switchboard System for Telephone Exchanges." The object of the invention covered by this patent is to provide a system in which the operation of the individual annunciator by signaling currents sent subsequent to the establishment of a connection with the line may be prevented and also to provide a suitable busy test. George P. Barton and Edward Rector of Chicago appear for the complainant and Frank P. Prichard of Philadelphia for the defendant. The bill was filed in the United States Circuit Court at Philadelphia on July 14th. The Western Electric Company was unsuccessful in a previous suit brought against the Keystone company on another patent.

COMMUNICATION.

Pole Question in Jamestown, N. Y.

To the Editor of the Western Electrician:

We note in your issue of July 5th a statement in reference to a misunderstanding between this [the Home Telephone] company and the local Bell company, from which we infer you have been misinformed as to the facts in the case. The city owns seven poles, which are occupied by the city and the Bell company jointly, but the Bell company asserts that it, and not the city, owns the poles. The city refused to grant us permission to set our poles on this particular street, but ordered us to occupy the poles in question. The Bell company says that such occupation by us is an interference with its lines, and proceeded to remove our lines from the poles. We replaced the lines, and on the second attempt of the Bell company to remove them, we restrained them by an injunction. The matter is now in the courts for adjustment. T. S. LANE.

Jamestown, N. Y., July 8, 1902.

American Bell Output.

The American Telephone and Telegraph Company has issued its monthly instrument-output statement for the month ended June 20th, as follows:

For the month—	1902.	1901.	1900.	1899.
Gross output	96,653	96,300	55 613	61,399
Returned	41,741	34,221	25,671	15,668
Net output	54,912	62,079	29.942	45,731
December 21 to June 20—				
Gross output	589,109	469,933	346,146	341,026
Returned	226,267	194,569	132,660	91,737
Net output	362,842	275,354	213,486	249,289
Outstanding, June 20	2,888 854	2,228,170	1.793,991	1,374,539

The net output for the month ended June 20, 1902, was 17,308 less than that for the previous month, and 17,369 less than the high record made in the month ended October 20, 1901.

TELEPHONE MEN.

"There's Nothing Like a Game of Golf," according to the title of a song on sale in the Chicago music stores. The words of this song are by Angus S. Hibbard, and the friends of the general manager of the Chicago Telephone Company bring the soft impeachment that he is the author.

Charles J. Glidden of the Erie Telephone Company, his wife and Dr. F. L. D. Rust of Boston sailed for Europe recently. They will tour the continent in an automobile, visiting places in Great Britain, France, Germany, Italy and Switzerland. They have planned a tour of 3,820 miles. Since last November Mr. Glidden has traveled about 6,000 miles in a Robinson touring car, in New England and New York state.

GENERAL TELEPHONE NEWS.

There was only one bid for the telephone franchise offered for sale by Pomona, Cal.; that was $85, by D. D. Parker, representing the Pomona Valley Telephone Company. It was accepted.

The Eureka Telephone Company of Eureka, Navarro County, Texas, has been incorporated with a capital of $4,000. The company will maintain a telephone line between the towns of Corsicana, Mildred, Angus, Eureka, Birdston, Winkler and Fairfield.

A. R. Metcalf has applied to the City Council of Pasadena, Cal., in behalf of the Home Telephone Company of Los Angeles for a franchise to construct, maintain and operate for 50 years a telephone system in that city. It is understood the company will put in an underground system.

The Chicago Telephone Company will spend $16,000 on a telephone-exchange building at Chicago Heights. The building will be two-story, 24 by 75 feet. The same company has begun the construction of an exchange building at Laflin and Nineteenth Streets, Chicago, the cost to be $30,000.

At the recent annual meeting of the stockholders of the Madison-Clark Telephone Company at London, Ohio, the following-named officers were elected for the ensuing year: President, William M. Jones; vice-president, James F. Rankin; secretary, J. C. McMillan; treasurer, R. W. Boyd; manager, F. W. Peirce. The annual report showed 995 telephones in the system, being a gain of 185 since January 1, 1902.

Papers incorporating the Canadian Machine Telephone Company have been issued by the Canadian government to Hon. George E. Foster, M. P. Ludwig and J. A. Phin of Toronto, Ont., and J. E. Ganong and J. D. Chipman of St. Stephen, N. B., authorizing them to carry on the general business of a telephone company. The capital of the new company is to be $250,000, and the head office will be established at Ottawa.

The Knox Telephone and Telegraph Company has been organized at Rockland, Maine, with a capital of $250,000, $900 paid in, and with Thomas Sherwin, president of the New England Telephone Company, as president, and Fred R. Spear of Rockland, Maine, as treasurer. The latter company is a combination of the interests of the Eastern and New England Telephone companies, both of which have been operating exchanges in Rockland, Maine. The directors of the new company include representatives of both the Eastern and New England. The company will operate in Rockland and vicinity, including North Haven and Vinal Haven Islands.

MANUFACTURERS AND DEALERS.

The St. Louis Electrical Supply Company of St. Louis, Mo., is distributing a new catalogue descriptive of its telephones, switchboards, terminal heads and general telephone equipments for Independent telephone companies. The company states that it is just shipping an order received from the catalogue of over two carloads of material, including everything for a complete telephone exchange.

A competitive telephone test over 400 miles of long-distance telephone lines, conducted by Wilbur H. Johnston, chief engineer of the Frontier Telephone Company, Buffalo, was recently held at Scranton, Pa. The result of this test is said to have been so satisfactory as to warrant the above company immediately placing an order with the Kellogg Switchboard and Supply Company of Chicago for 6,000 telephones complete. It is asserted that the Kellogg transmitters have been tested on lines up to 1,500 miles and found to be perfectly satisfactory.

Use of the Telephone in Operating Railroad Trains.

PART III.

Secretary Drew: How many telephones have you on that line?

Mr. Greene: About seven or eight, I think. There is one half way. I do not know that this is very different from some other devices, but I do not know of any just like it. We concluded to apply for a patent, but we ran against a patent that somebody had secured for grounding from the middle of the ringer coil, which is rather crude, and we concluded (we did not know of this patent at the time) to go further and get something more accurate. We did that by this additional non-inductive coil, balancing the ohmic resistance.

Mr. Ryder: I have been using under similar conditions a coil secured from the Bell company known as the Hess No. 7 repeating coil, just an ordinary coil, made up in a way so you can get at the center of the windings of the two halves of the coil, and the resistance of those coils is only 250 ohms on each one; so that the resistance is very much less than what you have been using. The result seemed to be perfectly satisfactory.

Mr. Greene: I do not know but that half the resistance that we have got in ours might work just as well. I have been thinking of placing this device on a quadruplex circuit. Mr. Ryder seems to think it would be successful. I thought I would just utilize that telephonic circuit on a piece of line we have, 44 miles long, and put that into the quadruplex. I am going to experiment on that on my return. It might not work, but I think it will work alright. The telegraph current does not seem to interfere at all with the telephonic with this apparatus.

H. P. Miller: I am going to say for Mr. Greene's information that we have been using that on our line for some time. It does not interfere with it at all; we are running a single wire from here to Brighton Park, six miles, and connecting that to the telephone, the same as you suggested here, and from there to Bloomington we run the two telephone wires; you cannot tell that the quadruplex is on, or when it is off.

President Jacoby: The point made by Mr. Greene, that of disturbance from high-tension currents, it seems to me, is a very good one—one that we all probably have to contend with: and it comes right in line with another question which I hope we will have time to discuss, that of parallel and overhead wires along the rights-of-way. We have been greatly annoyed by high-tension current, only for about 10 poles' length. Of course, that is comparatively a small matter to overcome, because we can transpose every pole, if we so desire, and can get that very nearly all off, although it is extremely difficult, even then by reason of the fact that the adjoining wires are not equidistant. Now, if those companies would build their lines perfectly parallel, and have them uniformly drawn up to the same height, there would be no difficulty; but you know how they build, according to their right-of-way, here a low pole and there a high one, and the wires not at all uniformly strung on adjoining poles; therefore, it is practically impossible to eliminate all the inductive noise.

Mr. Greene: I presume you can put up twin twisted wires?

President Jacoby: You can use twisted wires; that would be the only remedy; you can then kill all your induction; but when you have 200 or 300 miles to string, you can see what that would lead to; so it seems to me we ought to try and prevent all those things if we want to maintain good, first-class telephone and telegraph service. We do not want to let any one of those power-transmission companies mislead us on that subject.

Benson Bidwell: At Grand Rapids last winter we used a half mile of trolley line for one side of a metallic circuit in telephone; in order to shut off the current we used 1,000 feet of No. 29 german-silver wire in two coils. We could talk successfully, but we did have some trouble with the induction from the 500-volt power circuit. In order, finally, to make a success of it, we had a loud-talking telephone. I thought it might interest you gentlemen to know what we had actually done in talking over a 500-volt current.

President Jacoby: I will state that the 500-volt circuit, which is direct current, does not interfere to any appreciable extent. We have a mile of pole line that contains by reason of the peculiar conditions three different electric-light circuits, and we have six telephone circuits thereon, one of which is a long-distance line. We are able to eliminate every particle of induction on that line; but the moment we strike a 20,000 or 30,000-volt three-phase alternating current, then that is something quite different.

Mr. Annett: I will say that on our line between Grand Crossing and Forty-third Street, Chicago, we have a 6,500-volt, three-phase neutral ground. On our new line, which runs parallel on the Western Union poles, on the extreme edge of the roadway, about 18 feet away, there is not a particle of induction on that circuit. We were talking on that circuit yesterday.

Mr. Miller: In regard to putting in impedance coils and the amount of resistance, does not that depend upon the question of how you signal your distant station? In putting in our line we jumped at the conclusion that as long as we used a magneto ringer in signaling from Bloomington to Chicago, or vice versa, that it was necessary to have our impedance coils heavy enough in resistance so as not to absorb most of the current; inasmuch as we had been using 1,600-ohm bridging bells at the poles at both ends, we concluded that 1,600 ohms would be the proper thing to put in our resistance coil, and so used it. I do not know how we could cut that down without interfering with the ringing.

Mr. Ryder: The ratio is positively different in the experiments of Mr. Greene. I judge from our own experience. We are using, you understand, a 500-ohm coil on each set; that gives you 250 ohms; 1,000 ohms' resistance is a good deal; but I wish to ask the question if it is the judgment of the members of this association present, in the case of the extremely high-tension current that Mr. Greene is bothered with, whether it is probable that transposition will eliminate the trouble? Even taking it for granted that the wires were absolutely parallel, that is, the power wires with the telephone wires, the interference from a 30,000-volt current and that from a 2,000-volt power current, for instance, would be, it seems to me, vastly different, and the two are distinctly different from a 500-volt direct current with a street car.

Mr. Miller: Perhaps some gentleman here from Buffalo can tell us what they have at places between Buffalo and Niagara Falls; for they have any quantity of power current there.

President Jacoby: I observed while coming in over the Grand Trunk a power line, three-phase, along that road from Niagara Falls to Hamilton. I noticed they had a telephone line on some poles and they had the wires transposed every sixth pole, and they had them uniformly strung. I imagine that on that line they are obtaining fair results. Under those conditions, it would be comparatively easy to take care of the trouble. I would rather handle wires on the same pole than I would on adjoining poles close together, because then you have the matter entirely in your own hands, and you can equalize the distance. The theory is—and I suppose would be proven in practice—that so long as you have your wires equidistant and the transpositions exactly alike, you are bound to kill the induction, because what one pole will induce on the telephone wire will be neutralized by what is induced by the adjoining pole in an opposite direction, thus neutralizing the effect. The point is to get a perfect balance.

A thought came to me while Mr. Greene was speaking of his plan for equalizing the ohmic resistance. We have been using a rheostat for that. We find that, in order to maintain a perfectly working telephone circuit, composite circuit, it was necessary to keep both sides of the line perfectly balanced, the same ohmic resistance, not only of the coil, but of the line. There is generally a little difference in the resistance of lines over the same territory, although they may be copper and of the same cross-section. We put in a rheostat to adjust the ohmic resistance on both sides. In that way we get it exactly right. We find that a one-half ohm makes a very nice arrangement. It is all right to put in german silver, so long as you make the resistance of your line arms the same; but sometimes there is a loose connection or a bad joint, or something of that kind that changes the relative resistance of your two sides of your telephone circuit, and we adjust that by means of this rheostat.

Mr. Greene: I will say that between Tacoma and Seattle we made up our coils out of two old duplex spark coils, and we can adjust them, but it has not been necessary so far. We have a milliammeter there to measure the two sides; they are so nearly alike that the difference does not count.

Mr. Annett: A word about transpositions: Mr. Greene referred to the number of poles between. When we started out between Carbondale and St. Louis we adopted this plan: Instead of having 30 posts to this mile, and 35 to the next, we went by the mile posts which are measured to the inch, and we would take just half the distance between each mile post and measure from that to get our transpositions exactly uniform.

Mr. Miller: One other thought: You have to vary your transpositions to correspond with the taking off of different wires on your line at different points where they drop out; if you have an uneven transposition you will find that you will have noise, unless you straighten that out. That has been my experience. It is necessary to make the transpositions equal. That must be carefully looked into. The wires must not be allowed to get loose, your transpositions must be equidistant, and should correspond with all the breaks in all the wires. If that is looked to, I believe that much of the noise we now hear in the telephone will be taken out.

J. J. Nate, Stromberg-Carlson Telephone Manufacturing Company, Chicago: One thing that has impressed itself upon my mind during your deliberations here has been the wide range of inquiry covered, and the points raised in discussion in regard to line troubles, testing to locate the trouble, method of connecting up circuits, inductive results, and other causes pertaining to telephone lines in railway service. The Bell company has an absolute formula which enables it to locate with the greatest certainty and precision line and instrument troubles. I have no doubt that these engineers—Mr. Carty or Mr. Pickernell—would favor you with such formula if you desire it. As to the liability of trouble arising in telephone circuits, these are not really any more

probable or marked than is the case on telegraph lines. When we say that a telephone line frequently gets into trouble, we must also admit the same with regard to telegraph lines. When we discuss the probability of having simply one pair of telephone lines going down, and of that circuit being our sole dependence, we must remember that in telegraph service the condition is similar, except where the system has developed from one wire to a large number of wires. There is no valid reason why the telephone system may not be made as efficient in railroad service as the telegraph has become.

As to the working of a telephone line in connection with a quadruplex system, I understand it has not proven a success so far. Many engineers claim that it never will; but the combination has been successfully operated over Morse circuits for many years. While I do not make this statement from personal knowledge, I remember that when the long-distance telephone lines were constructed by the Bell company between Boston and New York, it was stated that these lines were leased for telegraphic purposes, at an annual rental of about 10 per cent. on the cost of constructing the lines. These wires were used at the same time for telephones, and they have been simultaneously operated, so far as we know, ever since. I understand that between New York and Chicago nearly every circuit is leased as a telegraph circuit in addition to the work of telephoning going on all the time. The solution of the telephone problem is simply to string more wires as you find the volume of business over these lines growing larger.

There is a further probability of wireless telephony becoming a success. At St. Paul or Minneapolis, recently, experiments were made with wireless telephoning across the river, which were successful. Why not the same for moving trains, with wires strung along your pole lines? These are matters of moment, which have yet to be fully developed, and no doubt will be in time.

The calling of aid for the injured is one of the sad applications of telephony—a use which many have found necessary. We can readily appreciate the great value of such a means of communication in case of accident or breakdown on the rails. You are all familiar with the necessity of constant communication in railroad yards, and here the telephone is most efficient, securing many details of information—such as car numbers, make-up of trains, report of crews, switching instructions, location of lost cars, broken rails, and many other uses. Let us suppose that a train is laid out between blocks, and that the mechanism has become inoperative; the telephone affords a means of communication direct with the controlling station. With a pair of wires worked simultaneously over the pole line, or a straight bridged proposition, it is only necessary to provide the train with telephones and suitable connecting apparatus for attaching to these wires, and one is able to call up any station on the line. These appliances could also be used by section men and construction trains; in fact, under all conditions when necessary to save time they are applicable. Conductors could report from intermediate points relative to time, accidents or delays. A means of connection could be in the nature of long poles with terminals at each end, arranged to clamp over the wires, with connections for attachment to the telephone sets at the lower end, or the main wires could be tapped and brought down near the ground on the telegraph poles, at intervals of a few miles apart. The proper connections could be contained within an iron box. Thus a means of communication between trains, section gangs, in fact, between passengers on board a train, could be established. Business men might even attend to important matters; railroad officials could be informed of the true state of affairs, and information secured from outside points.

As to train orders: There is little liability of errors, when you remember that every order must be repeated back and copied in duplicate. If it is stated that errors do not occur in telegraph practice, it may be considered as an amiable prevarication, for that errors do occur is known to all of us. The telephone gives you a better average of service every time.

You are perfectly safe in proceeding along the lines on which you propose to operate at the present time for the development of your simultaneous circuits. You have nothing to fear from the patents. The Independent telephone manufacturers are already preparing to make apparatus on which patents are soon to expire.

[*The end.*]

Stanley Company's Affairs.

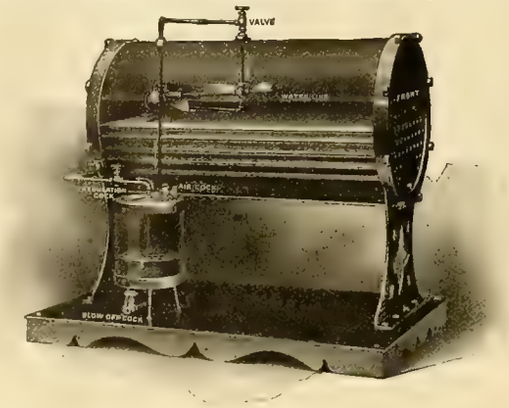
The Stanley Electric Manufacturing Company has filed papers at Trenton, N. J., increasing its capital stock from $10,000 to $4,000,000. The increase is made to enlarge its plant at Pittsfield, Mass., and to extend the scope of its business in the manufacture of electrical supplies.

Philadelphia reports are to the effect that the Electric Storage Battery Company of that city will absorb the Stanley company.

An ordinance for an elevated railway has been introduced in the City Council of St. Louis, Mo.

Garrigus Mechanical Boiler Cleaner.

The illustration shows a mechanical boiler cleaner which is said to have met with much success. The operation of the apparatus is described as follows: "The impurities in water separate under ordinary working pressures and are held in suspension. The sediment thus formed, together with any earthy matter, is carried by the currents to the surface of the water, and then to the rear of the boiler, where it is arrested by the trough-shaped wings; when the junction of the wings is reached, the sediment is taken up by the floating skimmer (the mouth of which is always at the scum line) and discharged through the outlet pipe, with a centrifugal force, into the precipitator. The lower temperature in the precipitator and its special construction causes the sediment to settle rapidly. It then remains in the lower compartment of the precipitator until drawn off through the blow-off pipe. The circulation is completed by the return pipe, which is connected with the boiler, and takes only clear water from the precipitator. Thus the sediment is continuously and effectively



GARRIGUS MECHANICAL BOILER CLEANER.

removed from the boiler. The precipitator should be blown off every two or three hours. This requires very little time; about one minute at each operation."

It is asserted that the use of this cleaner will keep a boiler free from scale, mud, oil and other impurities. Coe, Smith & Co., whose western office is at 413 Western Union Building, Chicago, are the selling agents for this device.

Meston Patent for Lubricated Bearing for Electric Ceiling Fans Sustained.

The suit for infringement involving the Meston patent (No. 622,247) for a lubricated bearing brought by the Emerson Electric Manufacturing Company of St. Louis against the Van Nort Brothers Electric Company, has been decided in favor of the complainant. The case was argued in the United States Circuit Court for the Eastern Division of the Eastern District of Missouri, and the opinion was handed down by Judge Adams. The patent involved covered an improvement in lubricated bearings, designed specially for use in connection with electric ceiling fans. The defenses were want of novelty and non-infringement, but the court states that the grant of the patent to Meston is prima facie evidence of novelty and invention, and that he is unable to find anything either in the patented or unpatented structures relied upon by the defendant as anticipations to disturb the prima facie case made by the patent itself. The opinion concludes that each of the four claims in question involves invention and is valid, that there is practically no dispute about infringement and that the defendant's device involves the invention of each and all the claims. A decree is accordingly entered for the complainant.

St. Louis World's Fair Notes.

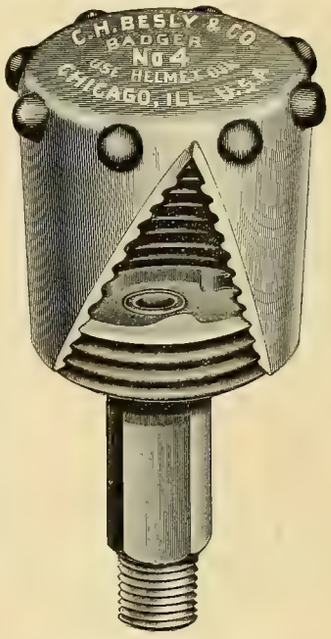
It is announced that the St. Louis World's Fair management will offer a prize of $3,000 to anyone who will transmit, without wires, energy amounting to one-tenth of a horsepower for a distance of 1,000 feet.

Construction work has been begun on the tower which will carry the wires from the electric subway on the exposition grounds to the second-story gallery of the Machinery Building. The foundation from which the tower will rise is 9½ feet below the floor of the building, and will occupy a space 14 feet wide by 22½ feet long. The switchboard for which the tower is to be constructed will be the controlling point of all the electric energy used for light and power on the site. The foundation for the tower will have a base of concrete and walls of fireproof tile, so that the structure will be fireproof in all its parts.

The council of North Amherst, Ohio, is procuring estimates of the cost of installing an electric-light plant.

Besly Badger Grease Cup.

The accompanying illustration shows the new double-depth Badger grease cup, made by Charles H. Besly & Co., 10-12 North Canal Street, Chicago. This cup is used largely on automobiles. It is similar to the firm's regular Badger cup, except that the cap has double the capacity and the stem is made proportionately longer. The Badger cup is made of cast iron and can be operated by hand or wrench. The base has a round thread, and, it is said, will



BESLY BADGER GREASE CUP.

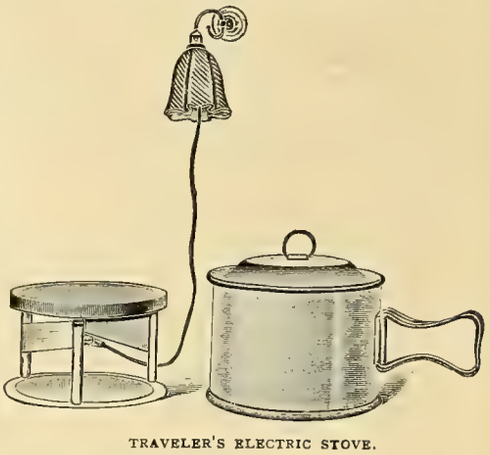
not strip, clog, or cross. The stem being made of bar steel, drilled and threaded, it will not break off in the oil hole.

Traveler's Electric Stove.

The outfit illustrated in the accompanying cut is designed to meet a need for an electric heater that is equally as useful when traveling as at home. The bottom is recessed, so that the cup encloses the heater when set upon it, and locks in place. The heater is of oxidized steel, and the frame of white enamel. It has six feet of conductor cord, and a lamp-socket plug, with an adapter, so it may be connected to either Edison or T.-H. sockets. An asbestos table pad permits its use on a polished table without injury from heat.

The cup has a capacity of three half pints, is heavily tinned inside, and of polished nickel outside. All parts of the apparatus pack within the cup, which is 3¼ by five inches in size and weighs complete 2½ pounds packed.

With this outfit it is said that hot water can be had in one's room when wanted for tea, coffee, shaving,



TRAVELER'S ELECTRIC STOVE.

sickness, etc.; one can boil eggs, cook cereals, make beeftea, etc. The heater is useful for making toast, and even heating a small "flatiron" in an emergency.

The Simplex Electric Heating Company of Boston, Mass., says it has made and sold thousands of these electrical heaters, the same size, but of less portable form, and thousands of people rely on them for their breakfast coffee, eggs, warm rolls, etc. The heaters can be furnished for any voltage up to 250 volts.

Articles of incorporation have been filed at South McAlester, I. T., by the Lehigh Traction Company with a capital of $300,000. The corporation will build and operate an electric line from Atoka to Coal Gate by way of Lehigh and other mining towns. It is estimated that 22,000 people will be served by it. Among the incorporators are Charles Copeland, Thomas Carroll and David J. Young.

New Weston Direct-current Instruments.

Several new types of electrical instruments are being put on the market by the Weston Electrical Instrument Company of Waverly Park, Newark, N. J., among which the "duplex" direct-current instrument is worthy of special mention. This instrument is illustrated in Fig. 1 and is called "duplex" because it contains a voltmeter and an ammeter in one case. For some purposes this combination will be found much more useful than two instruments in separate cases. For instance, in many cases where practically simultaneous readings of current and potential difference are to be made, these instruments will be found more convenient to use on account of the close proximity of the scales and indexes, and they will also be found specially useful in all cases where space is limited and compactness is a necessary or desirable feature. At present the company makes two models of this type of instrument, designated as R and T, respectively.

In the R model the two instruments are enclosed in a neatly designed and nicely finished waterproof aluminum case, which closely surrounds the operative parts of the instruments. These instruments are particularly suitable for use on electric vehicles on account of extreme lightness, compactness and freedom from danger of injury by water, snow, moisture or dust and dirt. The dimensions of this model and weight are as follows: Length, 9½ inches; width, seven inches; height (or depth), 3¼ inches; weight (without shunt), eight pounds.

It is asserted that thousands of these instruments are in daily use in this country and abroad, and are giving excellent results. They were originally designed for automobile service, and extreme care has been taken in designing and constructing the whole instrument, and especially, the moving parts, so as to be able to bear without injury the constant vibration to which such instruments are subjected while in use on vehicles.

Aside from their adaptability to use on vehicles, these instruments are also said to be particularly well adapted for use in all other cases where extreme vibration is met with, or where space is very limited, and lightness a desirable or necessary feature. The model R instruments are not well suited for used in cases where powerful external magnetic fields exist, since such fields would disturb the accuracy of their indications. They are, however, well adapted for use on small switchboards, and especially on motor-starter switchboards, where they will be found to render very valuable service in indicating the power used in driving single machines or groups of machines. Fig. 2 shows their application for this purpose in the Weston company's works, where each switchboard controls a motor running a separate group of machines. By their use in this manner it is easy to ascertain the power used to drive machines, and thus to charge the proper proportion of power to each department, or even to each machine. They also serve, when so used, to indicate abnormal conditions arising from friction or other causes, and will thus be found to aid materially in securing economy of operation of machinery in general.

The working parts of the T model are precisely the same as are used in type R, except that the scale is larger, and consequently the divisions more open for the same range, than is the case with the R, and that the case is made of cast iron, is not waterproof, and does not closely surround the working parts of the instrument. The difference in the size of the case and the material of which it is made, necessarily makes the T model much heavier than the R. The dimensions and weight of the T model are as follows: Length, 11 inches; width, 8½ inches; height (or depth), 3⅞ inches; weight (without shunt), 17 pounds.

The model T is well adapted for use in small isolated plants, and for all cases where the existence of powerful external fields would render it impossible to use the R model. The function of the cast-iron case is to shield the instrument from external fields, and this it does in a most effectual manner. In both forms of instruments the workmanship is of the highest character, and the design and construction such as to insure great durability and accuracy. The bearings are made of highly polished sapphire, and the pivots hardened and accurately ground and highly polished.

A cheap but good portable direct-current instrument (voltmeter and ammeter separate) is made by the Weston company, which is adapted for use in many circumstances where tests are to be made, but where the extreme accuracy which obtains in the Weston portable standard instruments is not necessary or desired. They are suitable for use in institutions of learning, and are specially serviceable in central stations, where stray magnetic fields exist, as the instrument proper is enclosed in an iron case which forms a shield against external magnetic influences, although care should be exercised not to subject the instrument to powerful magnetic fields which would permanently magnetize the iron case. The accuracy will be found sufficient to enable employes of central stations to check up their switchboard instruments, and in general testing.

The Weston company also makes a small round-pattern (type K) instrument that has been expressly designed to meet the demand for good but low-priced instruments for use on small direct-current switchboards, such as are installed in connection with small isolated plants, for lighting, power and other purposes, or for telephone, telegraph and other service, where a small instrument fully meets all the requirements. A round-pattern type S direct-current instrument has been designed to meet the requirements of the medical profession, dentists and others who need a very compact instrument for use in connection with the medical applications of electricity, and for other purposes where compactness, neat appearance and a high degree of accuracy are demanded.

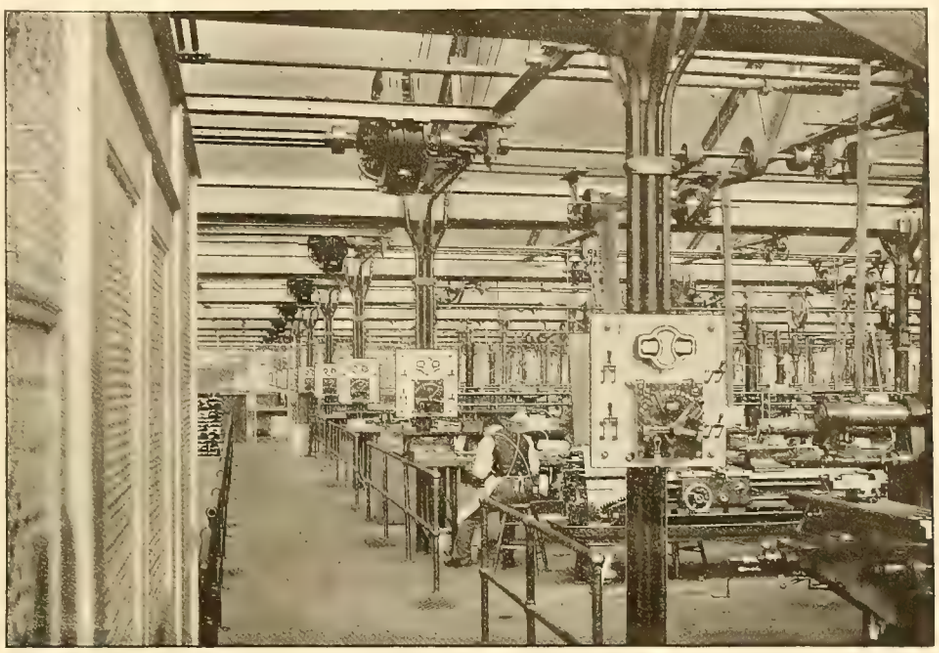


FIG. 2. NEW WESTON DIRECT-CURRENT INSTRUMENTS.—DUPLEX INSTRUMENTS FOR FACTORY MOTORS.

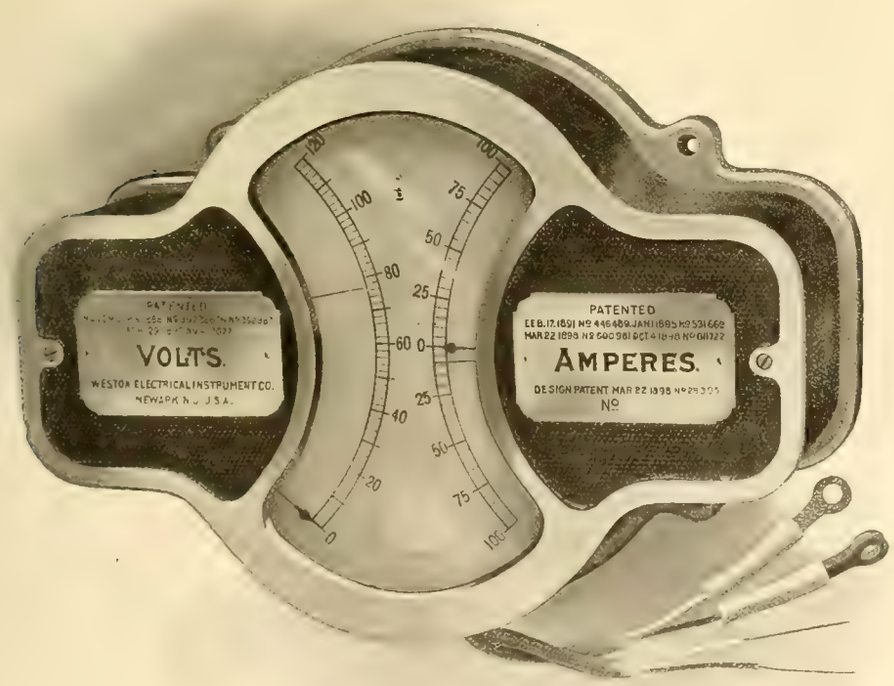


FIG. 1. NEW WESTON DIRECT-CURRENT INSTRUMENTS.—DUPLEX INSTRUMENT (MODEL R).

Waterpower Development on Drainage Canal Below Joliet.

A group of capitalists headed by Robert Gaylord of Chicago and represented by Charles A. Munroe, an attorney, is said to have secured options on lands lying upon both sides of the Desplaines River for three-quarters of a mile south of Joliet, Ill. It is announced that a dam will be erected and the waters of the Chicago Drainage Canal and the river used to develop 20,000 horsepower for electrical transmission to Chicago and Joliet. Condemnation proceedings against the Chicago Sanitary District have been begun by the promoters to secure land it holds for the furtherance of the scheme. For the purpose of heading off the attempt of private capital to develop this valuable waterpower the Sanitary District Board of Trustees has ordered Chief Engineer Randolph to resume immediately the work of developing the power, abandoned in 1900. Work will be begun at once on the cofferdam preparatory to the permanent setting for the turbines. The question of disposing of the power to be developed is not deemed a serious one by the trustees.

Electrical Development at Portland, Oregon.

The Oregon Waterpower and Railway Company, incorporated last year as the Oregon General Electric Company, has acquired all the rights and holdings of the Portland City and Oregon Railway Company, and that corporation has been formally dissolved by action of the board of directors. W. H. Hurlburt is president, and W. F. Morris is secretary of the company, which is capitalized at $2,000,000. Much has already been said about the plans for the construction of an electric power station on the Clackamas River and the building of a trolley road to that property. These plans may now go forward under the new company. F. S. Morris says that the company contemplates electric development in the vicinity of Portland or immediately tributary to that city that will call for the expenditure of several millions of dollars. A number of electric roads may be built to develop the country. Two shiploads of steel rails are now on the way from Europe.

The entire electric-light and ice plant of Crockett, Texas, has been destroyed by fire.

The Ideal Electrical Engineering Course.[1]

By Charles P. Steinmetz.

With to-day's meeting ends the first Institute year in the new century, and it may be appropriate then to look back into the work achieved and forward into the future.

At the entrance of the nineteenth century we see empirical science struggling for recognition against metaphysical speculation. At the entrance of the twentieth century metaphysics has practically ceased to be considered, and empirical science is universally acknowledged as the source of all human progress. In gradual advance from success to success this victory has been won. Without any restraint empirical science can now expand. But with the removal of the opposition of an hostile philosophy, has been removed also the searching criticism into the correctness of the results, the methods and the theories propounded by empirical science, and thereby the absolute safety which characterized the work of the earlier period. Herein lies the greatest danger to the unbroken progress of science.

Facts, whether incidentally observed, or intentionally, by experiment, are the foundation of science. But the mass of facts has accumulated so as to be beyond comprehension and we are forced thereby to work with the conclusions from the facts, the empirical rule, theory, hypothesis, and have become so used thereto that gradually the dividing line between the theory and the underlying facts has become blurred, and we consider the theory and attribute to it the same certainty as only the facts have on which it is based. But, however well a theory represents the facts and proves its value in successful application, it unavoidably contains besides the facts on which it is founded, foreign elements, mainly the personal equation of its originator and the personal equation of its times. And when building upon theories, the danger exists that instead of upon the facts represented by the theory, we may build upon the personal equation of the time without realizing the unsafe foundation of our structure.

The reverence for the facts as the foundation of science has been extended to the theories based thereon. But, when by building theories upon theories, conclusions are derived which cease to be intelligible, it appears time to search into the foundations of the structure and to investigate how far facts really warrant the conclusions. If we are told of matter moving in a vacuum tube with velocity comparable with that of light, of small chips breaking off atoms, of free atoms of chlorine and sodium floating around in a salt solution charged with opposite electric charges, whatever that may be, of electricity being propagated not through the conductor, as we used to assume, but through the space surrounding it, etc., it is time to pause and try to understand.

In the gradual replacement of facts by the belief in theories, more or less inadequately representing the facts, lies the chief danger to further scientific progress. Here is a field where splendid work can be done and should be done, in destructive criticism, by the younger generation, which, after leaving college with all the theoretical armament required, is not yet handicapped by personal relations with the men whose names are identified with the ruling theories.

Especially for our branch of electrical engineering, this is of fundamental importance, since all the success of our work depends upon the absolute safety of the foundations on which we build.

All future progress in science and engineering depends upon the young generation, and to insure an unbroken advance it is of pre-eminent importance that the coming generation enters the field properly fitted out for the work.

Here the outlook appears to me by no means entirely encouraging.

It is not the object of the college or university to turn out full-fledged engineers who can handle any engineering problem of any magnitude. The available time is altogether too short, and a very great deal of practical experience is required, which is not available to the educational institution. It is not necessary, either, and the college graduate is not expected to take immediate charge of engineering works of great magnitude. All the educational institution can do and should do is to fit the student so to take up the practical work as efficiently as possible, and that is to give him a thorough understanding of the fundamental principles of electrical engineering and allied sciences, and a good knowledge of the methods of dealing with engineering problems.

The average college course at present does not do this.

One of the reasons of the inefficiency of the present college course is the competition between colleges. By trying to teach more than other colleges, gradually the quantity of material taught by our colleges has increased so that it is not possible any more to give a thorough understanding, and memorizing takes the place of understanding. Memorizing, however, is an entirely useless waste of energy, since anything that is not perfectly understood, but merely memorized, will be forgotten in a short time if not continuously applied, and if continuously applied it would be remembered anyway. If, of the amount of material in electrical engineering as well as other branches which the educational institution of to-day attempts to teach, one-half or more would be dropped altogether, but the rest taught so as to be fully understood, with special reference to general principles and methods, the product of the institution would be far superior and more successful in practical life. To be dropped, then, are all formulæ, rules, etc., beyond the most simple ones, of the scope of the multiplication table, etc. When needed, formulæ can be derived from the fundamental principles, or looked up in the literature, and their memorizing is a mere waste of valuable time, useless, since the memory cannot retain them if the understanding cannot reproduce them from their premises. This, for instance, applies to the various formulæ of electromagnetic induction, the equations of the transformer and other apparatus, and theoretical investigations in general.

Still more than in electrical engineering this applies to the allied branches of science and engineering, of which the electrical engineer should have a fair understanding. Here anything beyond fundamental principles is objectionable. The electrical engineer should understand the principle of the steam engine, of the hydraulic turbine, know why the spouting velocity and the peripheral speed of the waterwheel are related to each other theoretically, and how this relation is modified actually, but should not memorize the mathematical theory of the turbine with its half-dozen unknown friction coefficients. He is not expected to design turbines, and if he did, his design would surely be a failure, but he is expected to understand the turbine, the steam engine, etc. The engineering graduate should know the principles of the strength of materials, the distribution of forces in the loaded beam, the reasons leading to the I-beam, to the triange in bridge and roof construction, but time should not be wasted in calculating bridges or deducing elastic curves, etc.

In short, in electrical engineering, and more still in all allied branches, nothing beyond the general principles is needed for success, but the principles should be fully understood, and with the limited time at disposition this cannot be done if time is wasted in memorizing things to be forgotten afterward.

One of the objectionable features of the instruction of most colleges is the step-by-step method. One subject is taken up, by application of sufficient time and energy pushed through, and then, after passing an examination, dropped to take up another subject. It is true that, by steady application to one subject a great deal can be learned, and so splendid results derived in the examination papers; but all that is learned in this manner is forgotten just as rapidly. To understand a matter thoroughly, so as really to have a lasting benefit therefrom, and not only make a good showing in examination papers, requires several years' familiarity therewith. Any subject, therefore, that is not kept up during the whole college course might just as well be dropped altogether and the time spent therein saved.

We hear that college graduates have no mastery of the language, cannot express themselves logically, and therefore recommend that more time should be devoted to literature and instruction in the English language. But as long as we do not teach logic, but have English language taught by philologists, more or less of the character of the florid newspaper style, that is, to write very many words on a very small subject, no useful results can be expected. Logic should be taught by a scientist, and the principle of English teaching to engineers should be to enable them to explain a subject intelligently and logically, with as few words as possible. That is, Faraday's researches, and not the product of the successful novel writer, should be the example aimed at.

The combination of textbook and home work offers a splendid means for incompetent instructors to make an elegant showing in the examination papers and turn out a very inferior grade of men, men who sometimes do not even know what real understanding means. Free lectures on subjects which the instructor himself thoroughly understands (which is by no means always the case now) make it possible to direct the course so that the student's understanding follows the course, and in this case home work becomes superfluous, excepting in connection with the laboratory. Reviewing the lectures and filling out the gaps due to absence, etc., appears to me the only legitimate requirement on the student's time outside of the lecture room.

The present method of examination, which consists in expecting the student to answer 10 questions or so within a few hours, is faulty. It shows what the student has memorized, but not how far he understands it. Furthermore, the brilliant student who usually answers nine out of 10 questions correctly and would have answered the last if he had not made a slight mistake, displaced a decimal point or so, in practical life may be utterly useless, since while doing very rapid work, his work is not reliable, while a slow man, who, however, can absolutely rely on the correctness of his work, will be very successful in practice, while hardly passing the college examination.

What, then, should an ideal electrical-engineering course contain?

Of mathematics, plain and some solid geometry, arithmetic, and a good knowledge of algebra. Plain trigonometry—no spherical trigonometry required—and a thorough understanding of analytical geometry and of calculus, but no memorizing of integral formulæ, etc.; they can always be looked up in a book when needed.

A thorough knowledge of general physics, especially of the law of conservation of energy, which, I am sorry to say, is not yet an integral part of our thinking, and of chemistry, especially theoretical chemistry and chemical laboratory, in the latter freely using tables, etc.

The electrical-laboratory work should be taken up right in the beginning. Even before taking up the theory of apparatus, the theoretical investigation of alternating currents, self-induction, transformers, etc., the student should have met this phenomenon and handled the apparatus in the laboratory. Only after seeing the effects of self-induction, for instance on the alternating-current circuit in the laboratory, the theory of self-induction will have any meaning and make an impression on the student. What the student has seen practically in the laboratory he will then take up in the theoretical course, to understand it, learn to calculate and control, and afterward, going back once more to the laboratory, apply it. It is here where the average college graduate is inferior to the practical man, and in spite of his handicap regarding theoretical knowledge, the latter frequently pushes ahead of the college graduate by his superior understanding of the phenomena, based on his familiarity with them.

Design of electrical apparatus is of very secondary utility and rather objectionable, with the exception perhaps of some very simple apparatus. The considerations on which designs are based in the engineering departments of the manufacturing companies and especially the very great extent to which judgment enters into the work of the designing engineer makes the successful teaching of designing impossible to the college. Far better is the reverse operation, the analytical investigation of existing apparatus, and more instructive to the student. That is, to derive from existing first-class apparatus by measurement and test, the constants of the apparatus, and to calculate these constants and compare them with tests. Besides, a very small percentage of the college graduates enter the field of designing, but most of them will have to handle apparatus, and it is therefore very much more important to be familiar with the completed apparatus in all its characteristic features, in normal and in abnormal operation, than to be able to design it.

The proceeding naturally can be a short outline only of the work which I consider appropriate to an electrical-engineering course, but I believe the general principles of the course can herefrom be understood. They are to give the student all the ground work required to be successful in future practice, but not the impossible aim of giving him a complete education as practical engineer.

1. Presidential address before the American Institute of Electrical Engineers at Great Barrington, Mass., June 21, 1902.

The Late Professor Rowland.

Writing in Scribner's Magazine of the late Henry A. Rowland, one of the most eminent physicists that the country has produced, ex-President Gilman of Johns Hopkins University, with which Professor Rowland was long connected, says: "A few words of personal delineation may help to keep in mind his remarkable individuality. He was tall, slender, but not slim, well proportioned, alert, giving every indication of a healthy body. Of physical exercise he was very fond; in winter the horse, in summer the sailboat, gave him never-failing delight. He knew where to find the trout and how to handle the rod. He would take great risks in following the hounds. 'You should think of the fox, and not of the ditch,' I have heard him say when he was chided for his rash horsemanship. He landed once in Liverpool and saw an advertisement of a meet. He took a train to the nearest station, hired the best nag he could find, joined in the run, won the brush, and then disappeared from among his competitors, who hardly knew what to make of this unexpected victor. He designed a sailboat, and before it was launched he told the builders to paint the water-line where his calculations said that it should be. They objected; he persisted. The boat was launched, and the builders smiled when they saw that the line was above the water's edge. 'Put in the mast,' said Rowland, and the boat sank to the painted line. 'That was what I had figured on,' he exultantly said."

Boat and Electric-railway Connection Between Chicago and Cincinnati.

The officials of the Dayton, Fort Wayne and Cincinnati Traction Company, it is asserted, have made such arrangements with other electric railways, either now in operation or under construction, that it will have but 40 miles of track to build, between Cincinnati, Ohio, and Michigan City, Ind., where it will connect with a boat line for Chicago. This company will, it is stated, absorb the Winona, Warsaw, Elkhart and South Bend Traction Company, whose line is now almost built. A new company will be formed to build the other 40 miles of road and the original company will act in the capacity of an operating company.

The Pacific Heights Railroad Company of Hawaii will extend its present Pacific Heights railway to Tantalus, a distance of more than five miles from Honolulu.

Selection of Street-railway Motor Equipment.[1]

By Fred A. Jones.

From the nature of my subject you will undoubtedly expect of me a paper somewhat technical, for it is my business to deal with the technical sides of electrical interests. I shall endeavor to point out some of the problems that arise in handling an electric street-railway service, and then show the difference, cost of power, and hence economy of operation, for different methods and equipment. I am going to make a statement that I know will be a matter of surprise to you, perhaps be doubted by some, but it is based on a study of the conditions of a large number of roads, and I believe would be well within the bounds of what actually is the case if a thorough canvass and investigation were made. Fifty per cent. of the electric roads of the United States are consuming at least 40 per cent. more power than is necessary to operate their cars and make their schedules; another 25 per cent. are consuming 20 per cent. more power than is necessary; 15 per cent. are using 10 per cent. of needless energy, and the remaining 10 per cent. of the systems have been thoroughly analyzed and are operating on the best possible economy. This statement would be indorsed by engineers in the East, older in the electrical field than I am, so that there is a vast field opened up for effecting a saving in cost of operation of the majority of railway systems, if only this one item of saving in energy, by reason of adaptability of equipment, is considered. Besides the saving in energy consumption, by reason of the nature of equipments, there are other problems of expense constantly before the street-railway superintendent that I shall not attempt to treat. Among these might be mentioned cost of labor and maintenance, and under these items would come the arrangements for handling at the car barn, the economy of the power plant, the difference in fuels, closeness of inspection and the energy loss in the line, as well as the rail bonding, etc.

My subject deals only with the railway-motor equipment, and what should enter in when making its selection. In the first place, the rating of the railway motor is a matter of temperature; the horsepower is purely nominal, and really indicates the commutating capacity of the machines. It means that if the motor is placed upon the stand and run at a current and voltage necessary to give its rated horsepower for one hour, the temperature rise will be about 75 degrees Centigrade. A motor on any railway service, if the cycle of events is steadily repeated, has a certain fixed rise in temperature, with small variations from this temperature. For example, if we have a 10-ton car, making a round trip of five miles in 30 minutes, with an average of five stops a mile, and including five minutes in lay-overs, and each stop an average of 10 seconds in duration, and the average passenger load is included in this 10 tons, then, for a certain motor, with a certain gear and pinion, there would be a certain rise in temperature, which can be correctly calculated by knowing the characteristics of the motor. As you well know, the smaller the pinion, the lower the speed of the equipment, and the larger the pinion the higher the speed. With any motor low or high-speed gearing may be furnished, and, as a matter of fact, eight or 10 different sizes of gears are manufactured for each standard motor by the large companies. The speed of a motor may also be increased by decreasing the number of turns per coil of the armature. Thus, we have one-turn, two-turn, three-turn, four-turn, five-turn and six-turn machines, and a few with even a greater number of turns. Very large motors have only one turn per coil when used for elevated-railway service. Each manufacturing company gets out a line of railway motors ranging from 20-horsepower to 250-horsepower rating, and each size of motor may have different-sized pinions and gears and a different number of turns per coil in the armature; so that in making a selection of the proper motor equipment to handle any service, we have 300 or 400 different equipments to select from. Some engineers, and some of the best engineers, have specified a high maximum speed for every condition that would stand it. This necessitates high-speed gearing, which means a lower tractive effort; that is, a greater current is required for obtaining the same tractive effort with high-speed gear than with a low-speed gar. Where the stops are few, for example, once every two miles, as in interurban or suburban service, this may not be so important, but in heavy city service, where the stops are six or seven per mile, for low-energy consumption, the equipment must be low-speed, and at the same time nothing is lost in time, for the low-speed equipment will accelerate more rapidly than the high-speed equipment.

There is a method of representing pictorially the service conditions of any railway line, and this is called a service characteristic. It is based upon the fact that a motorman will repeat the same cycle of events very closely in going over the same grounds and in the same time. If we represent as abscissa or in a horizontal direction, time, and as ordinate, or in a vertical direction, speed, and plot the cycle of a car from start to stop, first accelerating and then running on the motor curve free, running at a uniform rate, coasting, and then braking, we can draw this service characteristic, and the area of the figure will be the distance covered.

Thus, by going over a service, averaging the distance between stops, and the time per stop, taking the number of passengers at 10 o'clock in the morning, about the lightest service, and six o'clock in the evening, about the heaviest service, and thus getting the average load, if necessary dividing the line up into sections, especially where part of the running is in the city and part suburban, we might get very closely to the conditions of operation.

Now, it is very important that the temperature rise of the motor shall not be excessive. It is estimated that if rise in temperature is 100 degrees Centigrade, the motors will begin to burn out after one year's service, and will give probably a great deal of trouble the first year. If the temperature rise is 90 degrees, the probabilities are that no trouble will be experienced the first year; the second year there will be some trouble, and the third year new coils will probably be required for all the motors. With 75 degrees rise, the motor should last seven years, so that it is very important that the rise in temperature should not exceed this amount, and it is important to determine the expected rise before the motor is bought. This may be done very closely, if each motor is tested over a wide range of services and temperature is accurately taken. It is not probable that any service condition in practice will be identical with the conditions of one of these tests, but this is provided for in the following manner: If the degree rise is divided by the number of watts lost in the field and also by the number of watts lost in the armature, we get a series of values giving degree rise per watt lost for both field and armature for different ratios of distribution of losses. The ratio of distribution means the watts lost in the armature, divided by the watts lost in the field, and for every service there is a certain distribution of losses to be expected. The armature loss of the motor is made up of the core loss (which includes the eddy currents in the iron and copper), and the C^2R loss, C representing the current through the armature, and R the resistance of the armature. The field loss is entirely a C^2R loss, and the current of the field being the same as that of the armature, as railway motors are series motors, but are representing in this case the resistance of the fields.

Now, if by our analysis of the service conditions we can determine the ratio of distribution of the losses to be expected from the tests of the motor itself, we can determine the temperature rise, and this rise can be determined within three or four degrees. The motor that has high core loss cannot be used for high-speed work and long distances between the stops, for the core loss increases with the speed; but it is not so essential to have low core loss for a large number of stops per mile.

The best motor for interurban work is one with high resistance and low core loss; for city work, low resistance and as high core loss as is necessary. It is not possible to reduce the core loss below a certain point, or in intermittent work low armature reaction and high flux are necessary, and with high flux comes naturally high core loss.

I have tried to point out how the question of temperature primarily affects the selection of the equipment. Almost as important is the question of energy consumed, which is generally calculated in terms of watt-hours per ton-mile. The watt-hours per ton-mile for a 14-tooth pinion would be less than for a 17-tooth pinion, using the same motor and making the same schedule, with all other conditions the same, but the maximum speed would be less, and it might be that not quite as fast a schedule could be made by it. If it is possible to make the desired schedule, however, with a 14-tooth pinion, it would be much preferable to use, in spite of the fact of it not giving as high maximum speed as would be reached on a level. One of the elevated-railway companies in the North could undoubtedly save 10 per cent. of the money expended for power by reducing the number of teeth of its pinions, and still make the same schedule that it is now making.

I will close with an explanation of what is proposed by the two largest electrical manufacturing companies in regard to approximating service conditions in making tests on railway motors.

One company proposes to run at such a voltage and current as will give the losses met with in practice with the motor mounted upon a stand. This is undoubtedly the most convenient method of testing, but I do not believe approaches near enough to service conditions. The method of the other company, of actually running the motors at a voltage at which they will be used in practice on the experimental railway, and obtaining in this manner the motor characteristics, seems to me to approach nearer the absolute conditions in practice. I know from experience that there is a difference in the way the motor acts when stationary and when on a car, as to ventilation, heating and general operation.

1. A paper read before the Southwestern Gas, Electric and Street Railway Association at San Antonio, Texas, on April 15, 1902. Mr. Jones is a mechanical engineer of Houston, Texas.

The Paducah City Railway Company has been organized at Paducah, Ky., from the Paducah Railway, Light and Power Company, increasing the capital stock $300,000 and taking in several Cincinnati capitalists. Bonds will at once be issued for $600,000 to make extensions and improvements. The new officers are: President, George C. Thompson; vice-president, George C. Wallace; secretary and treasurer, A. L. Rich, Cincinnati; superintendent, H. S. Porter, Cincinnati.

CORRESPONDENCE.

New York Notes.

New York, July 14.—An important reduction in rates for electric lighting will be made by the New York Edison Company and the United Electric Light and Power Company of this city, beginning on September 1st. The reduction will average more than 20 per cent. to the large consumers and about 25 per cent. to the small consumers. The new schedule is to be 15 cents a kilowatt-hour for the first two hours, instead of 20 cents. For the third and fourth hours the charge will be 10 cents for a kilowatt-hour, and for the fifth and sixth hours 7½ cents a kilowatt-hour. Over six hours the charge will be five cents an hour. The small consumers will receive a greater advantage from this reduction than those who burn their lamps long hours. The two companies divide between them nearly all the electric illuminating business in the city.

The committee on railroads of the Board of Aldermen, at a meeting on Friday, considered the franchise and route accepted by the Rapid Transit Commission for the proposed tunnel to give the Pennsylvania Railroad Company direct connection with New York. The Board of Aldermen must either accept or reject the propositions submitted for consideration, as it can make no amendments. Arguments were heard from those in favor of and opposing the grant, and the committee took the matter under advisement.

At a meeting of the Rapid Transit Commission on Thursday a resolution offered by Mayor Low was unanimously adopted, providing for a conference between Bridge Commissioner Lindenthal, representing the city, and Chief Engineer William Barclay Parsons, representing the commission, in regrad to the working out of details in connection with the latter's plan for a tunnel under Center Street. The mayor presented a letter from Mr. Lindenthal in which he recommended, "First, that the tunnel line be built from the Williamsburg bridge to Center Street and down Center Street to the City Hall terminus, and that accurate plans and estimates of cost be prepared therefor; second, that simultaneously a moving platform be installed on the Brooklyn Bridge, and that the necessary legal steps be authorized therefor; third, that all further improvements be taken up later, and in a systematic manner, so as to fit into a general scheme of rapid-transit connection between the East River bridges and rapid-transit lines on both sides of the East River."

The results of the Columbia Yacht Club's recent races have been announced. There were three classes of power boats in the contest, prominent among which were some electric launches. The race was run over a 12-mile course, and in the electric class C. A. Starbuck's launch Carmen won the prize, a handsome silver cup, in one hour 44 minutes and 10 seconds.

The $150,000,000 mortgage authorized by the stockholders of the Brooklyn Rapid Transit Company in March last, covering the property, stock, securities, etc., of the company, has been filed with the county clerk of Kings County. The mortgage is dated July 1st, and the Central Trust Company of Manhattan is the mortgagee. The purpose of the mortgage is to allow the company to issue stock for the amount, the money raised to be used for the various improvements in the road and for taking up underlying mortgages as they become due.

J. Hampden Dougherty has resigned his position as commissioner of the Department of Water Supply, Gas and Electricity. It is said the one cause of the resignation was the policy of the Board of Estimate and Apportionment in not allowing him funds for what he deemed necessary improvements. He is succeeded by Col. Robert Grier Monroe.

It was announced during the week that August Belmont had purchased all the franchises, real estate and rolling stock of the New York and Queens County Railway Company, and it was reported that the Metropolitan company, controlling all the trolley lines on Manhattan Island, was associated with Mr. Belmont in the purchase. The New York and Queens County Railroad Company controls virtually all the electric-railway lines in the Borough of Queens on Long Island, and among the franchises acquired is one granted several years ago to the Long Island Railroad Company for the construction of a tunnel under the East River. Mr. Belmont plans to bring the Queens Borough cars into New York through a tunnel from Long Island City to Forty-second Street, Manhattan. The price paid by Mr. Belmont was not announced.

The Board of Aldermen has passed the Sullivan "car ahead" ordinance, which provides that every street car shall carry on the outside, in front and on top, a placard or signboard conspicuously announcing the point of destination.

As was prophesied some time ago, it now appears certain that excavations for the rapid-transit subway will not be completed before next January. One section of rock between Hillside Avenue and One-hundred-and-eighty-first Street will probably be left to be completed at that time. The present status of the tunnel may be mentioned briefly as follows: The excavations in City Hall Park are mostly covered over. Two long stretches in Elm Street are finished. At least 10 blocks in Fourth Avenue are repaved, and many more are ready to be filled in. Twenty or more blocks in Broadway are entirely completed, and over five or six of them trees have been planted

to take the place of those destroyed by the excavators. Lenox Avenue, which was a continuous scene of wreckage a year ago, is almost renovated from the Park to One-hundred-and-thirty-fifth Street, and in the Bronx the work has advanced far enough to assure its completion on time. The "binding points" are few and far between, and every effort is being concentrated to obviate the difficulties. M. L. G.

New England News.

Boston, July 11.—It is reported that the General Electric Company is considering the feasibility of buying the plant of the Middleton Paper Company, at Middleton, Mass., with the view of manufacturing its own paper. The mills are valued at $170,000.

The contract for building a waterpower plant on the Deerfield River, at West Deerfield, Mass., has been let. The dam will be 35 feet high and the power will be used by the Greenfield (Mass.) Electric Light and Power Company. The work is to be completed November 15th, and it will cost about $100,000.

The Taunton, Assonet, and Fall River Street Railway Company has asked the Taunton and Fall River aldermen for franchises in those cities. It has obtained franchises in the towns of Berkley and Assonet, and it proposes to build an electric railway between Taunton and Fall River, via those towns and Freetown. The company is capitalized at $150,000.

The General Electric Company has leased a factory on Astor Street, in Lynn, Mass., and is using it for an incandescent-lamp factory. The company will build an addition to one of its River Works factories, which will be 400 by 250 feet, and it will build a new factory for general machinery work, the latter to measure 500 by 250 feet.

The Holtzer-Cabot Company has taken the title to the estate at No. 100 Pearl Street, Brookline, Mass.

After being out two months, the striking motormen and conductors of the Providence lines of the United Traction Company, voted to return to work the first of the week. The company had less than 150 vacancies for the 400 or 500 applicants. As some of the new men have proven unsatisfactory, it is expected that they will be replaced by old employes who were among the strikers. The Pawtucket strikers at first refused to abide by the decision of the Street Railway Employes' Union, and they remained out a couple of days longer, when about 80 of them signed a contract agreeing to work 11 hours within 24 hours at the rate of 18⅔ cents per hour. The boycott on the company, which had been in existence a month, has now been removed and street-car matters have resumed their former condition.

William P. Williams has been awarded the contract to build the Port Jefferson and Patchogue Trolley Company's electric railway across Long Island, between Port Jefferson and Patchogue, N. Y., a distance of 15 miles. The road will be largely built on private land. Other lines will be built between Patchogue and Monches, Eastport, Speonk, Greenville, Islip, Bay Shore and Amityville, on the southern shore of Long Island. The line between Port Jefferson and Patchogue is to be completed by June, 1903.

The annual outing of the New England Street Railway Club was held at Whalon Park, near Fitchburg, Mass., the Fitchburg and Leominster Street Railway Company acting as host. About 150 railway men were present, representing nearly every electric railway in New England. H. E. Farrington of the Boston and Northern Street Railroad Company, president of the club, presided at the business meeting, and D. L. Prendergast of the Boston Elevated Railway Company was toastmaster at the dinner. The address of welcome was delivered by Hon. James E. McConnell of Fitchburg.

The Concord, Maynard and Hudson Street Railway Company has petitioned for authority to issue bonds amounting to $175,000, the proceeds to be used in funding its floating indebtedness, purchasing real estate, and improving its equipment.

The Kilton Electric Company has been organized at Kittery, Maine, with a capital of $10,000, $30 paid in, and with Albert E. Knowlton of Malden, Mass., as president, and Charles C. Smith of Kittery, Maine, as treasurer.

The directors of the Mutual District Messenger Company of Boston met July 8th and elected the following officers: President, Robert C. Clowry of New York, to succeed Samuel Carr of Boston; vice-president (a new office), Belvidere Brooks of New York; clerk and treasurer, Frederick Brown of Boston, re-elected; corporation counsel, George H. Fearons of New York, to succeed Parker C. Chandler of Boston; general manager, Dennis J. Hern of Boston, re-elected. The new officials represent the interests of the Western Union Telegraph Company. Mr. Hern's re-election is a source of great satisfaction to the business men of Boston.

The Haverhill Electric Company has appealed to the Massachusetts gas and electric-light commissioners from the decision and order of the Haverhill (Mass.) mayor and aldermen, by which the Haverhill Illuminating Company was given permission to build lines in that city for the transmission of electricity for heat, light and power. This is a move in the controversy over the establishment of a new electric-light company in Haverhill, as mentioned in previous letters to the Western Electrician. A similar appeal has been made by the Natick Gas and Electric Company in regard to the Wayland selectmen's grant of locations to the Weston Electric Light Company, the Natick company being already in the territory. The Weston company is in operation, but the Haverhill Illuminating Company has not yet requested the commissioners' approval of issues of stocks and bonds.

The Connecticut Railway and Lighting Company announces that its storage-battery system has proved satisfactory. It is installed at the Derby (Conn.) power station of the company, and furnishes supplementary power. It is estimated that it saves about 3,000 pounds of bituminous coal per day. B.

Southern Developments.

Charlotte, N. C., July 12.—W. T. Coffee of Tennessee will build an electric road 80 miles long, it is stated, extending from Tate Springs, Hawkins County, Tenn., to Gate City, Va. Hawkins County has voted $100,000 bonds toward the project.

The City Council has finally granted franchises at Nashville, Tenn., to the Nashville and Gallatin electric railway and to the Nashville and Columbia electric railway.

F. I. Tolbert will superintend the construction of a trolley line from Fernandina, Fla., to the beach, work to begin at once.

W. S. Dimmock, general manager of the Virginia Passenger and Power Company, Richmond, Va., has resigned, to accept a position with a western electric power concern.

The street-railway interests of Jacksonville, Fla., have been absorbed by Stone & Webster of Boston. This firm already controls a number of southern systems. It is said that the new company will spend $150,000 in the next 12 or 16 months in improvements at Jacksonville. New car sheds and shops are contemplated.

Frank J. Gould, it is reported, will spend $2,000,000 improving the electric railways of Richmond and Petersburg, Va., most of which property is controlled by Mr. Gould. Mr. Gould says he will give Richmond the best trolley service in the South. L.

Niagara Falls.

Niagara Falls, N. Y., July 12.—The Niagara Falls Hydraulic Power and Manufacturing Company is about to establish a new factory district at Niagara Falls and thereby make a very substantial addition to its possessions. With this object in view, the company has purchased a large block of land in the northeast part of the city, and will string a power-transmission line to its new territory. It is understood that between 100 and 400 acres of land are involved in the transaction. When the new industrial district is established it will be immediately north of the lands of the Niagara Falls Power Company. The Carter-Crume Company, manufacturer of counter-check books, has secured a five-acre site in the new industrial section, and will at once put up a fine new factory covering nearly four acres, the remainder of the site to be held for future enlargements. Other industries are also soon expected to locate in the new section.

Another large new plant is about to be erected on the lands of the Niagara Falls Power Company, the Atmospheric Products Company having broken ground for the first building of its new Niagara industry. This company uses the atmosphere as its raw material, and from it will manufacture various products. The first building of this company will be 125 by 50 feet at the foundation, and it will be used as a machine shop. In it will be manufactured all the apparatus to be installed in the company factory buildings proper. The building will be of the best construction, and the machinery in it will be operated by electric power. Soon the company will break ground for a second building, the dimensions of which will be 500 by 50 feet, and later other buildings will be erected. The initial building will be located on Buffalo Avenue, in front of the Pittsburg Reduction Company's plant, but the location of the larger building has not yet been selected. D.

Canadian Intelligence.

Toronto, July 11.—The Central Ontario Power Company, of which J. Alexander Culverwell is managing director, has purchased the greater portion of Healeys Falls and a half of the Crow Bay Falls, near Cambellford, on the Grand Trunk Railway. Healeys Falls, which has a head of over 70 feet, on the Trent River, is only four miles from the municipality of Cambellford. Crow Bay Falls has a head of about 30 feet. These two falls have a minimum power-development possibility in the dry season of some 15,000 horsepower. The company also owns Burleigh Falls, and about two months ago purchased Buckhorn Falls, both being within 20 miles of Peterboro, Ont. The whole combined may furnish about 25,000 horsepower, with which the company proposes to supply a number of cities and towns in Central Ontario with electrical energy for light, power and traction purposes.

Penalties amounting to several million dollars have been incurred by a number of electric-railway companies in British Columbia, owing to their not having made the necessary returns to the government at Ottawa under the railway act. At the last session an act was passed giving the government power to remit these penalties. In the case of the Nelson Electric Tramway Company the penalties amounted to $500,000, but a fine of $100 and costs was imposed; in that of the Lenora Tramway Company, they amounted to $80,000, and the company was let off with a fine of $50; for the British Electric Railway Company, which operates in three cities, Vancouver, Victoria and New Westminster, the penalties amounted to $2,000,000. This case was reserved.

Work on the Montreal Terminal street-railway line was begun on June 30th and the line is expected to be an accomplished fact before the snow flies. The contract for the supply of poles and ties has been let. Tenders for the rails and rolling stock are under consideration and will be called for in a few weeks.

On Dominion Day, July 1st, the number of passengers carried by the Montreal Street Railway Company amounted to nearly a quarter of a million, and the receipts to $10,000. On all lines there were some 350 cars in service. H.

Ottawa, Ont., July 12.—The Montreal Street Railway Company has voluntarily decided to give its employes an increase on the present scale of wages. All men who have been in the employ of the company for two years and over, will get from 15 cents to 16½ cents an hour, and those who have been in its service under two years will receive from 14½ to 15½ cents an hour. This increase will mean an extra charge upon the company of $50,000 annually.

The Ottawa Electric Street Railway Company is making preparation for the installation of a large storage battery adjacent to its present power house at the Chaudiere Falls. The battery will have a capacity of 1,000 horsepower. Its office will be to regulate the current so as to make unnecessary the automatic regulator now in use with the waterwheel. The battery has been purchased from the Electric Storage Battery Company of Philadelphia, Pa., and cost $75,000. It is expected that it will be ready for operation next December.

The Ontario government has been interviewed by several municipal representatives upon the matter of united municipal action, with a view to utilizing some of the vast electric power at Niagara Falls. At a recent meeting of representatives from near-by municipalities a proposition was discussed for developing power that would be under the control and at the disposal of the various municipalities, in order to stimulate manufacturing industries by supplying cheap power, and also to provide cheap light and power for municipal purposes. The government suggested to the deputation that those interested in the project prepare a plan upon which they could agree, and when they had a definite proposition to make the government would be quite willing to consider it.

The extensive works of the Ottawa and Hull Power Company, in Hull, Que., which have been in progress for the last 18 months, are expected to be completed within the next three months. When the present work is finished, the company will be in a position to furnish 12,500 horsepower of electric energy. The company will, in time, further develop its property to about 35,000 horsepower. Over half a million dollars has already been expended on the works, which will cost upward of $1,000,000 before final completion. Over 240,000 cubic feet of solid rock has been excavated for the reservoir. The water pressure is communicated to the turbines and transmitted directly to the dynamos, the turbines being at one end of the shaft and the dynamos at the other. Five dynamos, of 2,500 horsepower each, will be installed.

Richard Vyvyan, engineer in charge of the erection of the Marconi station in Canada, states that Mr. Marconi will not come to Cape Breton until the latter part of August next. The postponement of Marconi's return to Canada is said to be due to the fact that the Italian government has just placed at his disposal a war vessel, on board of which Marconi will make experiments in long-distance wireless telegraphy. In the meantime, it is altogether likely that communication with the station at Cornwall, England, will be established by Mr. Vyvyan. It is thought that Marconi will go direct to Cape Breton in the Italian warship. W.

From the Buckeye State.

Cleveland, Ohio, July 12.—An important announcement was made a few days ago in regard to the Akron, Bedford and Cleveland line, which is now a portion of the system of the Northern Ohio Traction Company. At a cost of something like $200,000 it is proposed to double-track the entire line, and it is thought that it will all be completed within the next two years. Traffic has become so heavy on this line that it cannot be handled on a single track, and since the ownership of the Northern Ohio has in a measure changed hands, an aggressive spirit has taken hold of the company, whose properties are among the most important in the state.

The efforts of Messrs. Everett and Moore to refinance the Lake Shore Electric Railway Company are likely to prove successful. According to good authority, the matter is now well under way, although it may take some time to complete the business. The syndicate will probably yet have a through line extending far up into Michigan, although a large portion of its other property has been sacrificed to save its creditors. To show that there has been a good growth in the business of the road,

it took in on July 4th last year $2,719, and this year, $4,780. It is not the policy of the Everett-Moore people to reorganize and cut the small stockholders out; hence they are refinancing the company instead, and the small fellows will have an equal chance with all others.

The Newark city electric-railway lines and the line extending from Newark to Granville have been transferred to the Appleyard syndicate. Quite a sum of money will be spent in improving both lines and they will be operated in connection with the Columbus, Buckeye Lake and Newark Traction Company's lines. When the line from Newark to Zanesville is completed, it will form quite a system of roads in the central and eastern portion of the state.

Mayor Hinkle of Columbus has approved the ordinance giving the East Columbus Heating and Lighting Company a franchise and signed it without its going to the Board of Public Works. It is believed by some that this will invalidate the bill, but it has been accepted by the company and a bond for $25,000 will be filed.

There are now ordinances for 11 different low-fare street-car lines before the Cleveland City Council, one ordinance for each route. They cover about the same territory as the old Hoefgen ordinance. In all probability, there will be two bidders for the line running through the flats and connecting with the new Akron line and several for the others.

The Pennsylvania and Mahoning Valley Electric Railway Company has applied to the City Council of Youngstown for a franchise to build a line the entire length of Mahoning Avenue, to the steel plant. It is also said that the company will extend its line from Struthers to Poland, a distance of four miles.

The electrical men of Cincinnati have organized a business and social club. The club will have permanent quarters and will be conducted along the same lines as the other business organizations of the city.

The Toledo, Bowling Green and Southern Traction Company will shortly take up the freight and express business. It now has 32 large passenger cars, each of 200 horsepower. A complete power house is being built at Cygnet, and the road will within a very short time be in prime condition. It will make one of the best roads in the state, and in connection with the proposed line through from Cincinnati will form a part of a great trunk system. The company furnishes light and heat for the town of Findlay, and is prepared to furnish light to any town along the line.

The City Council of Columbus has granted the Urbana, Mechanicsburg and Columbus road a franchise for 25 years. The road must be completed by October 1st, but this time will likely be extended. It will carry passengers in the city on tickets at the rate of 33 for $1.

It has been decided by the stockholders of the Lake Erie, Bowling Green and Napoleon Electric Railway Company to purchase the plant of the Bowling Green Electric Light, Power, Heating and Ice Company. The latter company is doing a good business and is a valuable acquisition to the railroad, which, besides furnishing power and heat, will be able to furnish current for some of the railroads that are being built in that section.

The Newcastle and Sharon Electric Railway Company has made arrangements to extend its line in Newcastle to Oakland, Pa. It is said that it will probably be connected later on with some of the Pittsburg systems.

The Canton and Akron Railway Company has been granted a franchise in Canal Dover. The company will build a line from Canal Dover to New Philadelphia. It is intended that cars shall be running within three months.

It is stated that the Cleveland, Painesville and Ashtabula Electric Railway Company has been financed, and Messrs. Holcomb and Latimer are engaged in securing rights-of-way.

The people of Eaton will vote upon the question as to whether to issue bonds for the purpose of building an electric-light plant.

The Springfield and Washington Court House Traction Company has asked for a franchise for its line in Washington Court House, which will probably be granted, as the people of the town are in favor of it.

The power house of the Columbus, Delaware and Marion road will be built at Stratford. A portion of the machinery has already been delivered.

The Cleveland, Painesville and Ashtabula Railroad Company, when its road is built, will operate cars into Cleveland from Painesville, over the Cleveland, Painesville and Eastern. It will build a line from Painesville to Ashtabula. From Painesville a line is being built by the Pennsylvania and Ohio Railway Company to Conneaut. From there a line is being built to Erie, and there is one in operation from Erie to North East. From the latter point to Dunkirk a line is under construction; another one is being built from the latter place to Hamburg, and a line is now in operation from Hamburg to Buffalo. With the Lake Shore and the Detroit and Toledo Shore Line, it will be possible to make the trip from Buffalo to Detroit by trolley.

The Cincinnati, Dayton and Toledo Traction Company has filed a mortgage on its properties with the Hamilton County officials for $5,000,000, to cover an issue of bonds, the proceeds of which will be used to pay for the roads which it has absorbed. The Cleveland Trust Company has been made trustee under the mortgage.

The Fostoria Incandescent Lamp Company has doubled its capacity on inner globes, but will not be in a position to make deliveries until September 1st. This company recently secured the contract for furnishing the United States Treasury Department incandescent lamps for the year ending July 1, 1903.

The city of Newport, Ky., will soon advertise for bids for lighting the city. A lot of data has been gathered by the council as to the cost of lighting in various cities. O. M. C.

Information from Indiana.

Indianapolis, July 14.—The Southern Indiana Traction Company, with a capital of $100,000, will build a line from Vincennes to Jasper, through Knox, Pike and Dubois counties. The incorporators are R. M. Gray, Herman Eckert, S. N. Chambers and E. F. Cox.

The French Lick, West Baden and Northwestern Traction Company has been organized with a capital stock of $100,000, which will soon be increased to $500,000. Incorporation papers are ready to be filed.

The Union Traction Company of Indiana has amended its articles of incorporation, so that it now has the legal right to construct, or purchase and lease from other companies lines and systems of street and interurban railways in towns and cities and throughout the state. The purpose of the amendment is stated to be that the Union Traction Company desires to secure power to take over the Indianapolis and Northern Traction Company, which has projected a line from Indianapolis north.

The Indianapolis and Greenfield and the Indianapolis and Eastern Electric Railway Company filed articles of consolidation and reincorporated under the name of the Indianapolis and Eastern Electric Railway Company with a capital stock of $1,200,000. It is the ultimate purpose of the company to control the system of traction roads into Dayton, Ohio. President Fauvre says that express cars will be put on in short time, and that as soon as connection is made at Dublin through parlor and sleeping cars will be run from Indianapolis to Dayton. He also says that a through trolley sleeper from Indianapolis to Cincinnati is among the possibilities.

The City Council of Tipton, Ind., has acted liberally with the Northern Traction Company and granted it an extension of time in which to complete the line from Tipton to Indianapolis. The limitation expires on July 20th and the franchise could have been forfeited at that time. H. B. Quick of Chicago has been engaged to superintend the building of this line and has begun the work at Noblesville. The construction will be pushed to a speedy completion.

An electric-light company has been organized at Newcastle, and is now placing preferred stock on the market with good success. The company will erect and equip a plant before winter.

An automobile line is to be established between Marion and Huntington by way of Banquo. For many years a stage line has been maintained on this route and has proved a paying investment. The distance is 30 miles, through a rich agricultural country. The automobiles to be used to displace the stage wagons will carry 50 persons and will be operated by gasoline.

The unusual sight of an Indiana farmer traveling around over his farm in an automobile to direct the work of harvesting and threshing was witnessed in Howard County last week. F.

Northwestern Notations.

Minneapolis, July 12.—The Western Union has completed a direct wire from Great Falls to Havre, Mont., giving direct connection from Spokane.

A report from the committee on lighting of the City Council of Winona, Minn., concludes that lighting could be furnished for about half the present rates by installing a municipal plant. The committee concludes that $50 a year is sufficient price for lights of 1,200 candlepower, lighted less than 3,000 hours per annum, and recommends that a tender of a five-year contract on that basis be made to the local company.

The Electric Light Company of Salem, S. D., has awarded contracts for new equipment to the Fort Wayne Electric Works.

The Western Union has installed in its office at Marquette, Mich., a quadruplex system in connection with the Duluth-Soo wire, which will greatly facilitate the handling of business between those points, especially the marine business.

The Houghton County Street Railway Company is negotiating with Faucett Bros. to purchase their franchise for a street railway through Lake Linden, Mich. It is exclusive, and will complete the former's right-of-way from Hancock to Laurium.

The council of Benson, Minn., contemplates purchasing the local electric-light plant.

The Oskaloosa Traction and Light Company has posted a $10,000 forfeit as a guarantee to construct an electric railway through Oskaloosa, Iowa, in accordance with the franchise. Extensive improvements will be made to the lighting plant also.

The village of Verndale, Minn., is considering an electric-light plant. The estimated cost is $6,000.

The electric-light company of Cedar Falls, Iowa, has been absorbed by the Gas and Electric Company of Waterloo, Iowa. The latter took charge July 1st. Passenger rates on the electric interurban line from Des Moines to Colfax will be made just half the rate of the steam railroad, or 1½ cents a mile. R.

On the Pacific Slope.

San Francisco, July 10.—Articles of incorporation have been filed at Baker City, Ore., by the Consolidated Power Company, which purposes to conduct a general light and power business, operate power and telephone lines, electric railways and power plants. The company has an authorized capital stock of $100,000. The incorporators are Frank S. Baillie, H. S. Bowen and John L. Rand.

On June 25th the City Council of Portland, Ore., decided to sell the proposed electric-light franchise to the highest bidder. It is provided that a deposit of $25,000 must be made by the successful bidder to insure the completion of the plant.

The Guy Owens Electrical Construction Company has filed articles of incorporation at Honolulu, Hawaii. The incorporators are Guy Owens, E. A. Mott-Smith, Robert Tatton, E. A. Ross and J. H. Soper, all of Honolulu. The capital stock of the company is $10,000. The company will take over the business formerly conducted by Guy Owens.

Engineer Fincle of the California Power Company, Bakersfield, Cal., says that work on the construction of the power plant will be begun this week. The construction work will require the boring of 20 tunnels, aggregating a total length of 8½ miles. The transmission line will be carried on steel towers, 110 feet high, which will be placed 1,200 feet apart.

The Board of Supervisors of Los Angeles County, Cal., has granted a franchise to the Pacific Light and Power Company, Los Angeles, Cal., for an electric-lighting plant, to be completed within six months.

The Bay Counties Power Company, San Francisco, is arranging to run another line from its substation in Solano County direct to Napa Junction, to furnish power for the cement works at that place.

The Capital Light and Power Company has been incorporated at Santa Fe, N. M., for the purpose of constructing a power house near Macho Canyon and the construction of a power line from that point to Santa Fe, N. M. A 600-horsepower plant is to be constructed. The headquarters of the company will be at Santa Fe.

The Southern Pacific Terminal Company of San Francisco is now building an electric power house at Galveston, Texas, which will develop power for the operation of its new grain elevator at that place. The plant will also supply power for the operation of freight elevators on the wharves and for the operation of fire pumps. General Electric generators of large capacity are to be used. A.

PERSONAL.

J. C. Moulton, formerly connected with Stanley & Patterson, New York city, is now identified with the Fort Wayne Electric Works at their New York office, 40 New Street, New York city.

F. J. Spaford, formerly superintendent of telegraph for the Burlington, Cedar Rapids and Northern, has been appointed assistant superintendent of telegraph for the Chicago, Rock Island and Pacific Railroad Company.

It is announced that Mayor Tom L. Johnson, the well-known street-railway capitalist of Cleveland, Ohio, will make a tour of the West this coming fall in the interest of his candidacy for the Democratic nomination for president.

James J. Dunigan, one of the oldest employes of the Western Union Telegraph Company, and for many years night manager of the delivery department of that company in New York city, died in Brooklyn on July 5th. He was one of the organizers of the Telegraphers' Mutual Benefit Association.

ELECTRIC LIGHTING.

The town of Hillsboro, Texas, has voted to issue $6,000 worth of bonds for a municipal electric-light plant.

The plant of the Middleport (N. Y.) Gas and Electric Light Company suffered about $50,000 damage by a recent storm.

Coraopolis, Pa., has advertised for bids for the construction of a municipal electric-light plant, which is estimated to cost $15,000.

It is stated that J. I. Beggs of the Milwaukee Railway and Light Company will erect an electric-light and power plant at Racine, Wis.

The Lenoir Electric Company has been incorporated at Lenoir, N. C., with $50,000 capital stock to furnish power and light, operate telegraph and telephone lines, etc.

The Gilmer Electric Light Company of Gilmer, Upshur County, Texas, has been incorporated with a capital stock of $4,000 by J. F. Croley, T. C. Mitchell and C. H. Buckner.

L. J. Law, A. H. Webber, C. R. Smith and C. P. Litchfield have asked the City Council of Cadillac, Mich., for a franchise to erect a heating, electric power and gas refrigeration and ventilation plant in the city.

Forfeiture of the franchise of the Standard Light and Power Company is prayed for in a suit filed by the city of Dallas, Texas. The litigation is based upon an alleged combine of the defendant company with the Dallas Electric Company. The Dallas Council offered the Standard a new franchise providing the company would agree to operate under an

ordinance similar to the one recently given to the Dallas Electric Company, which specifies reduced rates for lighting and protection against combining. The Standard company has made no indication of acceptance, hence the suit.

The Lehigh Valley Traction Company's electric-light plant at Allentown, Pa., was totally destroyed by fire recently. Two 500-horsepower cross-compound engines, 13 dynamos, an alternating machine and seven boilers are included in the loss.

E. S. Aldrich has sold his interest in the electric-light plant at Snohomish, Wash., and has purchased an interest in the Moscow (Idaho) Electric Light and Power Company, of which he has been made manager. The plant at Moscow will be enlarged at once by the installation of a 150-horsepower boiler and an engine of like capacity.

Central-station companies in Albert Lea, Minn., Anaconda, Mont., Clay Center, Kan., Durango, Colo., Fair Haven, Vt., Lancaster, Ohio, Mason City, Iowa, Menomonie, Wis., Middlebury, Vt., Montpelier, Vt., New Albany, Ind., Nokomis, Ill., Nyack, N. Y., Norwich, N. Y., Red Wing, Minn., Rutland, Vt., Tuxedo, N. Y., Wabash, Ind., and Watertown, N. Y., have recently joined the National Electric Light Association.

An ordinance will be presented to the councils of York, Pa., recommending the installation of a new city electric-light and power plant. After consideration, several of the councils have come to the conclusion that it would be cheaper for the city to own its own plant than to pay rent at the rate of $24,000 per annum for street lighting. It is stated that a new plant can be installed at a cost not to exceed $50,000.

In the reorganization of the Helena (Mont.) Power and Light Company, which was sold under order of the United States courts recently, the corporation is to take the name "Helena Light and Traction Company." The articles of incorporation have been filed. The company is empowered to do a general electric-lighting and gas business, also to operate street railways in Helena, and such points in the vicinity of Helena as may be advisable. The capital is $100,000, and the directors are Thomas A. Marlow, Henry M. Parchen, Albert L. Smith and Norman B. Holter of Helena, and Kenneth Clark of St. Louis, Mo.

The Los Angeles (Cal.) Edison Company, in addition to building a new steam plant and enlarging its present waterpower plant, is planning to install an additional waterpower plant on Kern River, which will be capable of developing about 20,000 horsepower. This plant will be located near Bakersfield, and the power will be transmitted over a double pole line to Los Angeles a distance of about 100 miles. With the installment of this additional horsepower, for which there is abundant demand in Los Angeles and vicinity, the indications are that the company's earnings will be nearly doubled during the next two or three years.

ELECTRIC RAILWAYS.

Fargo, N. D., has granted a franchise for the construction of 10 miles of electric railway to M. E. McDonald, George Price and others, of Scranton, Pa.

The Warren-Jamestown Electric Railroad Company has been incorporated under the laws of New York state. The company is capitalized at $100,000. It will connect, by an electric railway, Warren, Pa., and Jamestown, N. Y., which are about 20 miles apart.

Bees swarming from some hives that had fallen off a farmer's wagon were the cause of blocking several electric cars at Center Avenue and Twenty-fifth Street, Chicago, a few days ago. The bees swarmed around the cars, stinging the conductor, motorman and passengers.

Wellman & Romo have been granted a 25-year franchise to operate a street railroad in Walla Walla, Wash., and another franchise to cover the same period, to sell electricity in that city. A deposit of $2,000 has been posted as a guarantee that the road will be completed in two years.

Arrangements are on foot to build an electric-railway line from Jackson, Miss., to the town of Clinton, 10 miles distant. The board of trustees of the Mississippi College has offered to pay the Jackson electric railway a bonus of $10,000 to extend the line from the present western terminus.

The Jasper and Woodhull Railway Company of Canisteo, Steuben County, N. Y., has been incorporated with a capital of $250,000, to build a 13-mile electric railway from Canisteo to Jasper. The directors are L. D. Whiting, Canisteo; L. M. Hewitt, Buffalo, and Thomas Hannon, Bath.

A test of the Leffler electromagnetic street-railway system took place recently in Chicago. The test was made with a 10-foot model car, accommodating six people, on a track 180 feet long in an indoor shop, and is said to have demonstrated to the witnesses present the feasibility of the practical operation of such a system.

It is stated that Thomas A. Nevins of East Orange, N. J., is at the head of a syndicate which plans to construct 147 miles of electric railways between Liverpool and Manchester, England, and embracing side lines touching many populous towns. The work, it is said, will cost $20,000,000, all of which will be furnished by American financiers.

It is announced that electric-railway service may be established between Detroit and Kalamazoo, Mich., by October 1st. The Railroad Companies General, which already operates between Kalamazoo and Battle Creek, is building lines between Battle Creek and Jackson, and is making such rapid progress with the work that cars will soon be running between these points, and it is expected that traffic arrangements will be made with the Detroit, Ypsilanti, Ann Arbor and Jackson road.

The Trenton, Lawrenceville and Princeton, the Princeton street railway, the Yardley, Morrisville and Trenton, Newtown and Yardley street railways in New Jersey, known as the Johnson traction lines, have been consolidated with the New Jersey and Pennsylvania Traction Company, which concern controls the Lehigh Valley lines in Pennsylvania. The company will raise its capital stock from $1,000,000 to $3,000,000, and Jilson J. Coleman, who has long been in charge of the Johnson lines in that section, will be president of the directorate. It is the intention of the reconstructed company to build the connecting link between Trenton and Philadelphia. Then will come the proposed extension into the cities of Trenton and Princeton, and beyond the latter city, in the direction of New Brunswick.

AUTOMOBILES.

The City Hall records of Chicago show that over 800 automobiles are operated by licensed drivers in this city.

Concluding a census report on "Agricultural Implements," Joseph D. Lewis says: "It seems safe to predict, in view of the development of the automobile, that within the next decade this feature of modern invention will have found an additional application as a motive force in connection with agricultural implements of tillage, planting and harvesting. An automobile lawn mower is already meeting with considerable favor where the conditions warrant its use."

POWER TRANSMISSION.

Joaquin Miller, the poet of the Sierras, has located a large water right on a stream which he refuses to name. There is splendid waterpower, he says, which he discovered in 1856, when fishing with Indians, of whom he was virtually chief. He says that the power possibilities of the spot have remained undiscovered for years. A company of California capitalists will be formed to build the plant.

SOCIETIES AND SCHOOLS.

The next meeting of the Old Time Telegraphers and Historical and United States Military Telegraph Corps Association will be held at Salt Lake City, Utah, on September 10th, 11th and 12th.

The 1902-1903 catalogue of the college of engineering of the Ohio State University, Columbus, Ohio, has been published. It is a very complete publication of its kind and besides containing all the necessary information in regard to courses of instruction, buildings, equipment, faculty and alumni, has a large number of illustrations, showing the different buildings, laboratories, shops, surveying parties, etc. A short biographical sketch, with portrait, is given of the late C. N. Brown, dean of the college of engineering. Francis C. Caldwell is professor of electrical engineering of the college.

The contract for building the new electrical-engineering laboratory for the Massachusetts Institute of Technology has been awarded to a Boston contractor. It is said that this will be the best-equipped and most modern electrical laboratory for educational purposes in the world. Professor Puffer of the Institute recently visited electrical laboratories in Europe and obtained many valuable ideas. Dr. Louis Duncan, the recently appointed head of the electrical department, has directly supervised the plans for the building, which is to be ready for use during the fall term. The laboratory will be known as the Augustus Lowell Laboratory of Electrical Engineering, as a recognition of Mr. Lowell's long and intimate association with the Institute.

PUBLICATIONS.

Several reference tables of wires for electrical purposes are included in a recent publication issued by the American Steel and Wire Company of Chicago and New York. The catalogue also contains a full list of the products of the company.

James Ferguson is the author of a work entitled "Natural Philosophy: A System of Our Knowledge of Nature, With an Attempt to Explain the Mysteries," that is being published in six parts by the Alliance Publishing Company, 569 Fifth Avenue, New York. The author sets forth some new ideas of gravitation, electricity, magnetism, the tides and other physical forces. The first number just issued is an introduction to the finished work.

A very complete catalogue of Smith-Vaile pumping machinery has just been issued by the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio. It contains 140 pages and describes, with illustrations, a great variety of pumps, as well as jet and surface condensers, air compressors, etc.

The Seventh Annual Bulletin of the Engineers' Club of St. Louis contains useful information about the society, including a list of the names of the officers and members. D. W. Roper, 918 Rialto Building, St. Louis, is secretary of the club, and Colonel E. J. Spencer, well known to electrical men, is a director and past-president.

The Electric Storage Battery Company of Philadelphia is distributing a book of curves illustrating the operation of Chloride accumulators in their typical applications to electric railways, central lighting and power stations, isolated lighting plants, etc. The curves are self-explanatory of the advantages of storage-battery installations in their various fields.

The National Electric Light Association has issued a very valuable report of municipal-lighting statistics for the use of members only. The list covers 798 cities and towns in the United States and gives information regarding the number of arc lights, their candlepower, price per lamp per year, time of burning, etc. The headquarters of the association are at 136 Liberty Street, New York.

The Cassel self-governing waterwheels are described in a catalogue issued by the Cassel Automatic Water Motor Company of Seattle, Wash. This apparatus is said to be the only automatic-governing water motor made and is especially adapted for the conversion of waterpower for electrical generating, mines, air compressors, mills, etc. The catalogue contains complete descriptions of the waterwheel in all its applications, and considerable hydraulic and general engineering data are also included.

ELECTRICAL SECURITIES.

In financial circles it is stated that notice has been sent to the stock and bond holders of the Sprague Electric Company by President Markle, stating that the original contract for the sale of their property to the General Electric Company has fallen through because the original offer was based upon the showing of a certain percentage of earnings by the Sprague company, which careful examination of the books failed to verify fully. A new offer has been made by the General Electric Company, reducing the terms of purchase, but still considered advantageous to the Sprague company security holders.

TELEGRAPH.

A branch of the international union of Commercial Telegraphers has been organized in Milwaukee, Wis., 50 men, employes of the Western Union and Postal companies and mercantile firms, signing as charter members.

A report from Germany states that at a recent meeting of the stockholders of the German Atlantic Cable Company the proposition of the directors to issue bonds to the amount of $4,760,000, in order to lay a second cable between Germany and the United States, was accepted.

President A. J. Cassatt of the Pennsylvania Railroad Company is said to have notified the Western Union Telegraph Company to remove its property from the railroad company's premises not later than September 30th. The Postal Telegraph-cable Company began on July 7th to handle business over the Pennsylvania wires east of Pittsburg and Erie, Pa.

SPACE TELEGRAPHY.

It is quite probable that the Signal Corps of the army will use a system of wireless telegraphy in the coming joint army and navy maneuvers, and the navy will doubtless make use of some system in the large naval maneuvers to be held in the Caribbean Sea next winter.

A Paris dispatch states a successful test was recently made at Cherbourg of the application of wireless telegraphy to submarine torpedo boats. A mast with receivers was fitted to the submarine boat Tridon. The vessel dived and received signals from the central submarine station clearly.

R. Pfund, an electrical engineer, is said to be on his way to Alaska to establish a space-telegraphy system between Fort Gibbon, on the Yukon River, and the fort at Bates Rapids, on the Tanana River, a distance of 195 miles. The line, which will be constructed under the direction of Chief Signal Officer Greely, will be completed by October 1st. On his return from the North Mr. Pfund, it is said, will take measures to establish a station near the Golden Gate at San Francisco, so that wireless communication may be had with vessels on the Pacific.

MISCELLANEOUS.

The old saw that lightning never strikes twice in the same place seems to have been refuted in the case of a St. Louis man who says that he has been struck three times, the last time nearly resulting fatally.

Recently the Trail smelter at Trail, B. C., shipped the first pig lead smelted by electricity to Winnipeg. The success of this plant insures the construction of a larger refinery, and it is understood that plans are being prepared for a plant which will turn out 50 to 60 tons of pig lead, by the electric process, daily.

A Gothenburg (Sweden) newspaper says: "An

effort is being made to use electricity in agriculture. A seed field is covered by a network of wire, and a strong electric current is turned on during nights and chilly days, but cut off during sunny and warm weather. The system is invented by Professor Lemström of Helsingfors, Finland. Nothing can be said as yet as to its practicability."

TRADE NEWS.

The G. B. W. Electric Specialty Company of New York city has been incorporated with a capital stock of $15,000. The directors of the company are Josef Veit and C. F. Lewis of New York and L. C. Scrymser of Brooklyn.

The Standard Electric Company of Erie, Pa., has been incorporated under the laws of Pennsylvania under the corporate name—Federal Electric Company. There is no change in the management. All contracts and obligations of the Standard Electric Company will be executed by the Federal Electric Company.

The census reports of 1900 show that in that year the value of clay conduits for electrical wires manufactured in the United States was $685,273, an increase of $631,773, or nearly 1,200 per cent., over the value of the same product reported in 1890. The value of porcelain electrical supplies manufactured in the United States in 1900 was $470,355. Clay conduit and porcelain electrical supplies are manufactured chiefly in the states of New Jersey, New York and Ohio.

The Simplex Electric Heating Company of Boston has taken over the electric-heating and rheostat business which has been developed by the heating department of the Simplex Electrical Company. This change separates the electric-heating business from the manufacture of insulated wires and cables and is calculated to furnish opportunity for carrying out a broader policy in the conduct of the business. Additional factory buildings now under construction will, it is said, provide more than three times the present capacity, and will permit of more prompt service than has been possible in the past, owing to limited factory facilities. The management will remain the same as heretofore. The principal office of the company will be at 77 Cornhill, Boston, Mass. The Chicago office will remain in charge of H. R. Hixson, at 1137 Monadnock Block. The officers of the Simplex Electric Heating Company are: President, George U. Crocker; vice-president, Everett Morss; treasurer, Charles A. Morss, Jr.; manager, James I. Ayer.

BUSINESS.

The Electric Appliance Company, Chicago, takes particular pride in its multiple-burning sign lamp. This is effective for advertising and decorative purposes, and is useful in window displays. It is being sold quite extensively at present for sign work in connection with street fairs and expositions. It is a product of the Packard factory.

A recent catalogue issued by the Willard Storage Battery Company of Cleveland, Ohio, is descriptive of the Willard storage battery in all its prominent types. This new company has made many important improvements over the old type of battery manufactured by Sipe & Sigler and is now ready to take care of all kinds of business, especially in street-railway and lighting plants.

R. H. Macy & Co. of New York have awarded to the Jandus Electric Company of Cleveland, Ohio, a contract for 1,300 arc lamps for the complete illumination of their new store on upper Broadway, and expect to use altogether about 1,500 of these lamps in the completed building. This is probably the largest contract for arc lamps ever awarded for isolated service. The lamp to be chiefly used in the installation is of the Jandus improved standard type, which is more expensive than the ordinary lamp, and for which, it is asserted, the Jandus company receives a price in excess of that offered by other bidders. Macy & Co. have used the Jandus standard lamps in their old store for many years, and thoroughly believe in them, so that no inducements in the way of low price could wean them from their choice. The Jandus Electric Company naturally congratulates itself, not only on the size of this order, but upon the circumstances under which it obtained the award.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 8, 1902.

703,980. Combined Switch and Lightning Arrester. William J. Bell, Baraboo, Wis. Application filed March 26, 1902.

The line wire of a telephone or other electrical system is combined with an instrument, a carbon plate electrically connected with the ground, and a movable device for making and breaking electrical connection between the line wire and the instrument. The device has a portion of carbon, movable in close proximity to the carbon plate.

703,984. Supporting Device for Electric Lamps. William F. Brewster, New York, N. Y. Application filed December 19, 1901.

Combined with a series of lamp receptacles, and a series of separate adjustable receptacle-supporting devices connecting the receptacles, are independent plates or strips also connecting the several receptacles and located in front of the adjustable connecting devices.

703,985. Electric Locomotive Crane. George M. Brill, Philadelphia, Pa. Application filed January 4, 1901.

In the crane are a locomotive provided with driving wheels, a swinging crane mounted upon the platform of the locomotive, a winding drum mounted beneath the platform, adapted to receive the hoisting rope, a motor carried beneath the platform, mechanism controlled from one end of the locomotive for connecting the motor and the driving wheels and mechanism controlled from the same end of the locomotive for connecting the motor.

703,989. Magneto-therapeutic Apparatus. John Burry, Fort Lee, N. J., assignor to Max Wyler, Fort Lee, N. J., and Marie Burry, Brooklyn, N. Y. Application filed May 8, 1900.

The apparatus consists of a solenoid combined with, but insulated from, a metal lining.

704,010. Apparatus for Concentrating Magnetic-iron Ores. Thomas A. Edison, Llewellyn Park, N. J. Application filed May 23, 1898.

The apparatus comprises a set of pulverizing rolls by which the material is finely pulverized, a screen to which the finely pulverized material is fed, a magnetic separator for separating the magnetic from the non-magnetic particles of the screenings of the screen, a drier to which the magnetic particles are fed and by which they are dried, a fine screen to which the dried magnetic particles are fed, a second set of pulverizing rolls for pulverizing the tailings of the fine screen, and means for returning the re-pulverized material to the fine screen.

704,019. Electrical Transportation System. Henry F. Freed, Harrisburg, Pa., assignor of nine-tenths to Isaac Freed, Harrisburg, Pa., and Sylvester O. Spring, Peoria, Ill. Application filed March 11, 1901. Renewed January 13, 1902.

The system combines separate track rails, a carriage supported to travel upon the track rails, an electric motor carried by the carriage and geared with one of the track rails, a reversing switch carried by the carriage and circuited with the electric motor and the separate track rails, quick-break switches circuited with the track rails, and means located within the path of movement of the reversing switch to shift the reversing switch to break the circuit, open the quick-break switch and reverse the reversing switch.

704,023. Telegraph. Charles E. Fritts, New York, N. Y. Original application filed April 2, 1881. Divided and this application filed October 10, 1882.

A composite and organized main line is composed of two or more non-inductive and non-retarding sections inductively connected together in series by condensers. Water-tight casings protect the connecting devices from the tension of the line and are suitable for forming a constituent part of the line in the open air, earth or sea. One or more sets of transmitting apparatus are provided at the terminal stations for producing electrical signals or impulses and thereby charging the terminal condensers of the line; and one or more sets of receiving apparatus are arranged at the ends of the line for recording or translating the signals.

704,045. Apparatus for Cleaning the Interior of Hose or Like Pipes. Sven Hydén and Knut A. Simonsson, Stockholm, Sweden. Application filed May 8, 1901.

The apparatus comprises a motor, a carriage supporting the same and adapted to travel on rails or other guideways, a shaft operatively connected with the motor, a transmission shaft of coiled wire coupled to the shaft, and a brush coupled to the end of the transmission shaft.

704,092. Contact System for Electric Railways. Theodore B. Patch, North Cambridge, Mass. Application filed November 29, 1901.

In the system are included a series of standards located outside the tracks of the railway, a series of plates, one of which is fast to each of the standards and extends therefrom laterally toward the track in such a manner as to present only its under side to an upward-bearing shoe of sufficient length to contact with two of the plates simultaneously. The contact plates are insulated from the standards and connected to a source of power.

704,093. Contact System for Electric Railways. Theodore B. Patch, North Cambridge, Mass. Application filed April 4, 1902.

A shoe support is pivoted to one of the two car trucks and has a sliding engagement with the other of the trucks, and a shoe is supported upon the shoe support and arranged to engage two contact plates simultaneously.

704,099. Electric-motor Regulation. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. Application filed March 24, 1899.

An alternating-current motor has field windings, armature coils, commutator and commutator brushes arranged at the neutral point, all connected in series, as customary in constant-current motors, and a regulating device for controlling the speed of the motor consisting of a variable resistance permanently in shunt across the armature.

704,108. Programme Clock. Otis D. Rice, Winthrop, Mass. Application filed July 30, 1901.

In the apparatus described are two series of bars, means to connect any bar of one series electrically with any bar of the other series, a circuit including two endless conductors, means to put one conductor in electrical contact with the successive bars of one series at predetermined intervals of time, and to put the other conductor in electrical contact with the successive bars of the other series at fractional portions of such intervals of time.

704,113. Circuit-closer for Portable Electrical Apparatus. William Roche, Jersey City, N. J. Application filed December 5, 1901.

The device consists of a conducting cap or carrier with a circuit-closer carried by the cap, but insulated therefrom and provided with a contact arranged to engage the end surface of the cap or carrier.

704,117. Signaling System. John J. Ruddick, Newton, Mass., assignor to the United States Electric Signal Company, Watertown, Mass. Application filed July 26, 1901.

In the system are a power circuit including a main conductor and a return wire, a single signal circuit including a signal, the signal circuit normally having both ends thereof connected to the same side of the power circuit, means operated by a car entering the block to connect one end of the signal circuit to the opposite side of the power circuit and means operated by the same car leaving the block to connect the other end of the signal circuit to the opposite side of the power circuit.

704,125. Battery. William T. Seddon, Minersville, Pa. Application filed July 20, 1901.

The cell has vertically grooved strips arranged upon opposite sides. The zinc plates are arranged in the groove and have shoulders at their upper ends adapted to rest upon the strips, and the carbon electrodes have shoulders at their upper ends, the carbon electrodes being hollow and adapted to receive a depolarizing solution.

704,127. Combined District Telegraph and Telephone Signal. Charles Selden, Baltimore, Md. Application filed January 25, 1902.

The system combines with the apparatus at the central office for recording the box signals designating the number of the box, a vibrating receiver adapted to produce a prolonged vibratory signal of varying duration, a district-telegraph box having the usual circuit-breaking wheel and contact brush, and a supplemental contact brush adapted to bear upon the face of the wheel and in line with one or more prolonged breaks in the surface of the wheel for the purpose of sending a signal adapted to produce in the vibratory receiver a prolonged sound indicating audibly to the central-office operator that telephonic communication is desired.

704,135. Station Indicator. Harry T. Smith and Arthur J. Tarrant, Christchurch, New Zealand. Application filed January 14, 1902.

An escapement lever carries an armature attracted by a magnet, and a spiral spring is arranged to withdraw same with beveled gearing to reverse the movement of the indicator roller. Magnets to operate the escapement lever are connected electrically with any convenient source of current.

704,165. Telegraphic Safety Device. Selden R. Wright, Morton, N. Y. Application filed December 13, 1901.

Combined with a main-line circuit are an electromagnet and a key in the circuit, a normally open shunt-circuit around the key, a time mechanism, and a circuit-closer mechanism for the shunt-circuit comprising a movable part adapted when the main-line circuit is broken to connect with and be moved by the time mechanism, and a contact piece in the shunt-circuit having an insulated portion and an uninsulated portion, and a movable arm adapted to be moved from the insulated portion to the uninsulated portion when the movable part is operated by the time mechanism.

704,177. Electrical Apparatus for Operating Railway Switches and Signals. Théophile Ducousso, Paris, France. Application filed September 22, 1898.

In the mechanism are a transmitting commutator, a lever for working it, pawls on the lever acting in opposite directions, a current-controlled bolt, and means for projecting the bolt into the path of the pawls in case of accidental throwing of the switch.

704,202. Switching Apparatus. Carl Michalke, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Application filed November 18, 1899.

In the switch combined with main switch portions are a longitudinally movable metallic rod, metallic contact means, the rod and metallic contact means serving to open the circuit after the main switch portions have been separated, a sleeve of insulating material inclosing the rod, and means interposed berween the rod and the sleeve for preventing the heat due to arcing from injuring the sleeve.

704,246. Burglar Alarm. Patrick W. Dunne, River Forest, Ill. Application filed March 30, 1901.

A curtain is made of fabric so that a portion of the warp-threads are made of wire, the wire warp-threads being united together to form a continuous electric conductor. The shade-roller with metallic axes and fixtures is connected to the continuous curtain wire, and the electric circuit includes an electromagnet which controls a secondary circuit including an alarm bell.

704,247. Burglar Alarm. Charles Fruehauf, Chicago, Ill. Application filed December 26, 1901.

An electric burglar alarm for doors and the like is described. It combines battery terminals, a pivoted support, contacts on the support movable to engage the terminals, a spring-pressed rod movable to engage the block and elevate the contacts into engagement with the terminals, an electric circuit including an alarm signal connected with the contacts, and means on the door for engaging and restraining the rod.

704,252. Process of Making Plates for Storage Batteries and Product Thereof. Henry K. Hess, Philadelphia, Pa. Application filed July 30, 1901.

The process consists, first, in mechanically applying an active material or material to become active to the back piece of a suitable mold; second, arranging portions of a series of separate metal strips against the material in separated relation and other portions in sliding contact; third, applying mechanically extra active material or material to become active to the exposed surfaces of the separated portions of the strips so that the separated portions of the strips are concealed, and then compressing the active material so as to form a self-supporting mass to hold the strips in position.

704,264. Controlling System for Electric Hoists or Elevators. Andrew E. Maccoun, Braddock, Pa., assignor to the Otis Elevator Company, New York, N. Y. Application filed April 29, 1898.

In the electric hoist are arranged a reversing controller and a hand-controlled cut-out switch included in the circuit, and a mechanism connected with the cut-out switch operated by the movement of the hoist and arranged automatically to break the main circuit when the car has reached the limit of its travel.

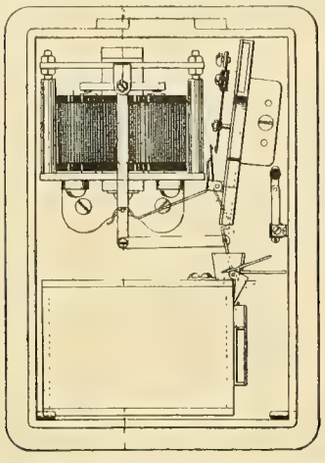
704,268. Coin Collector for Telephone Toll Lines. Joseph J. O'Connell, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed October 17, 1900.

In the toll-collecting appliance are combined a chute for receiving a coin, a coin-distributing electromagnet

and mechanism connected therewith for directing the course of the coin, an electric circuit, a pair of contact terminals controlling the continuity of the circuit, the terminals being adapted to be closed together to complete the circuit by a coin deposited in the chute, and mechanism operated by the armature of the electromagnet, for closing the contacts together independently of the coin. (See cut.)

704,271. Control Device for Hoisting Machines. George H. Reynolds, Chicago, Ill., assignor to the Otis Elevator Company, East Orange, N. J. Application filed December 29, 1898.

In a hoisting apparatus are combined control devices for starting and stopping the engine, and electric automatic regulating devices connected to some moving part of the apparatus for reducing the speed of the engine before the hoist reaches the limits of its movement.



NO 704,268 —TELEPHONE COIN-COLLECTOR.

704,303. Reversible Galvanic Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company. Application filed January 8, 1901.

For this and three succeeding patents see page 36.

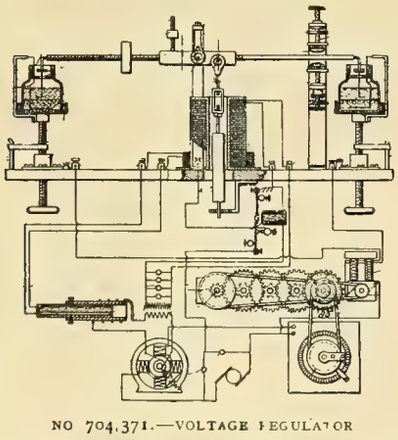
704,304. Reversible Galvanic Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company. Application filed March 1, 1901.

704,305. Electrode for Batteries. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company. Application filed May 17, 1901.

704,306. Reversible Galvanic Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company. Application filed June 20, 1901.

704,322. Electrical Push and Switch. Edgar G. Harcourt, Birmingham, England, and Marshall B. Lloyd, Minneapolis, Minn. Application filed July 9, 1901.

The base is provided with an apertured flange on its upper side, and a spring-catch projects through the flange aperture. A dome passes over the flange and has a groove on its inner side to engage the catch and a recess in its lower edge intersecting the groove.



NO 704,371.—VOLTAGE REGULATOR

704,323. Automatic Electric Semaphore Signal. James N. Harper, Kansas City, Mo. Application filed April 25, 1901.

An electric lamp is held at one side of a supporting column between an adjacent pair of colored media when the arms are in horizontal position.

704,336. Reversing Switch Motor. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, Orange, N. J. Application filed April 4, 1899.

In the switch are combined a number of electrically operated switch-arms, and a safety device controlled by the movement of one switch-arm and controlling the movements of another switch arm, whereby the switch-arms are operated in a predetermined order or succession.

704,337. Controlling System for Electric Elevators. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed January 11, 1902.

In the motor-controlling apparatus are combined controlling circuits of different potentials reciprocally controlling each other.

704,338. Controlling System for Electric Elevators, John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed January 13, 1902.

Combined with an electric motor, and its main circuit, are a controlling circuit of lower potential than the main circuit, and means for rendering a portion of the controlling circuit inoperative after the motor is started.

704,347. Railroad Signaling System. Allison W. Knee, Syracuse, N. Y., assignor of one-third to Frank J. Manz, Syracuse, N. Y. Application filed March 7, 1902.

A pair of separate metallic brushes are connected to the circuit and carried on the locomotive, the contact brushes being disposed one in front of the other to travel over the roadbed of the railway. A circuit closing rail is disposed parallel to and between the track rails and in the path of the contact brushes to effect the sounding of the alarm, and means are adapted automatically to form a cross in the electric circuit between the track rails and the circuit-closing rail to either prevent or stop the sounding of the alarm.

704,361. Electric Cut-out. Gustave N. Oehmen, Brooklyn, N. Y., assignor of one-half to Oscar F. Ehrle, New York, N. Y. Application filed December 14, 1901.

The cut-out comprises a spring-actuated lever, a catch-lever, an expansible rod adjustably carried by the catch-lever, a terminal plate on which the expansible rod rests, and a resistance wire around the rod and completing the circuit from the plate to the catch-lever.

704,371. Voltage-regulator. Thomas M. Pusey, Kennett Square, Pa. Application filed August 5, 1901.

One claim reads: In a voltage-regulator, a generator, a rheostat for the generator, a motor for controlling the rheostat, a shunt-circuit from the exciter-circuit in which the motor is arranged, a helix arranged in circuit with the generator, a balance beam arranged in the shunt-circuit and controlled by the helix, contacts carried by the beam, liquid-containing vessels into which the contacts extend supports for the vessels, means for adjusting the supports vertically, contacts fixed in the vessels and in the shunt-circuit, and an electromagnet in the main circuit of the generator for controlling the motor circuit. (See cut.)

704,393. Manufacture of Iron, Manganese and Alloys of These Metals by Aid of Electricity. Albert Simon, Bordeaux, France. Application filed February 27, 1901.

A process of manufacturing iron, manganese and the alloys of such metals consists in adding to the material to be treated carbon and an electrolyte consisting of fluoride of calcium, in sufficient quantity to dissolve the material and then subjecting the mass to the action of a continuous electric current to cause the electrolytic decomposition and the keeping of the material in a fluid condition.

704,398. Safety Device. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed October 12, 1901.

The invention consists of a motor, a field circuit normally closed in shunt to the mains, and a normally open switch in the armature circuit controlled by an electro-responsive device in the field circuit.

704,399. Stained-glass Window or Similar Object and Process of Making Same. Julius Taluau, Philadelphia, Pa., assignor of one-half to Henry W. Scattergood, Philadelphia, Pa. Application filed December 16, 1895.

The method of uniting sections of glass or tile consists in arranging such sections on a support with their adjacent edges apart, the support being provided with a conducting surface along the spaces between the edges of the sections, and then electrodepositing metal upon the support until the spaces between such sections are filled by the deposited metal.

704,400. Method of Framing Glass. Julius Taluau and Henry W. Scattergood, Philadelphia, Pa. Application filed June 30, 1897.

This method consists of exposing the whole in an electrolytic bath until the interstices between the sections are filled with the deposit formed, then continuing the exposure until the deposited metal is in the form of an I-beam.

704,401. Method of Framing Glass. Julius Taluau, Philadelphia, Pa., assignor of one-half to Henry W. Scattergood, Philadelphia, Pa. Application filed March 22, 1898.

The glass is exposed in an electrolytic bath and electrodeposited on the conductor and within the spaces until the spaces are entirely filled with deposited metal, so as form an electrodeposited holding frame therefor.

704,417. Igniter. Charles A. Wilkinson, Worcester, Mass. Application filed October 15, 1901.

An electrical igniter for internal combustion engines, comprising two conducting pins mounted in the cylinder head in parallelism with each other is described.

704,423. Wall Plate or Shield for Electric Wires. Boyd W. Allen, Boston, Mass. Application filed February 26, 1902.

The wall plate is adapted to be secured to the wall around the aperture through which the electric wires extend.

704,424. Junction Box for Electric Wires in Buildings. Boyd W. Allen, Boston, Mass. Application filed February 26, 1902.

The box described has a metallic main portion comprising the wall and a pair of slabs of porcelain or other insulating material held against the rear and front surfaces of the wall.

704,425. Junction Box for Electric Wires in Buildings. Boyd W. Allen, Boston, Mass. Application filed March 8, 1902.

In the junction box are a split nipple or pair of nipples set reversely with each other and provided with a gas passage.

704,439. Thermal Protector for Electric Circuits. Frank B. Cook, Chicago, Ill. Application filed July 29, 1896.

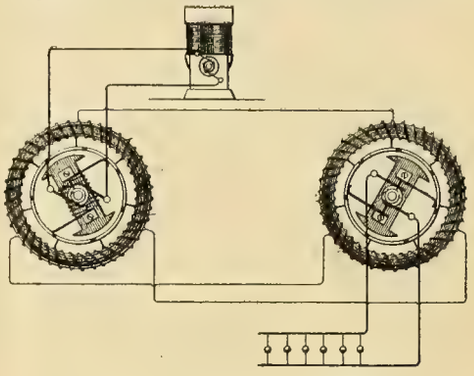
A heat-coil protector is described. It consists of an inclosing shell, interior insulating material a heat-coil, a concave socket, a convex head fitted therein, fusible material between the face of the socket and the face of the head, and means for holding a spring contact strip or contact strips.

704,446. Watch-dial Illuminator. Frederick M. Durkee, Newton, Mass., assignor of one-half to Ulric Blatter, Jamaica Plain, Boston, Mass. Application filed September 26, 1901.

An incandescent lamp is arranged to throw light on a watch as it is suspended.

704,447. Protective Operating Device for Electric Motors. Arthur C. Eastwood, Cleveland, Ohio, assignor to the Electric Controller and Supply Company, Cleveland, Ohio. Application filed November 16, 1901.

Means are provided for holding a contact arm at a level such that it will contact with contact plates, and means are operative upon the arm at its center of rotation for moving the arm away from the level whereby it is allowed to return to its off position without engaging the contact plates.



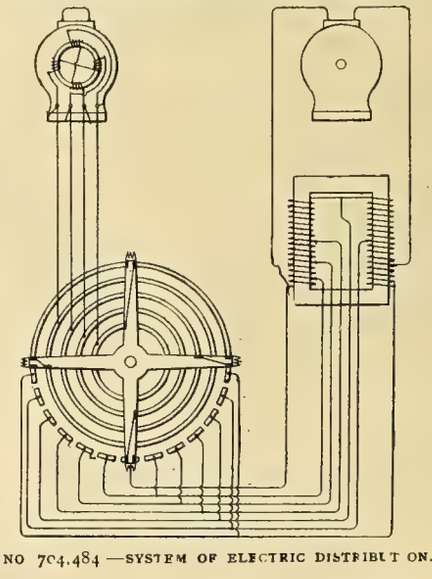
NO. 704,453 —TENSION CHANGER.

704,448. Rheostat. Arthur C. Eastwood, Cleveland, Ohio, assignor to the Electric Controller and Supply Company, Cleveland, Ohio. Application filed April 10, 1902.

The rheostat consists of a series of plates of relatively high electrical conductivity having coatings of relatively low conductivity, with means yieldingly holding the plates in contact with one another, the plates being connected to each other through the coatings.

704,453. Means for Changing the Tension of Currents. William M. Fairfax, Brooklyn, N. Y. Application filed October 11, 1892.

In a system of electrical generation, transmission and distribution are combined a generator of continuous currents, a local circuit or circuits connected thereto, a transformer having a stationary core and stationary primary and secondary coils, the primary coils being connected to a local circuit, and the secondary coils being normally permanently connected to interconnected three-phase transmission leads, a rotary commutating device electrically connected to the primary coils for producing successively acting magnetomotive forces in the stationary core of the transformer, thereby producing successively acting electromotive forces in the secondary coils of the transformer which result as three-phase currents in the interconnected transmission leads. (See cut.)



NO 704,484 —SYSTEM OF ELECTRIC DISTRIBUTION.

704,484. System of Electric Distribution. Carl J. A. Michalke, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Original application filed December 31, 1897. Divided and this application filed March 10, 1900.

One claim reads: In combination, a dynamo-electric machine, one member of which is provided with a plurality of angularly displaced windings, the winding on the other member being adapted to be traversed by single-phase alternating currents, a subdivided source of single-phase alternating current, and a switching device interposed between the source and the angularly displaced windings, the switching device being constructed and arranged to vary inversely the potentials at the terminals of the windings. (See cut.)

704,485. Weft-replenishing Loom. William E. Moore and Frank R. Clark, Augusta, Ga. Original application filed April 3, 1900. Divided and this application filed July 27, 1900.

Combined with a filling-changing mechanism are means for controlling the operation thereof including an electric circuit, the electric condition of which is changed upon the exhaustion of the filling in an active shuttle to a predetermined amount, and an auxiliary circuit partially completed by change in the electric condition of the first-named circuit.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, JULY 26, 1902. No. 4

Development of the Auditorium Electric-lighting Plant.

When the Auditorium was built in 1889 provision was made for supplying the lighting and heating systems from two separate power plants. These plants were both located in the basement, and one supplied the Auditorium Hotel proper and the other the theater and office portion of the building. The combined equipment of the plants comprised 11 60-inch by 18-foot horizontal tubular boilers, 13 high-speed engines of about 125 horsepower each, 10 100-kilowatt dynamos of the old Edison bipolar type, four high-duty pumping engines for the elevator service and 17 duplex steam pumps of various sizes and makes for domestic and boiler-feed service. The dynamos were each belt-driven by a separate engine, the three engines not thus accounted for being employed for other purposes, such as operating ventilating fans, etc. The high-duty pumping engines operated 14 hydraulic elevators.

These two power plants supplied electric current to 16,000 16-candlepower incandescent and 50 arc lamps in the original Auditorium Building. At the time the equipment was installed it was considered to embody the best and most modern features, and, in fact, considering the two installations as one station, it was the largest isolated plant in the United States. There had been other private plants of a similar nature installed in Chicago and vicinity before that time, but all were very much smaller than the Auditorium plant, which was regarded then as little short of wonderful.

In 1892 the need of additional hotel space was felt, and the Congress Hotel Company—a new corporation formed by the Auditorium people—erected the building known as the Auditorium Annex on the south side of Congress Street, and facing Michigan Avenue. The company concluded that the new building must have its own lighting and heating plant, and, after due consideration, it was decided to install a large central power plant which should supply the Annex as well as the older hotel and theater building. Accordingly the two old plants were abandoned and the present plant installed.

The equipment is placed in a separate brick building adjoining the Annex and facing westward on the alley in the rear of the Annex. The engine and pump room extends from the basement level to about the height of the second story, and supported above the south side of the room on a gallery-like construction is the boiler room. Rising above the latter to a height of 175 feet is a steel stack. This stack is double, the inner tube of which is nine feet in diameter and lined part way with fire brick, being used to carry the gases and products of combustion from the boilers. Surrounding this boiler stack is a shell 15 feet in diameter and rising to almost the same height which serves as a ventilating flue for the engine room, kitchens and other portions of the basement. In Fig. 3 on the next page is shown a rear view of the Auditorium Annex and the new Auditorium apartment building recently erected. The power plant, with its double stack, is located between the two buildings.

The boiler equipment of the power plant consists of seven 350-horsepower Campbell & Zell water-tube boilers equipped with Murphy automatic stokers. In the engine room are located six Williams vertical compound engines, each direct-connected to a Siemens & Halske 125-volt external-armature direct-current generator. These units have the following capacities: Two 500-horsepower engines driving two 350-kilowatt generators, two 300-horsepower engines driving two 200-kilowatt generators and two 200-horsepower engines driving two 100-kilowatt generators. A general view of the engine room, showing these units and the switchboard controlling them, is given in Fig. 1. The Siemens & Halske generators, which, after 10 years' service, are considered out of date, are eventually to be replaced by Westinghouse machines.

In installing the plant of 1892 it was deemed wise to change the operation of the hydraulic elevators from a gravity system to an accumulative system. With this end in view two vertical compound high-duty pumping engines of the E. P. Allis type were installed. Each of these pumping engines has a daily capacity of 6,000,000 gallons of water. Within the last year the hotel corporation has erected the new 12-story apartment building adjoining and immediately south of the Annex. Four electric elevators have been installed in this building, and the hydraulic elevator equipment of the two older buildings comprises 21 elevators.

There has been recently added to the engine-room installation a 1,000-horsepower Allis-Chalmers vertical compound engine, on the shaft of which is mounted a 700-kilowatt, 125-volt Westinghouse direct-current generator operating at 130 revolutions a minute. A view of this unit, showing the close quarters in which it is installed, is given in Fig. 2.

A straight 110-volt two-wire system is supplied by the generating plant, the total light equipment in the Auditorium buildings comprising 32,000 16-candlepower incandescents and 75 arcs. In various parts of the buildings 12 motors ranging in size from five to 30 horsepower are installed for operating ventilating and refrigerating equipments. About 100 electric desk fans are also used in the different public rooms. In addition to this load the plant supplies the Studebaker Theater and Fine Arts Building, adjoining the Auditorium on the north, with light, heat and power, the electric supply consisting of current for 6,000 incandescent lamps and five electric elevators. The total equipment for light and power supplied from the one plant is thus seen to be 38,000 incandescent lamps, 75 arc lamps, 21 hydraulic elevators, nine electric elevators and the motors mentioned above.

The boiler plant, besides supplying steam for the operation of the engines, furnishes steam for 250,000 square feet of heating surface—all direct radiation. The coal, which is conveyed to the boilers by a bucket conveyor, overhead bins and pendulum chutes, is an Indiana bituminous screening. During the winter months as much as 100 tons of coal a day is consumed. The steam is generated at a pressure of 150 pounds to the square inch. The maximum load on the generating equipment is 15,000 amperes and the minimum load after midnight is about 4,000 amperes. It is planned to have the new generating unit take care of the bulk of the load, it being operated 16 hours a day.

In its present state the power plant of the Auditorium buildings is said to be the largest private installation in the country, it being 25 per cent. larger than the plant installed in the Waldorf-Astoria Hotel in New York city, which at the time of its completion was said to be the largest isolated plant in the United States. An idea of the size of the Auditorium buildings may be gained from the fact that they contain 1,250 guest chambers, besides many large offices, the large theater, banquet halls, palm gardens, cafes, grill room, etc. An unique feature of the new apartment annex is the lounging room that is to be equipped with an atrium located in the center of the room. It is intended that this room shall be the most elegantly furnished room of any hotel in the world. An interesting part of the furnishings will be the Tiffany electric fountain that was formerly on exhibition in the Tiffany exhibit at the Pan-American Exposition.

In consideration of the growth of the Auditorium's power equipment, it is interesting to note the economy that has been attained by installing a central plant. It is a matter of ledger account that the old plants cost to operate about $90,000 a year. The present plant, with another hotel added and with the same earning capacity for leased power as the original hotel property, can now be operated for about

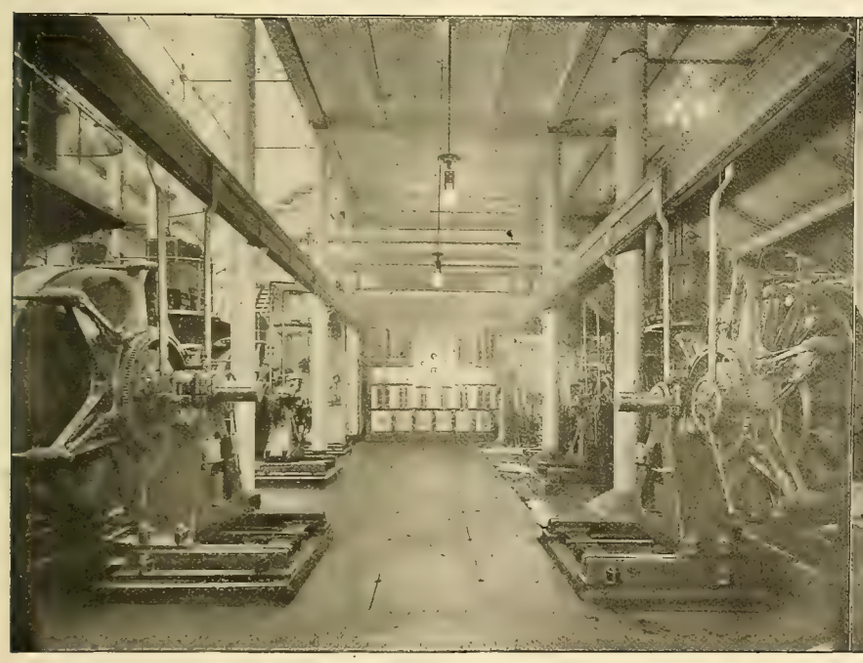


Fig. 1. View in Engine Room, Showing Plant Installed in 1892.

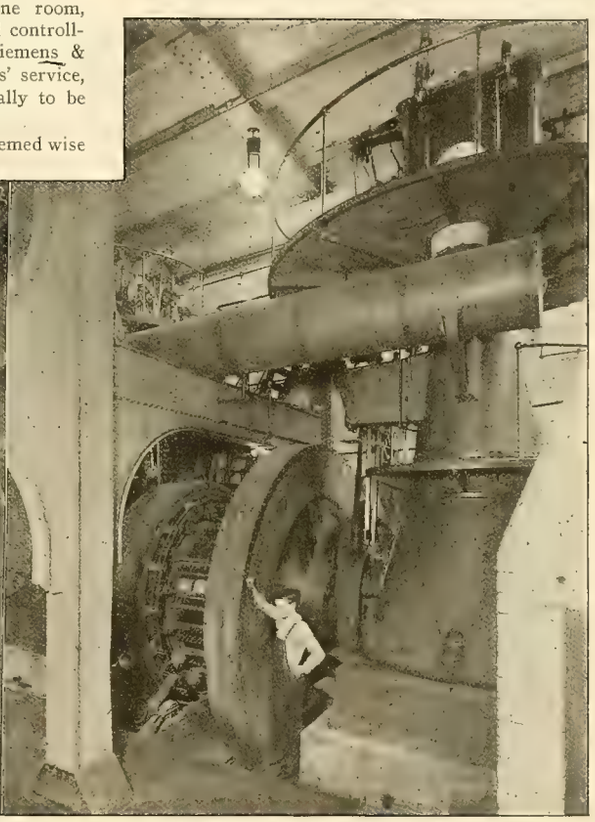


Fig. 2. New 700-kilowatt Generating Unit.

THE AUDITORIUM ELECTRIC-LIGHTING PLANT.

$50,000 a year, and since 1893 the plant has earned from supplying outside service between $60,000 and $70,000. No outside service is now connected, however, with the exception of the Studebaker and Fine Arts Building. G. M. Cowan, under whose supervision the original plants as well as the existing plant were installed, is chief engineer for the Auditorium buildings.

Another Susquehanna River Power Plant Proposed.

York, Pa., July 17.—Plans have been formulated for the erection of a new electric-light and power plant on the Susquehanna River, near Conowingo Falls. It is not the first time that this project has been broached, but new life has been injected by Philadelphia, New York and Baltimore capitalists for the purpose of utilizing the Peach Bottom Rapids from a point just below McCall's Narrows. On the islands in the river at that point the projectors may erect three great power houses, each of which, as talked of, will generate 50,000 horsepower. If this statement is correct, and it is given out by the projectors, the plant will generate twice the power of the $3,000,000 power plant now being constructed by Judge W. F. Bay Stewart of York and Mr. Henry L. Carter of New York city at York Haven.

Engineers have been working at the problem for the last two years, and they now have their plans matured. The current, they allege, will go to furnish power to Baltimore principally, and to Wilmington and other smaller towns en route. A large dam will be constructed, about 1,400 feet long, and 140 feet above tidewater. Another will extend from the lower end of Piney Islands to Bare Island, a distance of 4,400 feet. The headrace is planned to have a depth of 25 feet. This will pour into the great wheels 16,000 cubic feet per second. In each of the power houses will be installed 10 5,000-horsepower electrical units. For each unit there will be three pairs of 48-inch turbine wheels. It is stated that $12,000,000 will be needed to construct the great plant.

Among those who have given technical opinions on the project are Dr. Coleman Sellers of Philadelphia, president of the Niagara Falls Power Company; Clemens Herschel and John Bogart, consulting engineers on the Niagara works. At the head of this great undertaking is S. Davies Warfield, president of the Continental Trust Company of Baltimore. Bonds will be floated in that city by the different banking institutions, and from the promises made this great project will be matured within the next two years. O. P. W.

FIG. 3. REAR VIEW OF AUDITORIUM BUILDINGS, SHOWING POWER HOUSE AND STACK.

Lightning Takes an Unexpected Path.

Lightning wrecked a generator in the power house of the Detroit United Railway Company at Detroit, Mich., some time ago, and the officials of the company have been led to believe that the lightning came into the power house by way of the ground and not from the distributing wires. The theory is that the ground was surcharged and that, instead of scattering, as it would under normal conditions, the electric charge concentrated on a water pipe and in that way found its way into the power house.

Electrical Contractors in Philadelphia.

Fifty-nine delegates from several states and about 200 guests from various parts of the country attended the second annual convention of the National Electrical Contractors' Association, which was held in Franklin Institute, Philadelphia, on July 16th. Owing to the fact that the convention is only the second attempt to bring together the representative electrical contractors in the country, its success was looked forward to anxiously, but the most optimistic found their anticipations realized.

The headquarters of the officials and delegates were at the Hotel Walton. A committee of Philadelphia members was appointed to receive the visitors. This committee, which was composed of members of the largest electrical contracting firms of Philadelphia, was as follows: J. F. Buchanan, Henry D'Olier, Jr., William L. D'Olier, S. A. Jellett, Edwin R. Keller, H. G. Kepler, Alfred A. Lowry, H. A. Loeb, Frank E. McIntire, Walter C. McIntire, M. R. Mucklé, Jr., Clayton W. Pike, T. Carpenter Smith, Gilbert S. Smith, I. C. Walker and R. C. Williams.

The first day's session was opened by a meeting of the board of directors at nine o'clock in the Franklin Institute. The convention was called to order at 1:30 p. m. The meeting was held behind closed doors. It adjourned at 4:30, and members and guests turned their attention to pleasure seeking. A steamboat, specially chartered, took them up the Delaware River, stopping at Cramp's Ship Yard and the League Island Navy Yard. Returning, the guests were landed at Washington Park, on the Delaware River. Two hundred persons were present.

The delegates made their headquarters in the Bleak House, Atlantic City, N. J., on the second day of the convention. A meeting was held at two o'clock on the Steel Pier and the following-named officers were re-elected to serve for another year: President, Charles L. Eidlitz, New York; first vice-president, G. M. Jones, Minneapolis, Minn.; second vice-president, E. T. Cooke, St. Louis, Mo.; third vice-president, H. K. McKay, Baltimore, Md.; treasurer, George R. Mathieu, Pittsburg, Pa.; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.

The following-named directors were elected: From New York, M. L. Barnes of Troy, E. D. McCarthy of Buffalo and James Hilton of Syracuse; Pennsylvania, H. A. Loeb of Philadelphia; Michigan, E. McCleary of Detroit; Minnesota, W. I. Gray of Minneapolis; Maryland, John K. Howe of Baltimore; Missouri, E. E. Newbury of St. Louis; Washington, D. C., D. M. Anderson; Indiana, G. M. Saunders of Indianapolis.

An animated discussion took place over the selection of the next place of meeting. It was finally decided to hold the 1903 convention in Detroit, Mich.

The official register of delegates present at the convention contained the following names:

E. McCleary, McCleary & Colquitt Company, Detroit; D. M. Anderson, D. M. Anderson & Co., Washington, D. C.; M. L. Barnes, Barnes & Payton, Troy, N. Y.; E. M. Lawton, Lawton Electric Company, Cincinnati; H. A. Loeb, Francis Brothers & Jellett, Philadelphia; R. F. Metzel, Washington, D. C.; W. H. Morton, Johnson & Morton, Utica, N. Y.; W. I. Peacock, Snyder Supply and Electric Company, Rochester, N. Y.; C. Wilbur Sallader, Price & Son, Williamsport, Pa.; S. Davis, Conduit Wiring Company, New York; F. W. Newman, Albany District Telephone Company, Albany, N. Y.; F. B. Adams, Frank Adams Electric Company, St. Louis, Mo.; J. D. Van Wagoner, Van Wagoner & Linn, New York; W. I. Gray, W. I. Gray & Co., Minneapolis; Thomas H. Bell, Albany, N. Y.; F. S. Blackall, Blackall & Baldwin, New York; George R. Mathieu, Pittsburg, Pa.; P. C. Haviland, Edwards & Co., New York; J. C. Steins, J. C. Steins & Co., Buffalo, N. Y.; A. P. Kingston, Little Falls, N. Y.; Frederick C. Dobbier, Walker & Kepler, Philadelphia; E. J. McAllister, Electric Motor and Equipment Company, Newark, N. J.; W. L. Wilhelm, Wilhelm Telephone Company, Buffalo, N. Y.; W. C. Bolder, Utica, N. Y.; Rudolph Schmidt, Rudolph Schmidt & Co., Rochester, N. Y.; J. R. Strong, Tucker Electric Construction Company, New York; W. I. Patterson, Springer & Patterson, Pittsburg, Pa.; F. J. Miner, Seidler-Miner Electric Company, Detroit, Mich.; J. K. Howe, John K. Howe & Co., Baltimore, Md.; Robert A. M. Steele, Pittsburg, Pa.; E. S. Keefer, Western Electric Company, New York; A. I. Schubman, Cincinnati; M. S. Horton, Frederick Fish & M. S. Horton, Rochester, N. Y.; Emil Grah, Toledo, O.; E. E. Newberry, E. E. Newberry & Co., St. Louis, Mo.; Charles J. Sutter, St. Louis, Mo.; Walter C. McIntire, Philadelphia; James F. Burns, Schenectady, N. Y.; M. J. Snyder, Pittsburg, Pa.; J. C. Hatzel, Hatzel & Buehler, New York; H. I. Sackett, Buffalo; D. D. Crowley, Crowley Electric Company, Duluth; M. B. Wheeler, M. B. Wheeler & Co., Grand Rapids, Mich.; H. K. McKay, McKay Engineering Company, Baltimore, Md.; A. J. Martin, Commercial Construction Company, New York; J. F. Buchanan, Philadelphia; W. E. J. Deming, Deming Electric Company, Minneapolis; E. G. Bernard, Troy, N. Y.; T. Carpenter Smith, M. R. Mucklé & Co., Philadelphia; Charles L. Eidlitz, New York; James Hilton, Rogers & Hilton, Syracuse, N. Y.; Harry H. Alexander, New York; Thomas Hall, Northwestern Electric Company, St. Paul, Minn.; Edmund D. McCarthy, McCarthy Bros. & Ford, Buffalo; Herman Samuels, Kingsbury, Samuels & Co., Baltimore, Md.; G. M. Jones, Minneapolis Electric and Construction Company, Minneapolis; Joseph M. Zamoski, Baltimore, Md.

Curious Electrical Casualties.

"Electrical" fires are not always electrical. as is well known; electricity often suffers in reputation for alleged dangers of this sort of which it is entirely innocent. For instance, the latest report of the Electrical Bureau of the National Board of Fire Underwriters shows that a $65,000 loss, reported as the result of a fire caused by electricity, was found to have been incurred through the spontaneous combustion of some oiled rags. Again, a loss of $165,000 occurred in the celluloid room of a factory and was attributed to the use of electricity. This was afterward found to have been caused by overheating the celluloid on a softening press. A $4,000 loss, laid at the door of the long-suffering electric current, was found to have been due to the overturning of a candle in a storeroom.

However, some rather unusual casualties were mentioned in the same report as actually due to the careless handling of the electric current or the improper installation of electrical apparatus.

A 500-volt motor was installed in a room used as a pattern shop and for the storage of patterns. Upon the blowing of the fuse set in the line to protect the motor, molten metal was thrown into the surrounding inflammable material, resulting in a loss by fire of $4,816. Had the fuse been of the enclosed type, the accident could not have happened.

Another fire due to ignorance of the heating effect of an incandescent lamp resulted because a towel was thrown over a lighted incandescent lamp in a hotel chambermaid's closet and allowed to remain. In course of time the towel became ignited, resulting in considerable loss.

The breaking down of a transformer, due to careless wiring, is instructive. The secondary wires of the transformer entered a building through an iron ventilating shaft, between the ceiling and roof, being insulated from the shaft by means of clay bushings and running some 23 feet to the cut-out meter and switch. By improper wiring in installing some fixtures, grounds were made with the ventilator and tin roof. The strain produced on the insulation of the transformer was too great and a breakdown resulted between the primary and secondary coils. This allowed the passage of high-tension current in the secondary coil and resulted in the burning out of the coil and the starting of a fire.

Rome Compressed-air Cars May Be Abandoned in Favor of Electricity.

It is rumored that Horace E. Andrews and John J. Stanley, who head the company that operates the Utica (N. Y.) city lines and a line between that city and Rome, are negotiating the purchase of the system of the Rome City Street Railway Company. This system is operated with compressed-air motors, and it is said that it has not been as successful as it might have been, although a high figure has been placed upon it by the owners. As the Andrews-Stanley line will have to connect with this road for an entrance into Rome, the system would be a very valuable adjunct.

The car barns at the Cicero and Proviso power house of the Chicago Union Traction Company, Ridgeland Avenue and Lake Street, were destroyed by fire last week. Sixty cars and the summer supply of coal burned, and the fire also damaged the coal and ash-conveying machinery. The loss is estimated at $125,000. Practically no damage was done to the power house itself besides that mentioned.

COMMUNICATIONS.

The Injudicious Superlative.

To the Editor of the Western Electrician:

Referring to your editorial concerning the language used by President Eliot of Harvard in conferring the degree of master of arts, to support your statement that the distinguished recipient would not have given his own position in the electrical arts in the superlative language employed by the president, I may mention an incident which confirms your view. The distinguished gentleman gave some testimony on one occasion, and the first question asked him under cross-examination was substantially: "Mr. S., you are generally recognized, are you not, as the foremost living electrician, and at least as good as anybody else alive?" The answer which he gave was "I do not know." The cross-examination was continued on different lines.

T. J. JOHNSTON.

New York, July 16, 1902.

The Speaking Arc and Wireless Telephony.

To the Editor of the Western Electrician:

I have read with great interest the article of Dr. Guthe concerning the speaking arc and wireless telephony (Western Electrician, April 12, 1902). It Fig. 5 there is reproduced an arrangement of the speaking arc, which has been used by me for two years and which is described in the Annalen der Physik, IV, band 5, page 804, Fig. 1 (1901), as well as in Physikalische Zeitschrift, 2, page 325 (1901).

I should be much pleased if you would mention my priority of that arrangement in a following number of your paper. A continuation of these experiments resulted in my photographophone, a photographic phonograph, recording any change in the intensity of the speaking art on a sensitive film. The reproduction is effected by a selenium cell of highest sensitiveness, which is connected in a circuit containing two telephone receivers, which responds to any variation of the intensity of light thrown through the developed film. ERNST RUHMER.

Berlin, Germany, June 26, 1902.

In the accompanying illustration is shown an apparatus for wireless telephony constructed by Mr. Ruhmer in 1901 and exhibited by him in the exhibition of electrical novelties conducted by the Electrical Society of Berlin in March, 1902.

Dr. K. E. Guthe of the University of Michigan is the author of the paper to which Mr. Ruhmer refers. In answer to Mr. Ruhmer's letter he says:

RUHMER WIRELESS-TELEPHONE APPARATUS.

"I did not claim in my paper any priority for the arrangement of apparatus sketched in Fig. 5. The main point at issue seems to be that through the courtesy of someone connected with the Western Electrician—but entirely without my knowledge—this figure has been called 'Guthe's arrangement.' The device is so simple that anybody working with the speech-reproducing arc has probably tried it. In fact, it was made use of by Simon, the first observer of the phenomenon in question, as early as by Ruhmer, who has greatly increased our knowledge on the subject, especially on wireless telephony. Nevertheless, it seemed to me necessary to emphasize the simplicity of the arrangement and the satisfaction it gave, on account of the numerous devices proposed at various times, several of them—decidedly more complicated—being due to Mr. Ruhmer, and possibly giving the wrong impression that the simpler arrangement would not give satisfactory results."

Death of Mr. Mackay.

John William Mackay, president and founder of the Postal Telegraph-cable Company and also president of the Commercial Cable Company and the Commercial Pacific Cable Company, died at his house in London, England, on July 21st. Mr. Mackay was a man of great wealth, accumulated by his own exertions, and by reason of his extensive business connections was known the world over. He was unspoiled by success, being one of the few men who have acquired conspicuously large fortunes without forfeiting the sincere esteem of his fellows, whether rich or poor.

Mr. Mackay was born in Dublin, Ireland, November 31, 1831. At the age of nine years his parents

JOHN W. MACKAY.

moved to America, settling in New York, where he worked in a shipyard. He remained in New York until 1849, when he started for California to seek fortune in the gold fields which at that time had just been opened up. On his way to the western coast he made the acquaintance of James Flood, James G. Fair and William O'Brien, who were afterwards associated with him in all his enterprises on the western coast. It was not until he left the West that the firm composed of the four men broke up.

The career of Mr. Mackay in the California gold fields was a varied one, and it was not until 1872 that he became known to the general public. It was in this year that he moved his center of operations from California to Nevada. Here, in the same year, he made the discovery of the deposits of gold and silver, afterwards known as the Bonanza mines, from which he and his associates received the popular appellation of "Bonanza kings." These mines were worked five years, and during that time Mr. Mackay, who was the practical man as well as the heaviest owner, worked shoulder to shoulder with the lowliest men in his employment.

In 1878, together with Mr. Fair, the subject of this brief sketch founded the Bank of Nevada, with headquarters at San Francisco. Shortly after the establishment of the bank Mr. Mackay moved to Europe in order that his two sons (he was married in 1867) might be educated abroad. This change of base across the Atlantic was one thing that brought to Mr. Mackay's notice the condition of the cable service then in the hands of a pool. Believing that the cable rates were exorbitant and that the American people would appreciate an American cable company, the pool being a foreign concern, Mr. Mackay went into partnership with James Gordon Bennett and laid the two cables known as the Bennett-Mackay cables. One of these cables went to England and the other to France. The combination became known to the commercial world as the Commercial Cable Company, although the entire company was composed of the two men.

The project did not commend itself to the financiers, for few people thought the new concern would be able to stand against the old lines. Immediately the cables were laid the old lines, as was expected, informed the Commercial Cable Company that unless it raised the cable rates to 60 cents or 75 cents a word, the recognized rate being 50 cents, the pool would drop its rates to 12 cents a word. Mackay made answer that his rate would be 40 cents. The old lines then dropped their rates to 12 cents and Mackay came down to 25 cents, at which figure he held his rate until the other lines, tiring of the fight, came to that rate, which has ever since remained the standard.

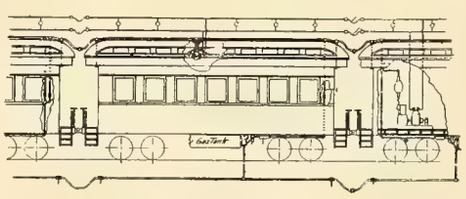
Having accomplished his cable project, he saw the necessity of land lines if he expected to cope successfully with the cable pool, which was closely allied with the Western Union Telegraph Company. His land scheme resulted in what is now known as the Postal Telegraph-cable Company, which he founded in 1883, and which has grown to the great dimensions of the present day. The Postal company has been a conspicuous factor in developing and modernizing the telegraph in the United States. Its enterprise, progressiveness and clean-cut business methods have been very generally recognized, even by opponents.

Mr. Mackay's connection with the telegraph has been a most noteworthy and honorable one. His achievements in this direction were the greatest features of a life more than ordinarily successful. He was a great financier and knew how to surround himself with able lieutenants; nevertheless he impressed his own sturdy individuality on the properties in which he was so deeply interested and which are his greatest monument. His death will naturally be a great loss to the three great companies of which he was the head, and, more generally, it is a loss to the business interests of the whole country. What effect the passing away of Mr. Mackay will have on the telegraphic situation remains to be seen; it may revive the talk of a combination of the Postal and Western Union—a consummation often rumored, but against which the deceased magnate resolutely set his face. On the other hand, Mr. Mackay's successors may tread with equal resolution the path which he marked out.

It is stated that the body of Mr. Mackay will be brought to the United States for burial and interred in Greenwood Cemetery, Brooklyn.

Combined Electric and Gas Car-lighting System.

A unique car-lighting system, embodying the use of both gas and electricity, has been devised by John L. Creveling of New York. The cars carry gas-storage reservoirs communicating with each other by means of gas-pipe systems and through automatically closing couplers. In one car there is provided a dynamo direct-connected to a gas engine. The dynamo is in electrical communication with the respective electric-lighting systems of the cars, and the gas engine is fed by train pipes in communication with the gas systems of the respective cars. The general arrangement of such a system is indicated in the accompanying diagram. The invention, which is covered by a patent issued last week, is such that the gas-lighting system and the system of electrical distribution are independent of each other.



CAR-LIGHTING SYSTEM.

Reorganization of the St. Lawrence River Power Company.

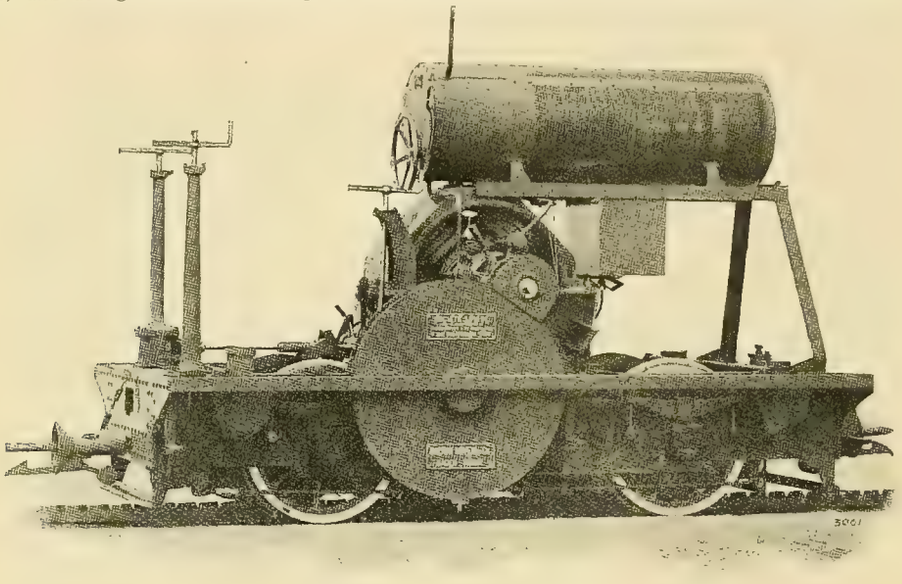
On July 17th the St. Lawrence River Power Company, Massena, St. Lawrence County, N. Y., filed incorporation papers at Albany, placing its capital stock at $7,000,000. This is the result of a reorganization of the old company by the men who bought up its stock at the foreclosure sale, which was mentioned in the Western Electrician of July 12th. The original company, it is said, expended in the neighborhood of $10,000,000 on the plant, which was intended to develop 75,000 horsepower. At the foreclosure sale the plant was bought for $500,000. Since the time of the sale the purchasers have been trying to reorganize the company. Evidence of their success is seen in the incorporation of the new company. The incorporators are William J. Wilson and Samuel Potter of New York, Henry P. Davison of Englewood, Mark T. Cox of East Orange and Thomas A. Gillespie of Massena, N. Y.

Electric Mountain Locomotive.

In order to haul loads successfully over the steep grades on the Ouest-Lyonnais electric railway between Lyons, France and the Saint Just Plateau an electric locomotive has been constructed which possesses several interesting features. The nature of the roadway is such that the engine is required to haul a load of 28 tons on a gradient of 19 per cent. at a speed of eight feet per second. This is accomplished through the agency of a rack constructed on the Abt system. On the portions of the line, above and below this gradient, where adhesion alone is relied upon, the locomotive must be able to do the switching. The locomotive is shown in the accompanying illustration with protecting cab removed. It has been designed and constructed by the Société Suisse of Winterthur, in conjunction with Brown, Boveri & Co. of Baden, Switzerland. It operates on a continuous current at a pressure of 500 volts.

The rack mechanism of the locomotive is brought into action by a 150-horsepower electric motor making 700 revolutions per minute. This motor transmits the power by means of two spur pinions, keyed on two countershafts, and engaging the spur-wheels on the two driving axles. When the engine runs with adhesion only each of the carrying axles is driven directly by a 25-horsepower electric motor. On the section of line laid with rack the motors for running with adhesion and with rack work simultaneously; but on the portions of line where adhesion alone is relied upon, it is only the adhesion motors which work.

The locomotive is provided with the brakes necessary for the rack and adhesion mechanisms, comprising two screw-brakes, independent of one another, and acting on the motive spur-wheels; a screw-brake acting on the wheels for running by adhesion; and a self-acting brake, which works on the rack section and acts on the brake-shoes of the spur-wheels when the maximum permissible speed is exceeded, or the electric current is interrupted for any reason. A small tank contains water for cooling the brake-shoes.



ELECTRIC MOUNTAIN LOCOMOTIVE.

The leading dimensions of the engine are as follows: Gauge, three feet 3⅜ inches; speed (per hour), 5½ miles; weight of locomotive, 11.8 tons; total weight of train, 27.5 tons; power of rack motor, 150 horsepower; revolutions of rack motor (per minute), 700; power of adhesion motors together, 50 horsepower; revolutions of adhesion motors (per minute), 300.

The whole mechanism is cased in with wood, having glass panes on every side, so that the driver has a clear view of the line.

Several locomotives of similar construction, for continuous and also three-phase current, are now running, and have given very favorable results.

The two motors for ordinary running are of the series-wound type, with four poles. Inasmuch as the weight of the vehicle is sufficient for an effort of 25 horsepower to be exerted on the axles without the wheels skidding, the adhesion motors may be used to add the whole of their normal power to that of the motor acting on the toothed wheels. On descending gradients these two motors revolve freely, being thrown in and out of gear by means of an ordinary controller of the parallel-series type.

The principal motor, intended to work on to the wheels gearing with the rack, is designed for 150 to 200 horsepower, and is of the shunt type, making about 700 revolutions per minute. On descending gradients this motor acts as a generator, thus constituting a brake; and the current produced is not absorbed in the resistance coils, but is sent into the electric conductor. For rendering possible this recovery of energy there must be the faculty for sufficiently increasing the tension of the current produced by the motor acting as a generator, and this result is obtained by increasing the motor's excitation. In order that the inductor winding may support, without too great heating, this increase in the intensity of the exciting current, it has been divided, and between these subdivisions free spaces have been arranged that permit of active ventilation. Thanks to the circumstance that the excitation is, as mentioned above, established in shunt circuit, it is possible to pass automatically from the working as motor to that as generator, according to the gradients encountered, and this without in any way changing the connections, the speed remaining practically constant in all cases.

The starting apparatus of the motor, which is mounted upon it, permits of starting with a maximum excitation of the magnets; so that it starts under practically the same conditions as a series motor, i. e., with a minimum of current. Variations of speed, both on rising and on falling gradients, are obtained by varying the excitation. The current is taken off by means of two trolley bows, on account of the great intensities required by the locomotive, and also for insuring a more regular taking off of the current. In the tunnels of this line the contact wire is hung at only a very slight distance from the carriage roof, while in all other parts of the line it is 19 feet above the rails.

Ferraris Monument and Award.

Those who remember the gentle, interesting personality and instructive electrical exhibit of Galileo Ferraris, the Italian physicist, at the Chicago World's Fair of 1893, will be greatly interested in a double announcement—that the Ferraris monument in Turin will be unveiled during the latter half of September, this year, and that the Ferraris award, after international competition, will be made at the same time. Ferraris died, greatly lamented, on February 7, 1897, and within a month or so a committee of influential Italians had been formed to raise funds to erect a suitable memorial in the city of Turin. Count Rignon was the chairman of the committee. The committee on the award was instituted a year later. The award is something over 15,000 lire (about $3,000), and will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, descriptions and drawings, or machines, apparatus and appliances, relating to their invention. Competitors are to file their applications not later than September 15, 1902, at the office of the secretary of the committee, in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

Wireless Telegraphy for the Great Lakes.

Daniel Kelley, representing the Marconi Wireless Telegraph Company of America, with headquarters in New York, has been spending a few days in Chicago in an endeavor to introduce the Marconi system on the boats of the various lake transportation lines running into Chicago. It is proposed to establish shore stations at all the large ports on the Great Lakes, such as Chicago, Milwaukee, Buffalo, Detroit, Mackinac, Sault Ste. Marie and Cleveland, and to equip all the steamboats plying between those ports. Mr. Kelley says the Detroit and Cleveland Navigation Company has virtually agreed to adopt the system. The Chicago station would probably be located on the North Shore, between the river and Evanston.

Unusual Features of the Natural Food Company's Plant.

By Frank C. Perkins.

One of the most important electrically operated factories at Niagara Falls, N. Y., is that of the Natural Food Company, which uses electric power for operating its entire plant. Two-phase alternating current is received from the Niagara Falls Power Company and reduced in potential from 2,200 volts to 110 and 440 volts in two transformer rooms at the Natural Food plant. The total power required for operating this factory is more than 5,000 horsepower and current is distributed throughout the building for supplying both incandescent and arc lights, as well as more than 100 motors. The 110-volt current is used for lighting purposes, and the 440-volt for the induction-motor circuits which supply motors ranging from one horsepower to 50 horsepower, and aggregating more than 1,000 horsepower.

In one of the transformer rooms two step-down static transformers of a capacity of 75 kilowatts each, lower the alternating-current potential to 183 volts, the two-phase current being changed to direct current by a 150-kilowatt Westinghouse rotary converter, which, at a speed of 500 revolutions per minute, gives a direct-current voltage of 220. The direct current is used for operating four electric elevators, as well as numerous fans and the electric stereopticon in the lecture room.

A completely equipped machine shop is provided with electrically driven lathes, shapers, grinders and planers, and all of the necessary repairs are made within the building. A hot-air fan system is utilized for heating and ventilating, various blowers being operated by both electricity and steam. One engine of 100-horsepower capacity drives two blowers, 16 feet in diameter, installed by the American Blower Company, which provide a complete change of air in 15 minutes. Electric motors of 10-horsepower capacity, with silent chain drive, operate four blowers for evaporating purposes.

The second or west transformer room is similarly equipped to that of the east transformer room, except that a motor-generator is provided for charging storage batteries, and supplying current for operating the miniature electric railway which is utilized between the electric kitchen and the electric dining room. The electric cooking transformers have each a capacity of 140 kilowatts, reducing the pressure from 2,200 volts to 80 or 120 volts, as desired, the potential being controlled by regulators in the primary. Two of the four electric Otis elevators are operated by 50-horsepower motors, and are used for passenger service, while the two remaining freight elevators are driven by 25-horsepower motors.

The electric kitchen of the Natural Food Company's plant is equipped with the latest cooking apparatus, and is used for preparing numerous dishes with the "shredded-wheat" biscuit. The balcony which surrounds the main floor is provided with seats for a large number of guests, and a miniature electric railway, fully equipped with trains, stations, guards and electric switches, is used for serving the visitors with luncheon. The numerous guests are seated at small white tables, which in reality consist of small electric cars. A menu card is provided at a small desk in front of the guest, and when the order is written out and placed on the car the pushing of an electric button signals the switchboard attendant in the electric kitchen. The tiny car automatically travels to the kitchen on the main track, and after being supplied with the necessary order, returns automatically and is switched from the main track to the guest to which the order belongs. A neatly designed block system is arranged, which prevents any disaster or accident, and the car moves back automatically to the station from which it started, with the luncheon attractively served, the car itself serving as a neat table for the use of the visitor.

The electric cooking equipment is very complete, and a dining room is provided for the women operatives. Food of various kinds is served to the employes, while a pleasant library and parlor is provided with comfortable chairs, a piano and an abundance of reading matter. All employes and visitors are frequently invited to a well-appointed lecture room, which is provided with electric stereopticon, as well as both direct and alternating current for demonstration purposes. The most approved electric cooking utensils, chafing dishes, coffee and tea pots and other utensils, are used for the demonstration of electric cooking. Fig. 1 illustrates the special cooking apparatus installed in the dining room that is used for preparing lunches for the employes and for other purposes. The appliances are wired non-inductively and are intended to be used on a 110-volt, 25-cycle circuit. They were furnished

FIG. 1. NATURAL FOOD COMPANY'S PLANT.—SPECIAL ELECTRIC COOKING APPARATUS.

by the Simplex Electrical Company and the Smith & Anthony Company of Boston.

Fig. 2 and the drawing Fig. 3 illustrate a circuit-breaker attachment designed by E. A. Deeds, factory manager of the Natural Food Company. Mr. Deeds had entire charge of the construction of the building, as well as the equipment, including both the electrical and mechanical work. In the photograph the instrument is shown in position resting on one of the barriers of the 5,000-horsepower Westinghouse circuit-breaker panel. Difficulty had been experienced previously to the designing of this piece of apparatus, in the failure of one of the phases at the power house, causing different fuses throughout the plant to burn out before the other phase failed. Furthermore, it was necessary for an operator to be in the transformer room at all times to protect the rotary converter in case of any trouble. By the new arrangement this attendant is not required, and he is able to devote fully one-half of his time to the care of apparatus in the plant, feeling perfectly secure so far as the apparatus in the transformer room is concerned.

The device consists essentially of a magnet in series with each of the phases so arranged that, in case of the failure of either, a small weight will drop, throwing the tripping device on both phases and throwing out both circuit-breakers.

In Fig. 3, (A) and (B) represent the two magnets, each of which is in series with one of the phases. These magnets are made with a core built up of annealed-iron wire, thoroughly shellacked, so as to avoid heating due to the alternating current. Beneath each of the magnets is a small lever (C) and (C_1), which are made with soft-iron pole pieces (P) and (P_1). These levers are pivoted at the center and engage a pivoted latch on the weight (W). The levers are provided with adjustable weights, as illustrated, which make the adjustment of the instrument very delicate. (L) and (L_1) are pilot lights, in series with magnets (A) and (B). These lights and magnets are connected to the two phases on the secondary side of the lighting transformers. In case of a failure in voltage in phase (A) the lever (C) drops down and disengages the latch which supports the weight. The weight falls by means of a small cord passing through pulleys and operates the tripping device of the two circuit-breakers.

In case of the failure of either phase, the weight drops and throws out the circuit-breaker, thus throwing off the power from the entire building. Since the installation of this little instrument there has been no difficulty with the blowing of fuses, and the services of the regular switchboard attendant have been done away with. A small block can be placed under the weight whenever it is desirable to have the attachment out of service.

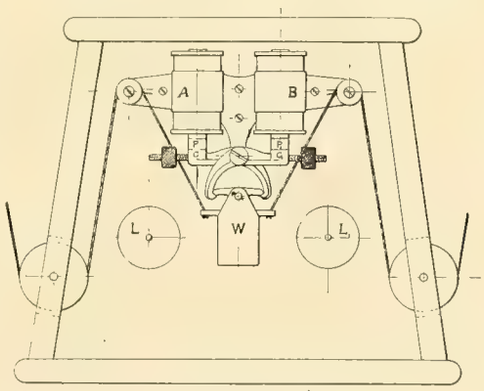


FIG. 3. NATURAL FOOD COMPANY'S PLANT.—DIAGRAM OF CIRCUIT-BREAKER ATTACHMENT.

The entire process of making the shredded-wheat biscuits from the grain to the finished product is performed in the one plant. The wheat-cleaning machinery has a capacity of 3,000 bushels a day. The material is not touched by hand in the whole operation, except when the biscuits are packed into cartons for shipping. The machines used to seal these cartons automatically are driven by two-horse-power induction motors, mounted on the ceiling. The driving is accomplished by means of silent chain gear, as shown in Fig. 4, the motors operating at a speed of 710 revolutions per minute.

A private branch telephone exchange is located in the center of the main-office floor, and supplies 30 telephones throughout the plant. The telephone operator is also a telegraph operator. A private wire is run into the telephone booth, and the telegraphic busines of the company is handled by this means. The exchange is operated by a storage battery, and a second storage battery is used for operating a system of gongs throughout the plant, the different door bells and other signal bells used in the place.

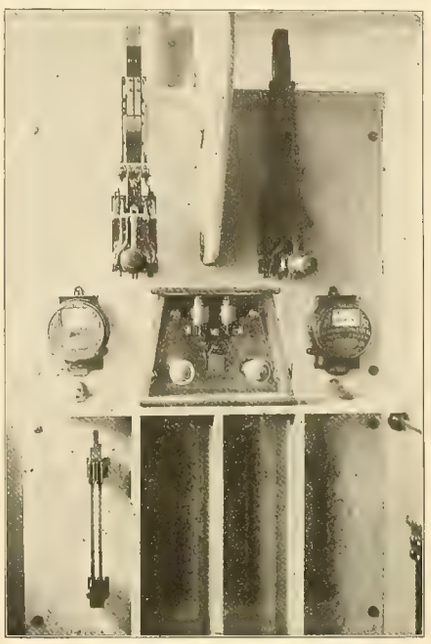


FIG. 2. NATURAL FOOD COMPANY'S PLANT.—CIRCUIT-BREAKER ATTACHMENT.

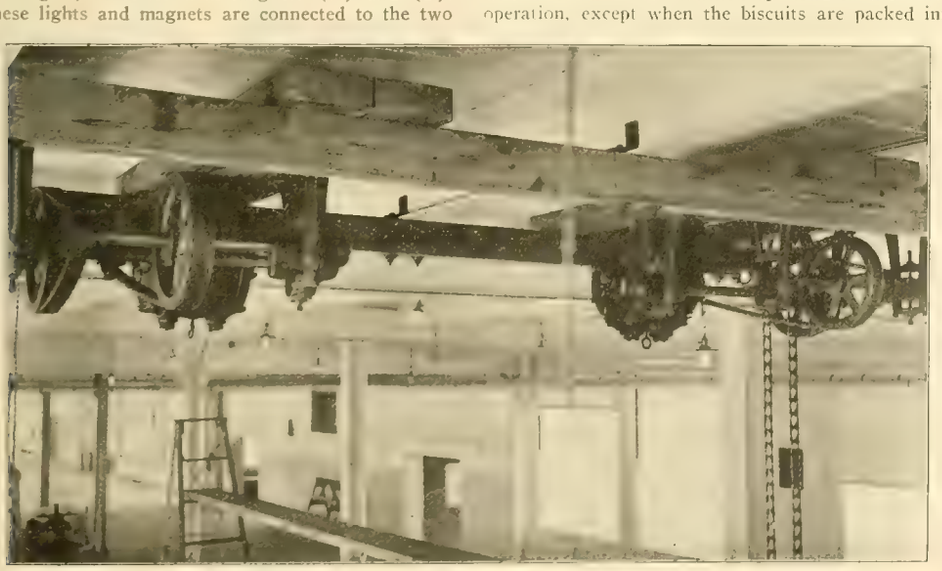


FIG. 4. NATURAL FOOD COMPANY'S PLANT.—MOTOR DRIVING BY SILENT CHAIN GEAR.

Pacific Cable from Honolulu to Manila Contracted For.

The Telegraph Construction Company of London, England, has entered into contract with the Commercial Pacific Cable Company, of which the late John W. Mackay was president, for the manufacture and laying of the latter company's cable from Honolulu to Manila, touching Guam. The construction company guarantees to complete the cable by June, 1903, if furnished with the necessary soundings. In the event that these cannot be furnished the company agrees to finish the cable laying within such time thereafter as is necessary to take the soundings. The steamer Silvertown, at Woolwich, is now said to be loading the San Francisco-Honolulu section of the Commercial company's Pacific cable, 2,400 miles, and is expected to sail for San Francisco in August.

It is stated that, while Mr. Mackay's death is a serious loss to the Commercial Pacific Cable Company's enterprise, yet the work will go on without interruption and the cable will be completed and in operation by July 1, 1903, unless the government soundings should be withheld from the company

Yerkes-Morgan Railway Contest in London.

The fight in London between the Morgan and the Yerkes syndicates over proposed systems of underground railways has reached an interesting state. J. P. Morgan's syndicate seems to have gained some ground over its rival, which has been established in London for some time. The trouble began when the Morgan concern attempted to obtain right-of-way paralleling one of the Yerkes lines. The Morgan syndicate has interests in some of the suburban and tramway lines and wants tunnels in the central district, through which to convey its passengers independent of the Yerkes lines. At the present writing the Yerkes system still has the best of the fight, apparently, although Morgan has recently gained ground by the passage to a second reading in Parliament of the London United Electric Railway Company's project for a new "tube" from Hammersmith to the City.

O. S. Adams has been appointed receiver of the Grand Junction (Colo.) Electric and Manufacturing Company by United States Judge Hallet, on application of the Morton Trust Company of New York, which asserts that the electric company is indebted to it to the extent of $50,000, having defaulted interest on its bonds for two years.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Development of the Auditorium Electric-lighting Plant. Illustrated	51, 52
Another Susquehanna River Power Plant Proposed	52
Lightning Takes an Unexpected Path	52
Electrical Contractors in Philadelphia	52
Curious Electrical Casualties	52
Rome Compressed-air Cars May Be Abandoned in Favor of Electricity	52
Communications. Illustrated	53
The Injudicious Superlative. By T. J. Johnston	53
The Speaking Arc and Wireless Telephony. By Ernst Ruhmer. Illustrated	53
Death of Mr. Mackay. Portrait	53
Combined Electric and Gas Car-lighting System. Illustrated	53
Reorganization of the St. Lawrence River Power Company	53
Electric Mountain Locomotive. Illustrated	54
Ferraris Monument and Award	54
Wireless Telegraphy for the Great Lakes	54
Unusual Features of the Natural Food Company's Plant. By Frank C. Perkins. Illustrated	54, 55
Pacific Cable from Honolulu to Manila Contracted for	55
Yerkes-Morgan Railway Contest in London	55
Editorial	56
International Tramways Congress and Exhibition in London	57
The Drainage-canal Power Situation at Joliet	57
Development of the Telephone Field	58
The Telephone System	58
Financial Statement of Michigan Telephone Company	58
Des Moines Telephone Strike	58
Ohio Telephone Notes	58
Indiana Telephone Items	58
Telephone News from the Northwest	58
Southern Telephone Developments	58
General Telephone News	58
Manufacturers and Dealers	58
The Progress of Electric Space Telegraphy. By G. Marconi. Part III	59, 60
American Falls Power Plant	60
Association of Edison Illuminating Companies	60
New Replogle Waterwheel Governor. Illustrated	60
Spanish Electric-railway Project	60
Mechanical Draft in an Electric-railway Power Plant	60
Novel Use of the Electric Arc in Prussia	60
Transatlantic Space Telegraphy	60
Municipal Trading in America. By Robert P. Porter	61
Chicago Union Traction Company's Annual Meeting	61
Proposed Extensions of South Side Elevated	61
Eastern Railway Systems to Be Studied by Chicago Aldermen	61
A "Scale Knocker" for Boilers. Illustrated	61
New General Electric Stock Listed	61

DEPARTMENTS.

Correspondence	62, 63
New York Notes	62
New England News	62
Canadian Intelligence	62
Southern Developments	62
From the Buckeye State	62, 63
Information from Indiana	63
Northwestern Notations	63
Personal	63
Electric Lighting	63, 64
Electric Railways	64
Power Transmission	64
Societies and Schools	64
Publications	64
Telegraph	64
Space Telegraphy	64
Miscellaneous	64
Trade News	64, 65
Business	65
Illustrated Electrical Patent Record	65, 66

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City,- Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

THE distinction between central station and isolated plant is sometimes an elusive one. It cannot be size, for some private plants are larger than some central stations; it cannot be serving only one consumer as opposed to the public generally, for owners of not a few isolated plants are known to sell current to their neighbors. Perhaps it is the use of the streets under franchise to distribute electricity by overhead or underground lines, for few, if any, of the isolated plants stand in this relation to the municipality. The question is brought forcibly to mind by the well-known Auditorium plant in Chicago, which, in its present stage, is described elsewhere in this issue. Here is an installation with a connected service of 38,000 16-candlepower lamps, besides arc lamps and direct-current motors. This is a plant larger than those of hundreds, perhaps thousands, of well-established central-station companies. It serves or has served outside customers, although, of course, the bulk of the current generated has always been utilized in the large Auditorium buildings. Yet the equipment cannot be called a central station in the usual sense in which the term is employed, although the odd expression "private central station" has been attached to it. It is asserted, and with truth, so far as we are aware, that it is the largest private electric-lighting plant in the United States, and this is its chief claim to distinction. Its development, sketched in the article already referred to, is interesting, as showing successive stages in the evolution of electric lighting by private installation.

COLLEGE managers and college instructors are greatly interested in correspondence instruction, which has lately taken on such extensive proportions. The methods of the correspondence schools have been studied and in some instances, perhaps, copied. The exhaustive investigation of the Northwestern Electrical Association, carried on a year or so ago under the direction of Professor D. C. Jackson of the University of Wisconsin, must still be fresh in the minds of the readers of the Western Electrician. The colleges have taken no antagonistic attitude toward the correspondence schools, and their spokesmen have not been behindhand in bestowing generous praise on the good results accomplished, knowing well the usefulness of correspondence instruction within certain limitations and likewise the necessity of class-room and laboratory work in some lines of teaching. But, if he has been correctly reported, President Harper of the University of Chicago has rather exceeded his brother administrators and pedagogues in outspoken commendation of correspondence study. He is credited with the statement that in some respects there is opportunity for better work in correspondence study than in the ordinary class-room recitation. Each student in a correspondence course has to recite on all the lessons, while in many a classroom the student recites on only about one-thirtieth of the work of a three-months' course. "It is safe to say," he is reported as saying, "that the standard of work done in correspondence courses is fully equal to that of the work done in the classroom. Indeed, I may say that there is a larger proportion of high-grade work done by correspondence than in class recitations. People who take work by correspondence do it because they want to get something out of it, while in many courses the students take the work merely because it is required in their curriculum." Dr. Harper was speaking of correspondence courses offered by the colleges themselves, and wound up by saying that to secure a degree the student should do at least a year's work in residence. But his words will be triumphantly cited by all advocates of correspondence schools. These schools have certainly a vast field of usefulness in this country; their possibilities for good are enormous. But they cannot supply the personal element in teaching—the uplifting influence of worthy professors or the stimulation of the rivalry of fellow students—nor do they afford facilities for laboratory work or the comradery of college life, the last not the least beneficial of the influences that work upon the youthful student. The truth is that both residence schools and correspondence schools are needed; there is not the slightest danger that either will interfere with the development of the other.

IT IS a fair question whether such large and heavy cars as those used on the Wentworth Avenue electric line in Chicago are desirable in city streets. In an accident last week at the street-railway grade crossing at Thirty-first Street and Wentworth Avenue one of these cars struck a smaller crosstown car and threw it 30 feet from the track, injuring 10 passengers. The rails were wet, and it is asserted that the motorman of the larger car could not stop it in time to avoid the crash. The Wentworth Avenue cars are 47 feet long and weigh 48,000 pounds when empty. Each is equipped with four 35-horsepower motors and has seating capacity for 52 passengers. The cars have air brakes, but when a live weight of, say, 8,000 pounds is added to the weight of the car itself it may be imagined that it is a difficult matter to make an emergency stop on a wet track. In this particular case the motorman of the crosstown car may have been at fault, as the larger vehicles on the through line have usually the right-of-way. Nevertheless the operation of these exceptionally long and heavy cars around curves, on grades and at crossings in streets thronged with pedestrians and other vehicles requires great care and caution—so much so that it may be doubted whether the limit of prudence has not been somewhat exceeded. On the other hand, the cars have large carrying capacity and give the passengers better accommodations and smooth, easy transportation. The question whether the use of such large cars should be extended has merit on both sides, and both the company and its patrons should have a voice in deciding it.

IT SEEMS that the Cuyahoga Telephone Company of Cleveland made the mistake that so many other Independent companies did, that of allowing the City Council to make the rates when the franchise was granted, and now it has come to a time when it is found impossible to operate a larger plant without increasing the tolls. It is unfortunately too true that many other companies in Ohio and other states have fallen into the same mistake, under the impression that expenses do not increase except in proportion to the growth of the plant. The mistake with companies in the larger cities has been in estimating upon a plant of five or six thousand stations. The demand for the service in almost every case has been so much greater than expected that the plants in most places must be enlarged under the penalty of falling behind in the competitive struggle. Where there is a fixed price for the service it has been found next to impossible to induce city councils to allow a modification, no matter what the conditions.

In the case of the Cuyahoga Telephone Company there seems to be a determined opposition on the part of both the council and the people. A number of societies, clubs and other organizations have already passed resolutions condemning the plan of allowing a readjustment of the rates, although the officers of the company assert that they cannot operate the plant at the prices they are getting and enlarge the plant as has become necessary. What will or can be done in case the City Council refuses to allow the readjustment is a question whose answer will interest all in the telephone business at this time. The present rates are $36 for residence telephones and $48 for business houses. The company, and undoubtedly with justice, states that they should be $48 and $72.

It has been suggested that in all cases a sliding scale of prices should be adopted where the city authorities insist upon prices being fixed when the franchise is granted, say so much for each instrument for the first two or three thousand connected, and then a graded increase in the price for every hundred, five hundred or thousand after that period. The price would then advance itself automatically and there should be no objection from anyone.

International Tramways Congress and Exhibition in London.

[Special correspondence of the Western Electrician.]

London, July 10.—The first week in July, this year, has been an exceptionally busy one for electrical engineers in Great Britain, for throughout this period two important engineering congresses—one of them of an international character—and a tramways exhibition have been in progress. Inasmuch as the holding of the exhibition in question has been a natural consequence of the International Tramways Congress, some particulars of the two events will be of interest outside Great Britain. The following is a summarized report of the more important papers read at the congress, which began on Monday, June 30th, and ended on Friday, July 4th. No serious work was done on Monday, June 30th, however.

The Transfer Problem.

After a few preliminary speeches the congress was opened on Tuesday, July 1st, by Mr. Lavalard, director of the General Omnibus Company of Paris, who read a paper on "Transfer Tickets." The author of the paper circularized 18 tramway companies on the question, and of this number 16 use the transfer system and admit the result to be more or less favorable, and two do not, viz., the Société d'Enterprise de Travaux of Liège, which does not consider it useful, and the Great Tramway Company of Berlin, which states that its tariff is too low to admit of it. The result of a brief discussion was the conclusion that a commission should thoroughly investigate the advisability of such systems and report to the next congress.

Motor Rating.

Dr. M. G. Rasch, instructor of the Polytechnical School of Aix-la-Chapelle, next read his paper on "Proposed Basis for Estimating Power of Motors." The author dissents from the view that the normal power of a traction motor should be that which in the test room can be yielded during one hour without causing the temperature to rise beyond the admissible limits. It is pointed out that a traction motor, although only loaded on an average below the normal, has to stand a daily run of from 14 to 16 hours. From this it follows, then, the author continued, that the length of the trial could be determined in another manner, and from a series of articles in the German Electrical Review for 1901 by M. Maximilian Müller the following formula is put forward as an attempt to condense the results of that writer's studies, viz., $X = \frac{t\ T_1}{t + 28\,(T - T_1)}$, where X stands for the required duration of the trial, T the time during which the car is out of the depot, T_1 the time during which the motor is working, $T—T_1$ the time during which the motor is not subjected to the electric current, and t for the heating of the motor, i. e., the excess of the temperature over the atmosphere. This formula permits of a cooling of 28° C. an hour, consequent on the rests of the motor. Applying this formula to an example with a motor which works 7.3 hours, and assuming an elevation of the temperature to 70° C. the following is obtained: $X = \frac{70 \times 7.3}{70 + 28\,(14 - 7\,3)} = 2$; i. e., a duration of two hours, during which it would be useful to try the motor under full load. The author does not think that the useful power which a motor will have to develop and the number of turns per minute at which it will have to run are sufficient in themselves to determine its dimensions. The opinion is also stated that a high efficiency should not be the quality to insist upon in the first place for a good motor, and that this question of efficiency should withdraw before other more important considerations. On the other hand, if a lowering of the rate of efficiency brought no other advantages with it, it would be necessary to weigh the importance of the two factors, efficiency and weight of motor, and especially if the electrical energy costs a high price.

The discussion did not reach a very high pitch, one speaker preferring American methods of testing, etc., to those advocated in the paper. In the result it was decided that the matter should be placed before the British standardization committee, presided over by Sir William Preece, and appointed by the Institution of Electrical Engineers.

Concessions and Legislation.

On Wednesday, July 2d, the first paper was "Conditions Under Which Tramways May be Laid on Roads," by M. Albert Janssen, secretary and director of the Brussels tramways. As its title implies, it dealt solely with the question of payment for concessions, as between tramway companies and the road authorities.

"Legislation in All Countries Relative to Tramways and Light Railways" was the next paper, by Mr. R. H. Scotter of London. Belgium is given the credit as being in the premier position, so far as the successful carrying out of the law has been concerned, a result due to the clever system of binding together three discordant elements, which, separately, the author states, are placing a great deal of hindrance in the way, all over the world, viz., the government, the local authorities and the public. The most vital point touched upon was the question, "What authority will ultimately become the owner of all concessions?" and the author goes on to state that the ultimate possessor of all tramways in Great Britain will be the municipal corporations. Belgium again leads the way, its concessions being granted in perpetuity, so that the tramway company may lay out its work unfettered by the fear of coming dissolution.

Conduit and Surface-contact Systems.

E. A Ziffer discoursed upon "Systems of Traction," another very comprehensive subject. The paper concluded that little progress had been made during the past two years with conduit and surface-contact systems. The former is stated to offer numerous objections, the great cost of installation and maintenance being put forward as a notable obstacle to the general application of the system outside of large cities. The employment of the lateral-conduit system offers great advantages over the middle conduit as used in America, and also partially in France; the nature of the existing construction in America seeming to be attributable to the cable-line railways which have been in use in that country. Within the last few years some improvements have been effected in the surface-contact system. Although the Diatto system has taken a great extension in France, it does not recommend itself, particularly, on account of defects in the distribution of the current, in the draining away of the water, and other disadvantages. The numerous attempts which have been made to discover a suitable mechanical or electromagnetic system with surface contact, Mr. Ziffer thinks, are eloquent proofs of the real necessity of a system more sure and less costly than that of the underground conductor. At the same time, the present state of things places the conduit before the surface-contact system, the latter not yet offering sufficient security in service.

Brakes.

"Brakes" was the subject of Mr. Poetz, engineer in chief of the Hamburg Tramway Company. According to the author of the latter paper, the discussion on the subject of brakes at present is on the following point: Should the compressed-air brake, or the electromagnetic brake, combined with the short-circuit brake, be preferred? When the number of trailers was great, preference should by all means be given to the compressed-air brake, because the short-circuit current set up in the car would not, under such conditions, be sufficient to brake the train. As far as reliability in service was concerned, the electric brake, owing to its greater simplicity, would be less frequently disabled than the air brake. The freezing of the pipes and valves was a great inconvenience of the air brake. It should also be kept in mind, he said, that it was natural that an electric car should be braked directly by electricity instead of actuating the air compressors by electricity first and then using this compressed air for the braking.

Seating Capacity.

J. H. Meszen, the manager of the Amsterdam municipal tramways, read a paper on "The Profitable Employment of Rolling Stock." The main argument was based upon the question, "What is the ratio between the number of passengers carried and that of the seats available?" If he were asked to indicate a limit, the author would fix upon 75 per cent. for a certain number of consecutive cars, as the ratio which it would be well to attain.

Cost of Power.

The final paper for the day was by M. C. Thonet, engineer and general manager of the General Contracting Company in Liège, on "Central Stations, and the Cost of Energy." The paper gives technical information concerning the maintenance, consumption and efficiency of boilers, gas engines, dynamos, batteries, etc., of a number of continental tramway undertakings, and further indicates the cost of electrical energy recorded at the switchboard of the central station. Most of the companies use feed-water heating apparatus, and cooling apparatus for the condensing water, the system most common being the water-tower type. Neither smoke consumers nor mechanical stokers are in general use. As a rule the steam engines employed are compound-tandem up to 1,000 horsepower; above that they are generally cross-compound in order to bring the dynamo between both cylinders. Laval steam turbines are used in Paris, Holland and Germany, but the information regarding these is somewhat scanty. The steam engines work condensing, the condensers being of the jet type, allowing of a vacuum of from 65 to 70 centimeters. Crossley gas engines are also used in a few places. Generators are for the most part direct-current, shunt, compound, or over-compound, at 550 volts. A few companies use high-pressure, three-phase currents, with transforming sub-stations. At Marseilles, for instance, the current is generated at a pressure of 5,500 volts, by 1,100-kilowatt alternators, and lowered in the sub-station to 340 volts, three-phase, through stationary transformers, after which it is converted again to 550 volts' continuous current by rotary converters. The mean efficiency varies from 90 per cent. to 93 per cent., at full load. Many companies at present use storage batteries, called "puffers," which are switched in in parallel with the dynamos and directly connected to both poles. Several companies employ the battery for the first and last hours of service, and for that purpose they operate a booster dynamo. The maintenance expenses of the battery, when taken up by the contractor, reach, as a general rule, from five per cent. to 10 per cent. of the original cost. Some idea of the prevailing operating costs on the continent may be obtained from the following: Brussels tramways, seven centimes per kilowatt-hour; Hanover tramways, 5.8 centimes; Liège tramways, 10 centimes; Nuremberg-Furth tramways, eight centimes; Orleans tramways (producer gas power station), 6.2 centimes; Marseilles tramways, eight centimes; Hamburg tramways, 18.5 centimes.

Baggage and Freight.

On Friday, July 4th, the concluding day of the congress, a paper on "Carriage of Luggage" was read. It consisted of a mere tabulated list of what continental tramways perform this function, and expressed the opinion that the example of Germany might be followed, inasmuch as foodstuffs, fruit, vegetables, etc., might offer a source of remunerative traffic for the company undertaking it, and also be economical for the working population, for whom urban tramways are constructed.

Car Heating.

"The Heating of Cars" was the other paper read on Friday, the author being M. S. Pieser, engineer of the Great Tramway Company of Berlin. All that the author can say for electric heating is that it is costly. The cost of equipping one car varies between 340 and 350 marks, the service costing 15 pfennigs per hour for a consumption of 1,500 watts, a consumption which trials have shown to be necessary when it is required to maintain a temperature of from 10° to 20° C. above that of the atmosphere. The Great Tramway Company of Berlin has had submitted to it by the Union Electric Company of the same city a system of heating apparatus said to have been introduced into America by the General Electric Company. This system uses for the production of heat the electric current which is ordinarily lost in the resistances placed under the car. The Tramway company, however, feels convinced that it is beyond doubt that on account of the nature of the production of the heat, it can only be moderate, and still more so if the cars are fitted with compressed-air brakes. For this reason, and on account of its comparatively high cost (425 marks), the Tramway company has not decided on making a trial of the apparatus.

General Observations.

The congress, which was the twelfth of its kind, was the first yet held in England. As a function it has been a great success, but it had that one fault so common in connection with these congresses—the endeavor to do too much in so limited time. With the numerous inevitable luncheons, receptions, etc., inherent on such occasions, it would have been well to have curtailed the programme in some way or another. However, the arrangements went through without a hitch, albeit one or two visits had to be dropped at the last moment. It is a source of satisfaction to ourselves that our foreign guests were delighted with their reception at the hands of the various governing bodies and companies with whom they came into contact, and the animation pervading the whole of the members was ample testimony in this respect.

Exhibition.

The holding of the Second Light Railways and Tramways Exhibition, originally fixed for 1903, was decided upon when it became known that the Tramways Congress was to be held in England. There is little American apparatus shown. J. G. White & Co., who have the order for the slotted rails for the London County Council conduit tramways, have a stand, and the Westinghouse company has a trolley tramway in actual operation, running the whole length of the Agricultural Hall, where the exhibition is under way A. W.

The Drainage-canal Power Situation at Joliet.

Actual construction work on the disputed water-power dam at Joliet, Ill., has been begun by the Chicago Sanitary District, under the direction of Chief Engineer Randolph. This work will first comprise a cofferdam, and when that is completed the permanent dam construction will be commenced. The Gaylord-Munroe syndicate, which is contesting with the Sanitary District for the control of the waterpower rights below Joliet, has filed an amended bill in its condemnation suit against the district. The suit will come up for hearing in September, and at that time it is expected that one-third of the work of building the drainage board's dam will have been completed. This dam is planned to be about 1,000 feet long and 14 feet high and will develop 7,000 horsepower. With a deep tailrace 4,000 additional horsepower could be developed. It is now thought that capitalists will not care to invest in the bonds that would be offered by the private syndicate for the construction of its power plant, as the Sanitary District has the right to raise the bear-trap at Lockport at any time, and thus shut off the flow of canal water at Joliet.

DEVELOPMENT OF THE TELEPHONE FIELD.

The Telephone System.

C. J. H. Woodbury has a well-written article in the Lynn Business Magazine on "The Telephone System." Following is an excerpt:

"The telephone business in its complications on one hand, and its close relations with the needs of its patrons on the other, is one requiring active zeal. As a certain French prisoner in the Bastile could always see an eye at a hole in an upper corner of his cell following his every movement, so with as vigilant, although more agreeable espionage, there is always an ear waiting at the office end of a telephone line to take the directions of subscribers in giving service.

"Notwithstanding that the operation of a telephone central station is continuous, and the plant must be equipped, under American conditions, with a sufficient apparatus to give instantaneous service, yet the maximum service occurs only through a few hours of the day, only 1½ per cent. of the calls occurring during the 12 hours between seven at night and seven in the morning.

"The subscriber to a telephone loses identity, and his name is merged into a number. When the telephone switchboard was first in use, the subscribers were known by name to operators with strong memories; an epidemic of measles ocurred in such a town, and a physician on the board of directors viewed with alarm the possible condition of affairs if more than two of the four operators should be taken with the measles, and proposed that the subscribers should be numbered. His associates demurred, saying that the subscribers would give up their telephones sooner than be numbered, but finally yielded, and the new state of affairs was accepted by the subscribers as an improvement.

"Essential as the telephone is now to the conduct of affairs, no one can state, except as a general principle, why a person subscribes for a telephone. While a large town uses more than a small one, the ratio of telephones to population differs materially in various places to an extent beyond what may be attributed to the personal energy of those in charge of local affairs; and in like manner, the relation of number of telephones to the number of horses, electric lights, business houses, assessed valuations, or any other of the details of census enumeration, fail to give any basis of close comparison.

"However, there are several lines of close comparison which cannot be tabulated in the logic of figures. Where highways are bad, there is a large amount of toll-line telephone traffic. A hilly town uses far more telephones than a similar one in a flat territory, and in some particulars, one in a warm climate appears to give more patronage than a town in a cool climate, all of which shows that there is force in the injunction, 'Don't travel; talk.'"

Financial Statement of Michigan Telephone Company.

The Michigan Telephone Company (Bell) of Detroit, Mich., as announced in the Western Electrician two weeks ago, has defaulted the interest due on its $5,000,000 bonds on July 1st. The company has 90 days to adjust its affairs, and meantime a committee of the bondholders is endeavoring to effect a satisfactory settlement. The accompanying financial statement, brought down to May 31st last, will be of interest:

	Calendar Year 1901.	January 1 to May 31, 1902.
Gross receipts	$1,328,681	$621,455
Expenses	1,180,914	521,255
Net receipts	$ 147,767	$100,200
Interest	440,135	166,895
Deficit	$ 292,368	$ 66,695

BALANCE SHEET, MAY 31, 1902.

ASSETS.

Property and franchise	$ 9,895,276
Supplies	194,553
Real estate	587,932
Stocks and bonds	1,635,625
Accounts receivable	272,183
Cash	72,098
Deficit	487,115
Total	$13,144,782

LIABILITIES.

Capital stock	$ 5,000,000
Bonds	5,000,000
Detroit company's bonds	594,400
Loans	2,182,112
Accrued taxes, etc	368,270
Total	$13,144,782

Des Moines Telephone Strike.

The strike of the Iowa Telephone Company's employes at Des Moines still continues, and the strikers seem more determined than ever since the success of the striking operators of the Mutual company at the same place. Solicitors are endeavoring to get the patrons of the Bell company to remove their telephones. Union men are ordered to boycott business houses that refuse to remove their instruments. The electrical workers are endeavoring to stir up trouble for the Bell company in Davenport, Rock Island and Moline. By this means they hope to strengthen the boycott.

The Des Moines Retail Grocers Association, in sympathy with the strikers, has, according to later advices, strengthened the boycott by having the Iowa telephones removed from their places of business. In the same movement the electricians and linemen of the Bell company at Davenport, Iowa, have gone out. This will affect the Bell system in Rock Island. In East Des Moines the Iowa system is entirely idle owing to the cables crossing the river having been cut by supposed sympathizers with the strikers.

Ohio Telephone Notes.

The Newark Telephone Company, Newark, is making arrangements to rebuild its plant almost completely. Something like eight miles of cable will be used and all lines will be made metallic. A rapid multiple switchboard will be installed and new instruments will take the place of the old ones, which are now rather out of date. The country lines will also be greatly improved.

The village of Caledonia has granted a franchise to the Marion County Telephone Company to operate an exchange.

The Central Union Telephone Company has issued a new directory for Findlay. It names 1,500 subscribers.

The holders of the $1,900,000 outstanding United States Telephone Company bonds have signed an agreement not to sell any of them for less than 90 before July 1, 1903. The Federal Telephone Company owns something like $700,000 worth of these securities, and because of the increased earnings of the lines of late it is believed that the securities will command a better price within a short time. The company will shortly pay the July interest on its indebtedness.

The Urbana Telephone Company, Urbana, has increased its capital stock from $50,000 to $100,000, of which $25,000 has already been subscribed by present stockholders. The money will be used in taking care of the business now on hand and increasing the facilities of the plant.

The Chittenden Hotel, Columbus, has decided to install a private exchange in the house, and every guest room, 275 in number, will be provided with a telephone. This exchange will be connected with the Bell exchange, and both the local and long-distance lines may be used by a guest at any time. An operator in the office will look after the private switchboard.

The East Springfield Telephone Company of East Springfield has been incorporated with a capital stock of $6,000 by W. L. Fiscus, W. R. Thompson and others. O. M. C.

Indiana Telephone Items.

The Palmyra Independent Telephone Company of Knox County was incorporated on July 14th with a capital stock of $14,000. The directors are Robert B. Patterson, John G. Dreiman, Edward E. Shaw, I. W. Alton, V. S. Manning, L. S. Root and C. W. Wilson. The company will establish exchanges and erect, maintain and operate telephone lines throughout Knox County.

The Svria and Orleans Telephone Company of Orange County has been incorporated with a capital of $5,000. Aaron Pickens, James L. Noblitt, Henry McCoy, John R. Gifford, A. L. Gallion, John M. Frost and H. S. Noblitt constitute the board of directors. The company proposes to construct telephone lines and establish and operate exchanges in Orange County, with headquarters at Orleans.

The Mount Summit Rural Telephone Company of Henry County has been incorporated with a capital stock of $10,000. The company will build an exchange at Mount Summit and construct and operate a telephone system throughout the immediate rural districts.

A terrific storm, accompanied by severe electrical disturbances, swept over Jay County on July 19th. The lightning burned out considerably more than a hundred telephones at Portland.

The citizens of Bedford express indignation over an announcement by the New Independent Telephone Company, which has secured a franchise, that the rates will be $30 a year instead of $1.25 a month, as was promised, it is said, when the franchise was asked. The Central Union Telephone Company has an exchange at Bedford, and the only reason a franchise was granted to a second company was to secure lower rates.

The telephone girls operating the exchange for the Cumberland Telephone and Telegraph Company at Jeffersonville have threatened to strike unless the management arranges for better comfort in the way of electric fans and screens on the doors and windows to keep out the mosquitoes. F.

Telephone News from the Northwest.

The Dakota Central Telephone Company has awarded contracts for the erection of a brick building at Millbank, S. D., to be two stories high, 50 by 100 feet in size.

The council of Oshkosh, Wis., has indefinitely postponed the proposed ordinance for an Independent exchange, as requested by Mr. Ferdinand. The latter can still file plans and enter the city under the state law, without a franchise from the city.

The Northwestern Telephone Exchange Company has constructed a seventh line between St. Cloud and Minneapolis.

The Twin City Telephone Company seeks admission to Anoka, Minn., for long-distance and local service.

The Union Electric Telephone and Telegraph Company has let the contract for the construction of an underground-conduit system at Davenport, Iowa. Work is to be started without delay.

The Johnson County Mutual Telephone Company at Iowa City, Iowa, has brought suit against the Long-distance Telephone Company and its contractor, Otto Wettstein. The plaintiff claims that the contractor has set poles of the defendant company so that the wires seriously interfere with the plaintiff's system, interfering in conversations and short-circuiting the wires.

The Le Grand (Iowa) Mutual Telephone Company will maintain a central office after August 1st, with day and night service with which all rural and party lines will be connected. R.

Southern Telephone Developments.

The South Carolina Long-distance Telephone Company has added to its connections Hartsville, Darlington and Society Hill. During the next few months the company will devote its attention to rebuilding its lines in the Pedee section, changing them into metallic-circuit lines.

The North Texas Telephone Company is a new concern with $5,000 capital, located at Pecan Gap, Delta County, Texas. W. A. Cockrell, W. R. James and J. H. Gordon are the incorporators.

The Bell Telephone Company is making a strong effort to secure a franchise in Sumter, S. C. The franchise is opposed by a local company, which holds a 10-year franchise.

The Cumberland Telephone and Telegraph Company is putting in a new exchange at Bedford, Ky., and is running its lines throughout the county.

The Ivy Telephone Company of Ivy, N. C., has completed connections with Asheville, traversing an undeveloped mountain region. L.

GENERAL TELEPHONE NEWS.

The Cumberland Telephone and Telegraph Company of Owensboro, Ky., which some time ago discharged all its union men, has recognized the union linemen, who will go back to work again.

The Missouri and Kansas Telephone Company (Bell) is said to be having considerable trouble in Wichita, Kan. Linemen have been repeatedly arrested for alleged violation of a city ordinance prohibiting them from erecting poles and stringing wires. The matter is likely to be settled in court.

In the suit brought by the Western Electric Company of Chicago against the Keystone Telephone Company of Philadelphia on Scribner patent No. 488,038, mention of which was made in the Western Electrician last week, the plaintiff's lawyers are George P. Barton and Edward Rector of Chicago and Frank P. Prichard of Philadelphia. R. S. Taylor of Fort Wayne, counsel for the Kellogg Switchboard and Supply Company of Chicago, and Paul & Sraley of Philadelphia represent the defendant.

MANUFACTURERS AND DEALERS.

The Hughes Telephone Manufacturing Company of Philadelphia has been incorporated at Wilmington, Del., with a capital stock of $100,000, to manufacture telephone supplies.

The Auxiliary Telephone Company has been incorporated at Newark, N. J., with a capital stock of $100,000. The company will manufacture and deal in mechanism for telephonic use. The incorporators are Egbert A. Reynolds of New York, Henry C. Ware of Orange, N. J., and C. G. Colver of Newark.

Manager J. L. Putnam, of the Clark Automatic Telephone Switchboard Company of Providence, R. I., is on an extended business trip in the interests of his company. He stopped off in Chicago one day last week on his way west. He said the Clark company is doing a very large business in small automatic switchboards.

The Superior Automatic Telephone Company has been organized at Portland, Maine, with an authorized capital of $5,000,000, nothing paid in. John G. Robinson of Melrose, Mass., is president, and Hayes Longee of Boston is treasurer. The company is a reorganization of the same company which was originally incorporated in West Virginia, but the taxes are so heavy in that state that a change was considered desirable. The company owns the patents of Uriah S. Jackson.

The Kellogg Switchboard and Supply Company of Chicago has closed a contract with the Keystone Telephone Company of Philadelphia, Pa., for a switchboard for its Fourth District exchange of 7,200 lines ultimate capacity and 3,420 lines as the present equipment. Included in this contract is all necessary power apparatus, distributing frames, sneak-current and lightning arresters. This exchange will be complete in all its details and embody the latest improvements.

The Progress of Electric Space Telegraphy.

By G. Marconi.

Part III.

The detector which I am about to describe is, in my opinion, based upon the decrease of magnetic hysteresis, which takes place in iron when, under certain conditions, it is exposed to the effect of high-frequency oscillations or Hertzian waves. As employed by me, it has been constructed in the following manner: On a core of thin iron or steel, but preferably hard-drawn iron, are wound one or two layers of thin insulated copper wire. Over this winding insulating material is placed, and over this, again, another longer winding of thin copper wire contained in a narrow bobbin. The ends of the winding nearest the iron core are connected, one to earth and the other to an elevated conductor, or they may be connected to the secondary of a suitable receiving transformer or intensifying coil, such as are employed for syntonic wireless telegraphy. The ends of the other winding are connected to the terminals of a telephone or other suitable receiving instrument. Near the ends of the core, or in close proximity to it, is placed a horseshoe magnet, which, by a clockwork arrangement, is so moved or revolved as to cause a slow and constant change or successive reversals in the magnetization of the piece of iron. I have noticed that if electrical oscillations of suitable period be sent from a transmitter, rapid changes are effected in the magnetization of the iron wires, and these changes necessarily cause induced currents in the windings, which in their turn reproduce on the telephone with great clearness and distinctness the telegraphic signals which may be sent from the transmitting station. Should the magnet be removed or its movement stopped, the receiver ceases to be perceptibly affected by the electric waves, even when these are generated at very short distances from the radiator.

I have had occasion to notice that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core, and are increasing their distance from it, while they are strongest when the magnet's poles are approaching the core. Good results have also been obtained by keeping the magnet fixed, and using an endless iron rope or core of thin wires revolving on pulleys (worked by clockwork), which cause the iron to travel through the copper-wire windings, in proximity to, preferably, two horseshoe magnets with their poles close to the windings, care being taken that their poles of the same sign are adjacent. This detector has been successfully employed for some time in the reception of wireless-telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles, also between Poldhu, in Cornwall, and Poole, in Dorset, over a distance of 152 miles, of which 109 are over sea and 43 over high land.

It would, no doubt, be possible to obtain signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding could be omitted. This detector, as I have already stated, appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessarily for the good working of the latter. It possesses a uniform and constant resistance, and, as it will work with a much lower electromotive force, the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger (in consequence of the smaller inductance of the circuit) than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves. As a call, a coherer in circuit, with a relay working a bell can always be used, and if it is found possible to make the magnetic detector record on a registering instrument (as to the possibility of which the results of recent tests have left little doubt in my mind), it may be found possible to receive wireless-telegraph messages at a speed of several hundred words a minute. At present, by means of this detector, it is possible to read about 30 words per minute.

The considerations which led me to the construction of the above-described detector are the following: It is a well-known fact that, after any change has taken place in the magnetic force acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind Professor Ewing has given the name of magnetic hysteresis. It has been shown also by Professors Gerosa, Finzi and others, that the effect of alternating currents or high-frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysteresis, causing the metal to respond readily to any influence which may tend to alter its magnetic condition. The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint in which they are ordinarily held, diminishing their retentiveness and consequently decreasing the lag in the magnetic variation taking place in the iron. I therefore anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysteresis, which would cause others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron, instead of slowly following the variations of the magnetic force applied, gives a sort of jump each time it is affected by the electric waves emitted by each spark of the radiator. These jerks in the magnetic condition of the iron would, I thought, cause induced currents in a coil of wire of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or, perhaps even read on a mirror galvanometer. The results obtained go to confirm my belief that this detector can be advantageously substituted for the coherer for the purposes of long-distance space telegraphy.

During the last few years the developments in the practical applications of my system have been exceedingly rapid. Time does not allow me to give you an account of the many cases in which it has proved its usefulness, but it may be sufficient if I mention that Lloyds have adopted the system exclusively for use at their stations at home and abroad for a period of 14 years, and that no less than 17 liners plying across the Atlantic carry permanent installations. In more than one case recorded in the daily papers the system has been of service to vessels in distress, especially in the English Channel. No less than 40 land stations (most of which are controlled by the corporation of Lloyds) are being equipped with the system in Great Britain and Europe, and over 40 vessels in H. M. Navy carry installations. The adoption of my system in the royal navy has brought about a certain slight change of appearance in the rig of the ships. Some naval officers believe that this change improves the ships' appearance; others think the contrary.

The Italian Admiralty, after experimenting for some time with the self-decohering coherers to which I have referred before, have informed me, officially, by a letter dated May 24th last, of its decision to equip their war vessels with the same apparatus as has been successfully employed on the transatlantic liners. On these liners commercial use is made of the system for the convenience of passengers, and as an illustration of its commercial workableness I might mention that lately the Campania and Lucania of the Cunard Line have been collecting as much as £60 each trip in receipts derived from passengers' wireless messages.

Nearly two years ago the facility with which communication was possible over distances of nearly 200 miles, and the improvements in syntonic methods introduced, together with the ascertained fact of the non-interference of the curvature of the earth, led me to decide to recommend the construction of a large power station in Cornwall and another one at Cape Cod, Mass., U. S. A., in order to test whether, by the employment of much greater power, it might not be possible to transmit messages across the Atlantic, and establish a transoceanic commercial communication, which the monopoly of the postmaster-general will not apparently permit between two stations if both are situated in Great Britain. An unfortunate accident to the masts at Cape Cod seemed likely to postpone the experiments for several months, when I came to the conclusion that while the necessary repairs were being carried out I would use a purely temporary installation in Newfoundland for the purpose of a transatlantic experiment, from which I might, at any rate, be able to judge how far the arrangements in Cornwall had been conducted on right lines. Before describing the results it may be useful if I give a brief description of the nature of the apparatus used at the transmitting and receiving stations.

The transmitter at Poldhu was similar in principle to the syntonic one I have already described, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged very much in excess of any that had previously been employed, the amount of energy to be used in this transmitting station having been approximately determined by me prior to its erection. The transmitting elevated conductor consisted of 50 almost vertical naked copper wires, suspended at the top by a horizontal wire stretched between two poles, each 48 meters high, and placed 60 meters apart. These wires were separated from each other by a space of about one meter at the top, and, after converging together, were all connected to the transmitting instruments at the bottom. The potential to which these conductors were charged during transmission was sufficient to cause sparking between the tops of the said wires and an earthed conductor across a space of 30 centimeters of air. The general engineering arrangements of the electric power station erected at Poldhu for the execution of these plans and for creating the electric waves of the frequency which I desired to use were made by Dr. J. A. Fleming, F. R. S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by me, and my special system of syntonization of inductive circuits, have provided an electric wave-generating plant more powerful than any hitherto constructed. Mr. R. N. Vyvyan and Mr. W. S. Entwistle have also greatly assisted me in the experiments carried out with the very high-tension electrical apparatus employed.

The first experiments were carried out in Newfoundland last December, and every assistance and encouragement were given me by the Newfoundland government. As it was impossible at that time of the year to set up a permanent installation with poles, I carried out experiments with receivers joined to a vertical wire about 400 feet long, elevated by a kite. This gave a very great deal of trouble, as in consequence of the variations of the wind constant variations in the electrical capacity of the wire were caused. My assistants in Cornwall had received instructions to send a succession of "S's," followed by a short message at a certain prearranged speed, every 10 minutes, alternating with five minutes' rest during certain hours every day. Owing to the constant variations in the capacity of the aerial wire, it was soon found that an ordinary syntonic receiver was not suitable, although a number of doubtful signals were at one time recorded. I, therefore, tried various microphonic self-restoring coherers, placed in the secondary circuit of a transformer, the signals being read on a telephone. With several of these coherers, signals were distinctly and accurately received, and only at the prearranged times, in many cases a succession of "S's" being heard distinctly, although, probably in consequence of the weakness of the signals and the unreliability of the detector, no actual message could be deciphered. The coherers which gave the signals were one containing loose carbon filings, another, designed by myself, containing a mixture of carbon dust and cobalt filings, and, thirdly, the "Italian Navy Coherer," containing a globule of mercury between two plugs. For the good results obtained I was very much indebted to two of my assistants, Mr. G. S. Kemp and Mr. P. W. Paget who gave me very efficient aid during the tests, which the extremely severe weather prevailing in December in Newfoundland made exceedingly difficult to carry out.

The result of these tests was sufficient to convince myself and my assistants that, with permanent stations at both sides of the Atlantic, and by the employment of a little more power, messages could be sent across the ocean with the same facility as across much shorter distances. The experiments could not be continued or extended in consequence of the action which the cable company, which claims all telegraphic rights in Newfoundland, saw fit to take at the time. Having received a most generous invitation from the government of the Dominion of Canada to continue my operations in the Dominion, it was thought undesirable to continue the experiments in Newfoundland, where I should have probably been landed into litigation with the telegraph company. I am glad to say that the Canadian government, on the initiation of Sir Wilfrid Laurier and Mr. Fielding, has shown itself most enterprising in the matter, and not only encouraged the erection of a large station in Nova Scotia, but actually granted a subsidy of £16,000 toward the erection of this transatlantic station, the object of which is to communicate with England from the coast of Nova Scotia. It is anticipated that the Canadian station will be ready for further tests very shortly. Another station for the same purpose is being erected on the United States coast.

Toward the end of February of this year I thought it desirable to test how far the messages transmitted by the powerful station at Poldhu could be detected on board a ship. The ship selected was the Philadelphia of the American Line. The receiving aerial conductor was fixed to the mast, the top of which was about 60 meters above sea level. As the elevated conductor was fixed, and not floating about with a kite, as in the case of the Newfoundland experiments, very good results were obtained on an ordinary syntonic receiver, similar to those I have already described, and the signals were all recorded on tape by the ordinary Morse recorder. Readable messages on tape were received up to a distance of 1,551 miles from Cornwall, and indications were received as far as 2,099 miles. Most of the messages were received in the presence of the captain or the chief officer of the ship, who were good enough to sign the tapes. I have some of these tapes here, in a frame, and they can be examined at the conclusion of my discourse. It is curious to observe that signals could not be received at over 900 miles by any of the self-restoring coherers. The reason for this lies probably in the fact that the tuned receiver, when connected to a fixed aerial, is more efficient. Another result of considerable scientific interest was that at distances of over 700 miles the signals transmitted during the day failed entirely, while those sent at night remained, as I have stated, quite strong up to 1,551 miles, and were even decipherable up to a distance of 2,099 miles. This result, which I had the honor of describing before the Royal Society yesterday afternoon, may be due to the dis-electrification of the very highly charged transmitting elevated conductor operated by the influence of daylight.

I regret time does not permit me to give you the views which have been expressed with reference to this phenomenon. I do not think, however, that the effect of daylight will be to confine the working of transatlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during daytime at the transmitting station, to make up for the loss of range of the signals, and therefore this business of communicating across the Atlantic will not be one of those works of darkness with which some people connected with cable companies would seem disposed to class it. It is, however, probable

that had I known of this effect of light at the time of the Newfoundland experiments, and had tried receiving at nighttime, the results would have been much better than those that were obtained.

The day is rapidly approaching when ships will be able to be in touch and communication with the shore across all oceans, and the quiet and isolation from the outside world which it is still possible to enjoy on board ship, will, I fear, soon be things of the past. However great may be the importance of wireless telegraphy to ships and shipping, I believe it will be of even greater importance to the world if found workable and applicable over such great distances as those which divide Great Britain from her colonies and from America. Any of those who have lived in the colonies will easily appreciate what a hardship it is to have to wait, perhaps, four or five weeks before receiving an answer to a letter sent home. The cable rates are at present prohibitive to a vast majority of people. May it not, perhaps, be for wireless telegraphy to supply the want?

[*The end.*]

American Falls Power Plant.

Work is progressing rapidly on the new power plant and transmission line of the American Falls Power, Light and Water Company at American Falls, Idaho. This new plant will soon deliver light and power into Pocatello, nearly 40 miles distant. The power plant will be situated on an island in the Snake River. A bridge has been constructed from the east shore to the island, nine feet wide and 12 feet above the water. It was built for the purpose of hauling material and machinery to the island for the power house and in construction of the raceway. On the island itself, there has been excavated out of solid rock a foundation for the power house, 34 by 53 feet, 20 feet below the water level. Besides this excavation for the power house, there are two pits blasted out of solid rock, each 24 by 32 feet, and 20 feet deep. The power house will be a two-story structure, built of cut stone, and will be situated at the south end of the island. It will be 12 feet above water level to the eaves, extending below water level about 20 feet.

The raceway begins with two wing dams, solidly constructed, 380 feet above the south side of the power house. The intake gate to the raceway is about 125 feet distant. The raceway is 34 feet wide, built of concrete and stone and has a carrying capacity of seven feet of water. The waste gate is 15 feet wide on the west side of the raceway.

There will be in place two generators of 500 kilowatts each. Six transformers will be installed at the east end of the building. These will raise the potential from 2,300 volts to 33,500 volts for transmission.

The transmission line will consist of No. 4 B. & S. copper wires. Three wires will be used for the three-phase system. They will be strung so as to form a triangle, the wires being four feet apart. A telephone line will also be strung on the pole line, six feet below the power line. Insulators will be mounted on 14-inch locust pins boiled in paraffine, set in cross-arms of Oregon fir boiled in carbolissium. These arms are five feet long and 5½ by 3½ inches at the ends. The insulators weigh 5½ pounds each and are guaranteed to transmit a working voltage of 40,000 and to stand a test of 60,000.

Association of Edison Illuminating Companies.

The eighteenth annual meeting (twenty-third convention) of the Association of Edison Illuminating Companies will be held at the Mount Washington Hotel, White Mountains, N. H., commencing Tuesday, September 9. A number of valuable papers are in course of preparation on subjects pertaining to the business of the member companies, and already there are indications which point to the coming convention as probably the most valuable of a series of excellent conventions. The Edison association was organized in 1885 by companies licensed under the Edison patents. It embraces nearly all of the present licensees under these patents. The Edison conventions are noted for their close application to business. The place of meeting this year is selected because of the absence of outside allurements, with the expectation that this convention will exceed all others in the strict attention to business. A list of the papers to be presented and the subjects to be discussed will be announced later.

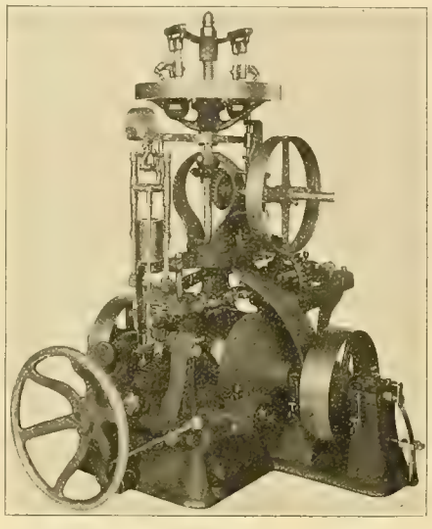
The officers of the association are: President, Louis A. Ferguson, Chicago; vice-president, A. W. Field, Columbus, Ohio; treasurer, Alex Dow, Detroit, Mich.; secretary, Walter H. Johnson, Philadelphia, Pa.; assistant secretary, Wilson S. Howell, New York, N. Y. The executive committee is made up as follows: Louis A. Ferguson, chairman, Chicago, Ill.; Charles L. Edgar, Boston, Mass.; W. C. L. Eglin, Philadelphia, Pa.; Samuel Insull, Chicago, Ill.; John W. Lieb, Jr., New York, N. Y.; Thomas E. Murray, Brooklyn, N. Y.; A. W. Field, Columbus, O.; Alex Dow, Detroit, Mich.; Walter H. Johnson (ex-officio), Philadelphia, Pa.

Moved by the recent reduction in rates by the electric-lighting companies of New York, Chicago newspaper reporters have been asking officers of the Chicago Edison Company if a similar reduction is contemplated in this city. The answer was that no change in prices is contemplated, as the existing rates are equitable.

New Replogle Waterwheel Governor.

The rapid advance in hydraulic development of late years has created a steadily increasing demand for a reliable waterwheel governor. Some of the principal troubles have been "hunting" or "racing" on the slightest provocation, lack of co-operation with the flywheel effects of the plant, and lack of sensitiveness and accuracy. The inventor of the Replogle governors is one of the pioneers in this line, having spent some 12 years in designing and perfecting waterwheel governors.

The latest speed governor, or controlling device, which is now used on all the mechanical governors manufactured by the Replogle Governor Works of Akron, Ohio, is worthy of some attention. This is found on the differential-relay governor illustrated herewith. It is easily understood that in an ordinary ball governor, with any increase or decrease in speed, the first effect is a tendency to pinch or bind at the joints at the ends of ball arms, and the balls cannot raise or lower until the speed has varied sufficiently to overcome the friction at these points. This is entirely overcome by introducing an inertia wheel in the governor and suspending it to the balls



REPLOGLE WATERWHEEL GOVERNOR.

by a flexible chain. It will readily be seen that, due to the resistance of the air, friction, etc., the inertia wheel, which receives its motion from the balls, will always lag behind them. Assuming a drop in speed, the inertia wheel will catch up with the balls, in so doing lowering itself and putting the governor in action before the balls themselves can overcome the friction at these points and drop. The opposite is true in a raise of speed. This, it will be seen, makes this speed governor quicker than an ordinary ball governor can be.

The differential-relay governor shown is the manufacturer's latest type and is peculiarly adapted for governing turbines having long, closed flumes to admit the water, as with a very slight change in speed the gate movement is barely perceptible, but with a heavy change the gate movement is very rapid. This, as will be seen, gives the water column a slight length of time to get in motion, and in itself tends to prevent the disastrous racing evident in a number of the leading governors.

This governor can be so adjusted as to lower the speed slightly at full load, as is the case with all other governors, but, it is said, it may also be so adjusted as to give absolutely the same speed at full load as at light load, or it may be adjusted so as to give a higher speed at full load than at light load, making it peculiarly adapted for governing alternating units running in parallel and for long-distance transmission plants, where a raise in speed is very welcome at full load to make up for the "loss in the line." The Replogle governors are guaranteed not to race under the worst conditions. The "non-racing" appliance is a simple device, easily and perfectly adjusted, thus securing to the plant as good government as can be had under the conditions presented.

Spanish Electric-railway Project.

A new electric-railway company has just given notice of its incorporation under the Ontario (Canada) electric-railway act with a capital of $2,500,000 in $100 shares. Its title is the "Malaga Suburban Railways, Limited." Some of the principal directors are Sir Richard J. Cartwright, Canadian minister of commerce; Peter Ryan, registrar of the city of Toronto and a millionaire; J. Enoch Thompson, Spanish consul for Ontario, and Ernest L. Sawyer of Toronto and Paris. The company proposes to build a narrow-gauge tramway through the Spanish province of Malaga, under a concession secured by Mr. Thompson last year. The total length of the line will be about 120 miles, connecting the city of Malaga with 25 towns and villages having a total population of 420,000, including Malaga. On the line of road are two waterfalls capable of developing 5,000 horsepower, which have been secured. If found necessary, this will be supplemented with steam power. The route will be from Malaga to Coin, 23 miles, with a branch along the coast southwest 65 miles to the bay of Gibraltar, and another branch from Malaga to "Torre del Mer," 30 miles. The head office of the company is in Toronto. Hon. Peter Ryan is president, and J. Enoch Thompson secretary.

Mechanical Draft in an Electric-railway Power Plant.

A paper on "Mechanical Draft" was presented recently by F. R. Still of Detroit, Mich., before the Western Society of Engineers in Chicago. During the discussion George A. Damon described the mechanical-draft equipment installed in the power plant of the Grand Rapids, Holland and Lake Michigan Rapid Railway Company at Jenison, Mich. The boiler equipment consists of four 250-horsepower boilers of the Babcock & Wilcox type, with the smoke connection at the back, leading into a short steel breeching, which runs along back of the boilers and discharges directly into the fan intake. The fan is driven by an upright engine and discharges into a stub stack which passes through the roof. In case they do not wish to use the fan, the gases can be passed directly up the stack. At the present time only one fan is in place, and this is located on an iron platform on a level with the engine-room floor, so that the engine driving the fan is brought directly under the care of the engineer, but at the same time is not far away from the man running the boiler plant. The fan is of the three-quarter housing type, and the top of the stack is 40 feet above the grates. By means of the fan engine they ordinarily obtain about three-fourths inch of draft, but by speeding the fan up they can get as high as two inches. The speed of a fan engine can be controlled by hand with a valve, and there is also an automatic valve connected directly to the steam header, so that immediately when the steam pressure drops, the fan engine is speeded up and the draft is increased and vice versa. When the plant is increased by adding more boilers another fan and direct-connected engine will be installed, and both fans connected so that either or both can be used on any one or all the boilers.

"Our office," said Mr. Damon, referring to the Arnold Electric Power Station Company, "has studied over a number of ways of putting in economizers, and the arrangement of this plant is the result of a number of different plans we have tried. The economizer is always a heavy piece of apparatus, and by placing it as low as possible something is saved in supports and cost of installation. Flues and dampers are provided so that gases from the boiler can be either diverted through the economizer or can be by-passed around both the economizer and the fan, and allowed to escape directly up the stack. The fan and engine cost less than half of the investment required for a self-supporting unlined steel chimney. It has now been in operation for about six months, and the engineer tells us that the equipment gives him less care than any of the apparatus around the plant. The station has not yet been tested, so we have no figures in regard to economy."

Novel Use of the Electric Arc in Prussia.

Several accounts have been published in the Western Electrician of the use of the electric arc in Chicago in cutting iron beams and the like, and now a similar experiment is reported from Prussia. At a colliery in the Dortmund District of Prussia it became necessary to dismount a horizontal arm of some pump rods. The bolts and cotters could not be removed on account of rust, and lack of space prevented the use of chisel and hammer. The electric arc was therefore called into service. The energy employed, says the London Colliery Guardian, was obtained from a continuous-current dynamo, generating 320 amperes at 110 volts, which served for lighting, the negative pole being put in connection with the pump rod, and the positive with a carbon of 20 millimeters diameter, held in a well-insulated gas pipe. The latter was fitted with a rest, so that the carbon might be guided by hand; and, for preventing danger from fire, a bucket filled with sand was placed under the spot where the melting was to be effected, while a small hand pump was also held in readiness. For protecting the men's eyes from the bright light, red and green glasses were provided, to be held in the hand. The work was carried through with a current of 320 amperes at 60 to 70 volts, the carbon point being held from 40 to 50 millimeters away from the point to be melted in such a manner that a vertical slot of 20 to 30 millimeters was formed, and then gradually deepened. The work was performed by six men, who relieved one another every hour or half hour, in about 12 hours altogether, including a few interruptions.

Transatlantic Space Telegraphy.

Marconi believes that, if all goes well, he will be able before Christmas to send wireless messages from his Cornwall station in England to the American station at Cape Cod or the Canadian station at Cape Breton. Connection with distant points in Africa is also promised by Marconi.

Municipal Trading in America.[1]

By Robert P. Porter.

While I do not propose in this article to be enticed into a defense of all the private-company iniquity of the United States, and while there has been, and is now, much that is reprehensible in their actions, we are still obliged to admit that the general result has been satisfactory. Public officials are giving more attention to these matters, and the rights of the public are much more carefully guarded than heretofore.

A municipal-trading city may make a profit on its transportation, its gas supply, and its electric lighting. It is for those who represent private enterprise in Great Britain to demand to know how the profit compares with the amount of money which American private companies working such undertakings annually pay into the city and state treasuries for the right to use the streets for various purposes. Mr. Garcke has given us, I think, nine sound principles which should be strictly adhered to in making fiscal comparisons between corporations and company undertakings. Prominent among these should be an estimate of the taxes which a municipalized city loses by owning and operating its own profit-making enterprises.

One of my municipalistic friends said to me the other day, that the city was entitled to every penny of the profit from such enterprises. Suppose, for argument's sake, we admit this assumption. Having done so, can we not conceive of a condition wherein private enterprise, with its greater experience, its scientific experts, and with its bolder operation, might bring better results in a given field, and while yielding a profit for its own capital and a reward for its own enterprise and experience—which should not be given grudgingly—still pay a greater sum into the city treasury, and at the same time serve the public more cheaply and more efficiently? Take, for example, the Brooklyn Rapid Transit company, paying over a million dollars annually as taxes. It has worked up an extensive business in transportation, has consolidated smaller tramways, pays the city nearly $200,000 annually for the privilege of carrying passengers from New York free across the Brooklyn bridge, and will even carry passengers 22 miles at a good speed for the modest fare of five cents, or two-pence half-penny. Then, again, the Metropolitan street railway of New York, carrying nearly 200,000,000 passengers on transfers free of cost—$10,000,000 thrown away, some people contend. Surely here America can match the British municipalist half-penny fare of which one hears so much.

This bold stroke on the part of the Metropolitan street railway of New York, of free transfers, brings business, just as would be the case if some great central-railway company secured the underground and tubular railways of London, electrified the roads, unified the fares, and sent the passengers night and morning in whichever direction they wished without thought of greater and less fares for greater and less distance, or of class, for a run of 10 or 15 or even 20 miles around London.

This same Metropolitan street railway has just "scrap-heaped" a good cable plant worth over $5,000,000 because it stood in the way of electric progress. The same company last year paid nearly a million dollars in taxes, without counting the value of paving and street cleaning, and removal of snow, which, under the agreement, it has to do on streets over which its tracks run, and which is charged in with the operating expenses of the company.

The Union Traction company of Philadelphia has, for this article, made an estimate of its taxes, and, including the cost of maintenance of paving, removal of snow and ice, and the interest on the original $14,000,000—the cost of improved pavements laid by the company at the time the franchise was granted—this aggregates over $2,000,000 annually. These would seem goodly sums, and certainly dispose of the assertions that the American street-railway companies use the streets free. The official report from Massachusetts shows, on gross receipts of about $23,000,000 for all street railways of the state, taxes of $13,500,000—about six per cent. of the gross earnings.

These companies also pay out enormous sums for injuries and damages. American courts are severe on the railways and juries liberal to the injured passenger. The Brooklyn Rapid Transit paid last year $800,000; the Metropolitan railway of New York, $335,000, and the street railways of Massachusetts, $600,000. The Manhattan elevated railway of New York, besides its very heavy annual taxes, has paid, since its existence, $12,500,000 in claims for damages, and has an equal number of claims still pending.

Here and there large fortunes have been made out of these ventures, but the street-railway companies of the United States, when enormous items of special expenditure as above indicated are deducted, are not making as much money as the municipal trader seems to think. The same holds true of companies supplying gas, electricity, telephone communication, and telegraph service. The British government is losing heavily, I understand, on its telegraph business. We have two competing companies which give us a good and cheap telegraph service, and both seem to make reasonable dividends, in spite of the inroads of the telephone.

The unhappy story of the British telephone industry, divided now under three heads—governmental, municipal and private—is too familiar to readers of Cassier's Magazine to require more than a passing reference. A strong company, if given a fair chance, would have, in my opinion, served both public and state more satisfactorily. The telephone is of real value in the United States, because it works well, the connections are quickly made, and it is easily reached. In our large cities public telephones may be found on almost every block. Our telephone stations in some cities are places of luxury, where you may read the latest newspapers and smoke while waiting, and when your "calls" are answered, do business all over the United States. Sharp-witted and quick American girls serve you with civility and promptitude. If you do not get the person you want, you do not pay. The trouble some of these operators take to connect the proper exchanges and get the right people on the telephone would astonish the coolly indifferent operators in British postal or trunk-line exchanges. It is private business, and in many instances competing business. It pays to push it. And it is vigorously pushed.

[1] 1. Part of an article in Cassier's Magazine.

Chicago Union Traction Company's Annual Meeting.

The annual meeting of the Chicago Union Traction Company was held on July 22d. The financial report for the year ended June 30th showed a deficit of $247,527. The company also added $95,000 to its floating debt, which is now over $2,000,000, and is in arrears $1,050,000 dividends due and unpaid on the preferred stock. The company's earnings showed an increase during the year, and President Roach in his report attributed the deficit to the exceptionally large expenditure for taxes, $683,731 which he said would not be as large another year.

Joseph Downey, John Lambert and Henry G. Foreman were elected to the board of directors to succeed Charles L. Hutchinson, William Dickinson and C. K. G. Billings, resigned, and William F. Harrity of Philadelphia was elected to succeed and represent P. A. B. Widener. Aside from the gentlemen named, the board includes Jesse Spaulding, Walter H. Wilson, J. H. Eckels, John V. Clarke, and John M. Roach of Chicago and R. A. C. Smith and H. B. Hollins of New York. Eight of the eleven directors are now Chicago men. The directors re-elected the old officers, as follows: President and general manager, John M. Roach; vice-presidents, R. A. C. Smith and Walter H. Wilson; treasurer, James H. Eckels; secretary and assistant treasurer, Markham B. Orde; general counsel, W. W. Gurley; general attorney, John A. Rose; auditor, F. E. Smith.

Proposed Extensions of South Side Elevated.

The South Side Elevated Railroad Company of Chicago is said to be planning extensions and improvements to its railway service which will afford needed transportation facilities to neighborhoods untapped by the present line. The plans include the construction of three spurs, embracing a total of 10 miles of new track. One branch may leave the main line at about Sixty-third Street and Prairie Avenue, extending west to Englewood. Another may connect at Fortieth and State streets, going west to the Union Stockyards. The third may start at Fortieth Street and Prairie Avenue, extending eastward to Lake Avenue. It is proposed to build the stockyards branch over the tracks of the Union Stockyards and Transit Railway Company, using a double-decked elevated structure. All of these extensions, however, will depend on the construction of a third track alongside the company's elevated structure from Twelfth to Forty-third Street for express service. Permission to build this additional track will be asked of the City Council this fall.

Eastern Railway Systems to Be Studied by Chicago Aldermen.

Members of the local transportation committee of the Chicago City Council left on July 23d for the East, to inspect the street-railway systems of New York, Washington, Philadelphia, Baltimore and Boston. The committee expects to be gone 10 days, and its inquiries will extend over the whole subject of street-railway operation. Accompanying the committee is B. J. Arnold, the city's engineering expert.

A "Scale Knocker" for Boilers.

The removal of scale, particularly from the tubes of fire-tube boilers, has always bothered the steam engineer. Many mechanical devices have been offered to the public to perform this duty, and one that is said to be entirely satisfactory is a pneumatic or steam "scale knocker," invented by a practical engineer in St. Louis. This device is only made for use in return tubular boilers, with tubes from three to six inches in diameter. By its use a boiler tube may be freed from any incrustation in quick time. It can be operated either by steam or air pressure.

Fig. 1 shows the outward appearance of the knocker; a sectional view is given in Fig. 2.

The action of the device is as follows: The steam or air pressure enters through the pipe (E), Fig. 2, causing the valve (D) to reciprocate. It then passes through the ports and causes the hammer (A) to strike the dies (C) and (C¹). The exhaust passes out the ports at (F) and blows out any soot or other accumulation in the tube. The dies (C) and (C¹) are held in brass holders, which have a sliding fit in the main casting. This causes the dies to be pressed out against the inside of the tubes, by the pressure in cylinder (B), and so prevents any direct blow from being struck on the tube.

The force of the blow struck by the hammer is very light, but the reciprocation is so fast, about 1,000 strokes per minute, that the scale is knocked off by the vibration. There is said to be no danger of denting or otherwise injuring the tubes of a boiler, for the reason that the force is transmitted through the iron and not by a rebounding blow.

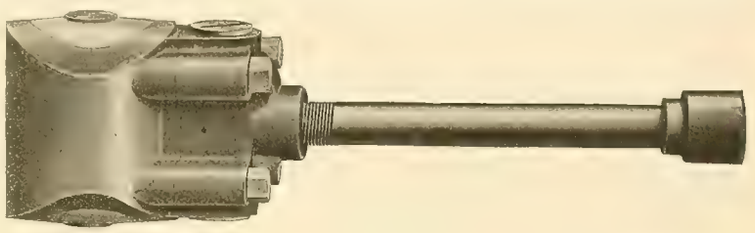


Fig. 1. Outside View.

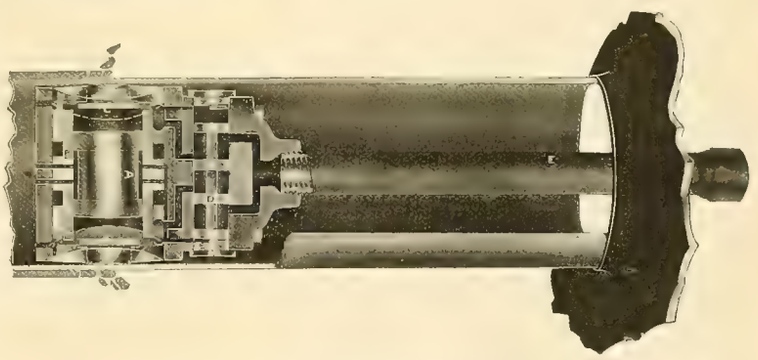


Fig. 2. Sectional View.

A "SCALE KNOCKER" FOR BOILERS.

The small amount of mechanism in this device is a point in its favor, there being little chance of its getting out of repair. The fact that the two moving parts, the valve and the hammer, are entirely encased (Fig. 1) makes it impossible for the device to get choked by grit or dirt. W. N. Matthews & Bro. of St. Louis, Mo., general distributing agents, are putting the device on the market.

New General Electric Stock Listed.

The New York Stock Exchange has listed the $16,812,600 additional common stock of the General Electric Company, making the total $42,031,600. The application of the company to list the additional stock in connection with the 66 2-3 per cent. stock dividend, payable July 15th, contains the following balance sheet as of May 31, 1902:

Assets.—Patents and good will, $2,000,000; factory plants, $4,524,422; stock, bonds, real estate, etc., $10,199,293; cash, $4,658,113; notes and accounts, $10,730,032; work in progress, $1,800,662; inventories, $9,882,213; total, $43,794,735.

Liabilities.—Preferred stock, $200; common stock, $25,052,100; debentures, $200,000; accounts payable, $971,374; profit and loss, surplus, $17,571,061; total, $43,794,735.

The consolidated profit and loss account of May 31, 1902, is as follows:

Earnings.—January 31, 1902 (surplus), $15,287,141; sales, royalties, and sundry profits, $10,252,827; profit on sales of stocks and bonds of other companies held in treasury, $246,135; total, $25,972,773.

Expenses.—Cost of manufacturing and selling, $7,891,707; interest on debentures, $10,098; dividends paid, $499,906; surplus, January 31, 1902, $15,287,141; undivided earnings, February 1 to May 31, 1902, $2,283,921; total, $25,972,773.

General Electric stock closed at 192 on July 15th and 188½ on July 22d.

The Northern Illinois Traction Company of Springfield has been incorporated with a capital stock of $5,000. The incorporators and first board of directors are William D. Ball, Frederick B. McKinnon, W. T. Block, Charles H. Lenhart and Edwin B. Smith.

CORRESPONDENCE.

New York Notes.

New York, July 20.—Col. Robert Grier Monroe took the oath of office as commissioner of water supply, gas and electricity on Tuesday, succeeding J. Hampton Dougherty, resigned. Among the last official acts of Mr. Dougherty was to send Mayor Low the report of his department for the three months ended June 30th. Included in the report are the following statistics in regard to lighting and electricity for the half year: 8,103 applications for inspection of interior wiring, 4,722 permits for outside electrical work, 1,903 complaint notices issued, 196,277 incandescent lamps covered by certificates, 36,083 inspections, 21.25 miles of overhead wires removed without expense to the city. The report says: "The questions arising for solution in connection with the Electrical Bureau of this department are numerous and perplexing, and the extent of the jurisdiction of the department over wiring in the interior of houses and dwellings throughout the city is uncertain. Difficult problems have engaged its attention in deciding what corporations and especially gas-light companies were entitled to permits from this department." The report gives the total of lamps in public service and lighted June 30th as 31,078.

The first lot of the new 40-foot double-trucked cars to be operated on Broadway and Columbus and Lexington Avenues were put in operation last Monday by the Interurban Street Railway Company, lessee of the Metropolitan Street Railway Company. Fifty cars of this type were sent out, 25 for use on the Columbus and 25 on the Lexington Avenue lines. The new cars are similar to those operated on the Sixth and Amsterdam, Eighth, Fourth, and Madison and Second Avenue lines. President Vreeland said that he expected that by fall the small cars will all be withdrawn and placed in use on the Seventh Avenue, the Ninth Avenue, and the cross-town lines. The first electric cars on the Ninth Avenue line of the company's system were placed in operation last week. This road has been operated by animal power but is now electrically equipped between Twenty-third and Fifty-fourth Streets.

The Board of Health has declared the storage-battery railway operated by the Interurban Street Railway Company on Thirty-fourth Street a public nuisance on account of the sulphuric fumes that are given off from the batteries. Commissioner Lederle of the Department of Health has sent to the corporation counsel all the facts which have been gathered in regard to the alleged nuisance, and requested him to give his opinion as how best to proceed legally against the railway company.

Eugene E. McLean, engineer of the controller's office, has made an elaborate report on the application of the New York City Interborough Railway Company for a franchise to construct a double-track surface railway in the Bronx. He says that the several proposed routes and their branches amount to a total franchise of about 38.1 miles of double track. He proposes that the company pay three per cent. of gross receipts for the first five years and five per cent. for the succeeding 10 years.

The Long Island Railroad Company has acquired nearly all the land that will be required in Long Island City for the Pennsylvania-Long Island tunnel. It has purchased from the New York and Queens Electric Light Company a tract several hundred feet in length on the south side of the railroad tracks at Dunton. It is to be used for an extension of the Jamaica yards westerly to prepare for the increase in business expected upon the completion of the East River tunnel between lower Manhattan and Flatbush Avenue, Brooklyn, and the Atlantic Avenue improvements.

The Brooklyn Rapid Transit Company is making arrangements for opening Young Men's Christian Association rooms in six of its car barns, where 10,000 employes spend much leisure time each day. At one of these $20,000 has been expended for libraries, bowling alleys, social rooms, and a restaurant. An employes' benefit association is an adjunct.

The Board of Aldermen has authorized an appropriation of $150,000 for the lighting and heating of the Kings County Hospital.

Officials of the Kings County Electric Light and Illuminating Company of Brooklyn have stated that no reduction in rates was contemplated by their company, although the rates in Manhattan are to be reduced on September 1st.

A portion of the plant of the John A. Roebling's Sons Company at Trenton, N. J., was destroyed by fire to-night, and the loss has been roughly estimated at nearly $100,000.

The American Gas and Electric Company of 525 Main Street, East Orange, N. J., has been incorporated with a capital stock of $1,000,000. The incorporators are Edward S. Magoffin, Herbert S. Murphy and Alfred S. Brown.

During the hailstorm in Brooklyn on Tuesday lightning struck a street car and set it afire. All of the passengers and the conductor and motorman were stunned and some of them quite severely burned. The dress of a woman passenger caught afire and she was so seriously injured that it is thought she will probaby not recover. The car was a total wreck. M. L. G.

New England News.

Boston, July 19.—The Massachusetts railroad commissioners have granted a charter to the Worcester and Holden Street Railway Company, which proposes to build an electric railway between Worcester and Jefferson, Mass., a distance of 8½ miles. The company has a capital of $100,000.

Last Sunday about 80 Western Union, Postal, broker and newspaper telegraph operators organized a Boston branch of the International Union of Commercial Telegraphers, which is affiliated with the American Federation of Labor. Recent radical changes in the Western Union operating force of this city, including the discharge of a number of men who had been in the service a number of years, led to the formation of this organization.

After occupying 109 State Street as its main office for some 30 years, the Western Union Telegraph Company has decided to remove to better quarters. The high officials of the company have been in Boston during the week, deciding upon the location. "Hundred and nine" has been far from a pleasant office for the employes, for a number of years. It is poorly ventilated, dingy, and decidedly uncomfortable.

The Springfield (Mass.) Street Railway Company is about beginning the building of additions to its power plant, which will practically double its capacity. The improvements will cost about $250,000 and the new equipment will include a Westinghouse engine of 3,000 horsepower, a General Electric Company's generator of 2,000 kilowatts' capacity and four Babcock & Wilcox boilers, with 1,500-horsepower capacity. The addition to the power house will measure 100 feet square, and that to the boiler room will be 50 by 100 feet.

While assisting in installing a new switchboard in the station of the Lynn (Mass.) Electric Light Company, Harry Kidger, an electrician of that city, accidentally placed his right hand in contact with a circuit carrying a current of 2,080 volts. A fellow workman placed the end of a board under Kidger's foot, breaking the circuit, and Kidger fell. The great toe of his left foot was virtually burned off and he was unconscious for some time, but otherwise he was apparently uninjured.

The city of Boston has entered suit against the Boston Elevated Railway Company for injury done its property by the construction, maintenance and operation of the company's elevated structure. The aggregate addamnum is $179,500. The city asserts that the value of various abutting pieces of realty has been materially depreciated.

The Augusta and Waterville and the Augusta and Oakland Electric Railway companies have filed articles of association with the Maine secretary of state. Each is capitalized at $200,000. The first-named will build an electric railway between Augusta and Waterville, Maine, via Vassalboro and Winslow, a distance of 20 miles, and the other will build between Augusta and Oakland, via Belgrade Lake, a distance of 19 miles. The promoters are well-known Kennebec County men, several of whom are interested in other electric-railway companies in that state. The entire amount of stock of both companies has been taken and five per cent. of the capital has been paid in. The roads will reach territory not now provided with railways.

The stockholders of the Boston Elevated Railway Company will hold a meeting July 25th, to vote on increasing the capital stock from $10,000,000 to $15,000,000, the proceeds to be used in defraying the cost of the construction and equipment of the road. The company states that the cost of the elevated structure far exceeded the engineer's estimates, and the rolling stock has also cost more than was estimated. Some of the proceeds from the new stock will be used for land and other damages. If the increase is authorized, the Massachusetts railroad commissioners will fix the price at which the stockholders will obtain the new stock. B.

Canadian Intelligence.

Toronto, Ont., July 18.—The Lower Niagara River Power and Water Supply Company of Lewiston, Niagara, N. Y., has been incorporated with a capital of $5,000,000. The directors are James Low, James S. Simmons and F. J. Brown of Niagara Falls.

The water committee of the Montreal City Council has awarded the contract for the supply of power for the new electric pump at the upper level pumping station, to replace the steam plant, to the Lachine Rapids Hydraulic and Land Company, at $20 a horsepower, the power to be on continuously, if required, from 10 p. m. to 10 a. m. The contract is worth about $8,000 a year and the term is to be either three or five years, at the discretion of the City Council. The only other bid was from the "Light, Heat and Power Company" of Montreal, which asked $21.50 a horsepower from 7 p. m. to 7 a. m.

An American engineering party is making a survey of the country between Windsor and St. Thomas, Ont., for a syndicate of American and Canadian capitalists, which, it is said, proposes to build an electric railway between these places. H.

Southern Developments.

Charlotte, N. C., July 18.—An election will be held at St. Francisville, La., on an issue of $10,000 bonds for water and electric lights.

The big electric-power plant at Ivy, N. C., will be enlarged, as the available water power has proven greater than expected.

M. B. Greensfelder has applied for a petition in St. Louis for the privilege of building an electric or horse-power street railway about three miles long at Olivette, Mo. Olivette is a suburb of St. Louis.

M. B. Wilkerson of Asheville and Philadelphia associates are endeavoring to interest New York parties in developing falls on Linville River, near Morganton, N. C., where 20,000 horsepower is available. It is proposed to distribute this power along the line of the Southern railway. The river has a fall of about 2,000 feet in eight miles, embraced in the holdings of Mr. Wilkerson and associates.

At Nashville, Tenn., the Chancery Court of Appeals has delivered a decision invalidating the consolidation proposed by the constituent lines of the Nashville railway. The city held that the consolidation was effected in 1900 without its consent. The consolidated properties are bonded at $6,500,000.

The St. Louis (Mo.) Terminal Depot Company has been organized to bridge the Mississippi. Among other things, the company desires a franchise for right-of-way over about 10 miles of city streets, and the privilege of operating by either steam or electricity. J. C. VanBlarcom and others are interested.

A. K. Bonta, representing the United Electric Securities Company of Boston and also head of the new Metropolitan Street Railway Company of Dallas, Texas, announces the purchase of the Rapid Transit electric street railway of Dallas. L.

From the Buckeye State.

Cleveland, Ohio, July 19.—The purchase of the Port Huron (Mich.) street-railway system by the Everett-Moore syndicate was consummated on Tuesday of this week. The details of the transaction were arranged last fall before the embarrassment of the syndicate, and since that time the securities have been on deposit with the Cleveland Trust Company. The purchase price is in the neighborhood of $800,000. The fact that the syndicate is again looking after business is an indication that it is on its feet and will from now on show the progress that formerly characterized it.

Negotiations are pending for the purchase of the gas plant at Wyoming by the Cincinnati Gas and Electric Company. What system of lighting will be used in case the deal is made has not been announced.

Ben W. Johnson has been appointed receiver of the Sandusky, Milan and Norwalk Railroad Company for the purpose of enforcing the stockholders' liability in order to satisfy a judgment obtained by John E. Doman for $8,555.51. Doman met with an accident in which he lost one of his legs while on the road.

P. B. Foster, a few days ago, made application to the council of Cleveland for a franchise to operate an electric plant for the purpose of furnishing fuel, heat and power, but upon being questioned he admitted that it is the intention to furnish light at a lower price than the present company is doing. The laws of the state provide that a light franchise must be submitted to a vote of the people, and it was the intention to get around this by securing the franchise and then making the claim that light is but a form of power and that the company could not be prevented from furnishing electricity to the people for this purpose. It is a question whether this idea would prove to be worth anything in a contest, but the matter was referred to the director of law for an opinion which will be given at a future meeting of the council.

The 11 three-cent fare ordinances were passed by the Cleveland City Council at the last meeting. They include the most important of the old Hoefgen routes and one or two in addition. The line through the flats to connect with the Gildensperger line to Akron is a new one. John B. Hoefgen and Harrison B. McGraw will both bid for the franchise. McGraw represents Cleveland capitalists.

It is stated that the Toledo Railways and Light Company is negotiating for the purchase of 30 acres of land upon which to build shops and storage houses. It is the plan to have such a plant that complete cars may be turned out and all repairing done by the company itself.

The people of the town of Bremen have voted to issue bonds for the purpose of building a municipal light plant and waterworks.

H. C. Lang has resigned his position as secretary of the Springfield and Xenia Traction Company, and Will Christy has been chosen in his place. Mr. Lang will give his time to other of the Mandelbaum properties.

The Citizens Lighting and Heating Company of Columbus has been incorporated with a capital stock of $10,000.

The Parkersburg, Marietta and Interurban Railway Company, organized under the laws of West Virginia, has been authorized by the secretary of state to transact business in Ohio. The capital stock of the company is $440,000 and the Ohio headquarters will be at Marietta.

At Lorain on Friday morning a car on the line running between Lorain and Elyria jumped the track and ran entirely through a building, the front end protruding more than two feet through the wall opposite from the point of entrance. J. L. Gaudern, a conductor on the road returning from his work, was killed. Fifteen others were more or less seriously injured.

The Columbus, Delaware and Marion Railway Company is having four handsome coaches built at the Kuhlman works at Collinwood. They will have smoker, toilet rooms and all the conveniences and will be finished in mahogany with handsomely upholstered seats. The seating capacity will be 58.

The Sterling Electric Company of Warren has elected the following-named officers: President, W. A. Smith; vice-president, C. G. Denison; secretary, Glenn C. Webster; treasurer, William Cole; manager, Glenn C. Webster.

Judge Mower of the Common Pleas Court of Clark County has held that the City Council of Springfield has no right, either expressed or implied, to pass an ordinance requiring the street cars to have fenders. This opinion was given in the decision of the case brought against the city railway company by the Trades and Labor Assembly, in which the city won, on appeal from the lower courts.

A suit has been filed in Cincinnati to test the right of the Cincinnati Gas and Electric Company to charge an arbitrary price for electricity instead of computing it by meter.

The Toledo, Angola and Western Railway Company of Toledo has been incorporated, with a capital stock of $300,000, to operate either a steam or electric road. It will extend from Toledo to the state line in Williams County.

The contract for the construction of the Hamilton, Eaton and Richmond Traction Company's line has been awarded to Falk Brothers of Milwaukee. They will build the road complete and furnish 10 62-foot cars, two freight cars and two combination baggage cars. O. M. C.

Information from Indiana.

Indianapolis, July 21.—Electric-railway companies were greatly interested last week in the meeting of the State Board of Tax Commissioners, before which the companies' representatives appeared to argue against an increased assessment for taxation. As a rule, the companies want assessments left unchanged, but the board insists on knowing where the earnings have gone, the increase in mileage, the value of stock, dividends paid and a correct return of tangible property. The Union Traction Company asks that no increase over last year's assessment of $8,000 a mile be made; while the Indianapolis, Greenwood and Franklin and the Fort Wayne Traction companies insist that the assessment of $11,000 and $25,000 a mile, respectively, last year is entirely too high. A week more will be consumed in considering the interurban lines' property, and the progress for the year promises rich returns for the state in the matter of taxes.

At a meeting of the stockholders of the Union Traction Company at Anderson on the 17th inst. it was voted to authorize the Union Traction Company to rent the lines of the Indianapolis Northern Traction Company for a period of 50 years, at the same time guaranteeing the principal and interest of an issue by the latter company of $5,000,000 of bonds. The lease provides for the control of the street and interurban systems, by the Union Traction Company, in and connecting Logansport, Peru, Kokomo, Tipton, Elwood, Marion, Alexandria, Muncie, Anderson, Noblesville, Walton, Bunkerhill, Atlanta, Cicero, Frankton, Broad Ripple, Gas City and Jonesboro to Marion. A resolution of consolidation was also passed. A mortgage in favor of the Colonial Trust Company of New York, for $5,000,000, was filed at Indianapolis the next day and copies thereof will be filed in each county through which the consolidated lines run. This completes the merger of all the McCulloch lines, and the work of construction will now be pushed. When completed this will be the greatest interurban electric-railway system in the world.

The Marion (Ind.) council has taken summary action against the Marion Transit Company and ordered it to tear up all its tracks in the streets of Marion and put the streets in good repair within 30 days. If this order is not complied with, the city will begin damage suit for $50,000 against the stockholders. The cause for such action was the act of the Union Traction Company in tearing up a street and connecting its track with a line of the Marion Transit Company. The franchise of the Marion Transit Company was repealed by the council, and it is asserted that the Union Traction Company, as a successor, is a trespasser and has no right to run cars over the tracks of the Marion Transit Company. Bitter litigation is expected.

Scarcity of material has retarded the completion of the Shelbyville, the Martinsville and the Plainfield lines, which expected to be running cars into Indianapolis this week. Another injunction proceeding against the Shelbyville line has been filed to prevent its crossing the Belt Line railroad south of the city at grade. Work on the Tipton-Elwood branch of the Union Traction Company's interurban line has also been suspended until material can be procured. It is impossible to get iron at present. The Muncie, Hartford City and Fort Wayne electric line is finished up to Muncie and the construction of an $8,000 truss bridge across White River is all that prevents the operation of cars.

The only new interurban company to file incorporation papers last week was the Winchester and Muncie Traction Company. This company will build a line from Union City to Muncie, by way of Winchester, Farmland, Parker and Selma. The board of directors is headed by James E. Lowes, who was also elected president. The power house will be located at Winchester, where a site has been donated.

A company is being organized to establish an automobile line between Paola and New Albany, over the Vincennes and New Albany turnpike, 40 miles apart. The automobiles are to carry 16 passengers each. F.

Northwestern Notations.

Minneapolis, July 19.—E. A. Titze has resigned as resident manager of the Electric Light, Heat and Power Company of Pipestone, Minn. He is succeeded by O. F. Forbes, the chief electrician of the plant.

The annual meeting of the stockholders of the Electric and Water Company of Little Falls, Minn., resulted in action being taken to change the headquarters from St. Paul to Little Falls.

The council of Benson, Minn., has concluded to purchase the electric-light plant in that city.

The council of Sheboygan, Wis., has granted a franchise to the Sheboygan-Elkhart Lake Electric Railway Company and revoked the franchise granted April 1st, which was declared void by a decision of the Supreme Court.

The council of Duluth, Minn., has concluded that it would be impracticable for the street-railway company to engage in the transportation of freight, as it would be extremely likely to interfere with general passenger traffic.

Grand Rapids, Minn, has awarded the contract to J. G. Robertson of St. Paul for the installation of an electric-lighting plant for the village, to cost $24,500.

Nearly all the subscribers to the fund of $30,000 at Mankato, Minn., raised to secure the establishment of an electric street-railway company, have received their money back.

The City Council of Jamestown, N. D., has granted a franchise for 25 years to the Jamestown Electric Light Company, whose present franchise still has five years to run.

The Columbia Construction Company of Milwaukee may become interested in the construction of an electric-railway line from Fond du Lac, Wis., to Milwaukee. This would give a complete line of electric railway from Milwaukee to Green Bay.

A final settlement has been reached in the litigation on the matter of electric lighting for the city of Kaukauna, Wis. A committee has had the matter in hand, seeking some solution whereby a settlement can be made. The company has made liberal concessions and offers the city all-night service at $65 per light per year, which is now the price paid for service until one o'clock.

Rains softened the ground so that a pole carrying electric-light wires fell across the roadway at Eveleth, Minn., recently. Martin Mayerle attempted to step over the obstruction and grasped one of the wires. It was partially insulated, but he received a shock of 2,300 volts from the alternating current. He was taken to the hospital and was extremely violent, it taking six men to hold him. As a result of his struggles, he suffered a hemorrhage of the lungs and died. The hand with which he grasped the wire was burned to the bone.

H. H. Natwick has made a proposition to the city of Sioux Falls, S. D., to purchase from the city the new electric-light plant, and also a proposition to light the city for 10 per cent. less than the city is now paying. R.

PERSONAL.

Morgan Brooks, professor of electrical engineering at the University of Illinois, was in Chicago last week.

C. A. Miller has been appointed general inspector of mechanical and electrical work of the New York Central and Hudson River Railroad Company.

George F. McCulloch, president and general manager of the Union Traction Company of Indiana, with Mrs. McCulloch, will sail for Europe in August, to be gone two months.

H. A. Dodge, local manager of the Western Union Telegraph Company of Denver, recently resigned to take the position of superintendent of telegraph of the Santa Fe railroad, with headquarters at Santa Fe, N. M.

H. C. Abbott has succeeded Edward Labadie as local manager of the Western Union and Akron District Telegraph companies at Akron, Ohio. Mr. Abbott was transferred from the Western Union office at South Bend, Ind.

R. E. Gaunt has been appointed general manager of the Lexington (Ky.) Railway Company, succeeding E. C. Hathaway, who has been made general manager of the Norfolk-Portsmouth and Newport Railway Company of Norfolk, Va.

The Chicago Tribune says: "W. R. Holligan, formerly chief operator for the Western Union Telegraph Company in Chicago, has been elected a member of the New York Stock Exchange. He is with the firm of Osborne, Holligan & Co. His seat cost him $75,000."

Theodore K. Jackson, an attorney of Chicago, who has been associated with electrical enterprises for some time, has been appointed manager of the Evanstan (Ill.) Yaryan Company at the instance of the bondholders, to succeed Edward Yaryan, resigned. He is making an investigation of the company's affairs, which are not in a good financial condition, to see if it is necessary to appoint a receiver.

Royal H. Holbrook, former manager and superintendent of the Ottumwa Traction and Light Company, Ottumwa, Iowa, has resigned to become advisory engineer to the People's Gas and Electric Company, Burlington, Iowa. Mr. Holbrook is well known in street-railway circles. He was for several years connected with the Cedar Rapids and Marion Railway Company, as chief engineer, and secured some low records as to coal consumption. His duties in this new field will require him to rebuild and redesign the lighting and railway systems.

Dr. John Daniel Runkle, ex-president of the Massachusetts Institute of Technology, died suddenly of heart failure at Southwest Harbor, Mount Desert, Maine, on July 11th. He was born in Root, N. Y., October 11, 1823, and graduated from the Lawrence Scientific School at Cambridge, Mass., in 1851, with the bachelor's and master's degrees. He was active in preparing the plans for the Institute of Technology, when it was projected, about 1860, and was a member of the first faculty, remaining the head of the mathematical department, except during his presidency, 1870-78, until he retired, during the year just closed, when he was made professor emeritus.

ELECTRIC LIGHTING.

The electric-light plant of Plattsburg, Neb., was rendered useless for a time by a recent cloudburst.

Tacoma, Wash., will receive bids until July 31st for supplying the city with electricity for light during a period of five years.

The city of Ocala, Fla., will expend about $20,000 in improvements on its electric-light plant. M. Fishel, mayor, may be addressed.

Bruce Nejj of Lakeland, Fla., has purchased the Lakeland Electric Light Works and will expend $5,000 to $6,000 for improvements.

The Pontiac Electric Company, located at Pontiac, Ill., has certified to a change of name to the Pontiac Light and Water Company.

The Cumberland Manufacturing Company of Nashville has been incorporated for the purpose of supplying electricity for light and power.

George Dier of Bozeman, Mont., is organizing a company to use the power in Hell Roaring Creek in West Gallatin for an electric-light plant.

The Quitman Light, Ice and Power Company of Quitman, Miss., has been incorporated with a capital of $10,000. The chief stockholders are S. W. Pettibone and B. H. McDonald.

The new Easton Light and Fuel Company of Easton, Md., will issue bonds to the extent of $50,000 for extensive improvements on its plant. Clarence P. King of Philadelphia is president.

The directors of the Easthampton Electric Light Company of Easthampton, Long Island, have decided to construct a plant costing in the neighborhood of $50,000. Schuyler Quackenbush has been elected president of the company.

The Le Noir Electric Company of Le Noir, N. C., wants a 100-horsepower boiler, a 75-horsepower, single-acting engine, an electric generator, and all the supplies necessary for an electric-light plant. G. L. Benhart may be addressed.

J. C. Brackenridge, chief engineer of the Brooklyn Rapid Transit Company, is making a horticultural use of the electric light. He has rigged five lamps over his garden, and these he keeps burning all night long. He says that his vegetables appeared sooner and have grown much faster than those of his neighbors.

The property of the St. Joseph Railway, Light, Heat and Power Company of St. Joseph, Mo., which includes the street-railway system and electric-lighting plant, steam-heating plant and other utilities, has been sold to Seligman & Co. and E. W. Clark & Co. There will be no change in the local management, President W. T. Van Brunt remaining in charge.

At the recent annual exhibition in Paris of the Société Française de Physique many novel and interesting devices were shown. Among these was a contrivance designed as a startling attraction for fêtes and advertising purposes. It consisted of a wall of rippling and constantly changing colors of light, the effect being produced by different series of electric lights, alternately switched on and off by a revolving wheel.

The Electric Power Company of Boise, Idaho, has about finished installing an up-to-date electric plant in South Boise. The plant is operated by water-power from the Boise River and has a maximum capacity of 600 horsepower. The light and power generators are set in duplicate and are connected to duplicate Sampson turbines. The plant is pronounced very complete, and as it has only about 1½ miles to transmit, the company expects to be a strong factor in the furnishing of light and power to the city. H. O. Pope is president of the company.

Sealed proposals will be received until 12 m., Au-

gust 12th, by the Sewerage and Water Board of New Orleans, La., for furnishing and erecting engines, boilers, dynamos and power-transmission lines and appurtenances for the equipment of a central generating station and for transmission lines therefrom to seven sub-stations, and for motors for the automatic operation of these sub-stations. Specifications, general plans and blank forms of proposal may be obtained at the office of the board and at the office of Hering & Fuller, consulting engineers, No. 170 Broadway, New York.

ELECTRIC RAILWAYS.

The York County (Pa.) Traction Company has completed the erection of a power station at Red Lion.

The Union Traction Company has been organized with a capital of $50,000 to obtain right-of-way for an electric railway from Flint, Mich., to Saginaw.

Messrs. Park and Hamilton of Youngstown, O., have been granted franchises authorizing them to construct and operate electric street railway lines through the city of Havana, Cuba.

The St. Louis and Suburban Street Railway Company of St. Louis, Mo., has been reorganized, with Samuel M. Kennard as president. Improvements are to be made in the roadbed and equipment.

Abingdon, Ill., has passed an ordinance authorizing the People's Traction Company, recently organized in that place, to operate and maintain a power plant and street railway on the streets of Abingdon.

The Amelia Beach Company has been incorporated in Fernandina, Fla., with a capital stock of $100,000, to construct and operate an electric railway from Center Street to the beach. John G. McGiffin, president, may be addressed.

It is reported that the Macon (Ga.) Consolidated Street Railroad Company and the Macon Electric Light and Railway Company are to be consolidated and operated under the direction of the Railways and Light Company of America.

The Sioux City Traction Company, which owns the street-railway lines in Sioux City, Iowa, and the Sioux City Gas and Electric Company have been purchased by the interests which control the Sioux City stockyards, in which the Swifts have heavy investments.

The Chicago, Milwaukee Avenue and Inland Lakes Traction Company of Chicago was incorporated with a capital of $50,000. The company is to operate a street-railway and power plant. The incorporators were: S. A. Walther, J. A. Walther and G. F. Lanaghon.

In order that the new Aurora, Elgin and Chicago electric railway, now nearing completion, may connect with the incline at the end of the Garfield Park section of the Metropolitan West Side Elevated road of Chicago, four blocks of the elevated structure is to be moved a distance of 20 feet. It is planned to effect the work without removing a bolt. Until recently a right-of-way could not be secured which would allow of a straight incline. Now, however, the land has been secured and the structure will be straightened.

Thompson, Tenny & Crawford of New York are interested in the organization of a company to control a number of the street railways in the state of New Hampshire. The combination will be known as the New Hampshire Traction Company and will be capitalized at $1,000,000. Charles S. Fairchilds, president of the New York Security and Trust Company, will be president of the concern. The properties will consist of 135 miles of modern trolley road, pleasure resorts, and electric-lighting plants in Exeter and Portsmouth.

The People's Gas and Electric Company of Burlington, Iowa, which has recently succeeded to the Burlington Railway and Light Company, has planned to rebuild and remodel its entire system of lighting and railway operation. To accomplish the expected results the company will need a 400-horsepower engine, some new boilers, stokers, heater, condenser, separators and generators. It will build about four miles of new track and rebuild several miles of the old tracks, renew many miles of the service lines and make many other improvements.

A very pronounced expansion of electric-railway systems is noticed in Maine. Lines now running out from Bangor are to be extended, and two interurban roads are to be built from Augusta. A line is in process of construction between Portland and Brunswick; lines are being surveyed in Hancock and Aroostook Counties, and a road across the state from the Kennebec River to Penobscott Bay is projected. It is predicted that within five years all the important cities and towns in Maine from Bangor to Biddeford will be connected by electric railways.

POWER TRANSMISSION.

The Lower Niagara River Power and Water Supply Company of Lewiston, Niagara County, N. Y., was recently incorporated with a capital stock of $5,000,000. The directors of the company are James Low, James S. Simmons and F. J. Brown of Niagara Falls.

The Grand River Electric Company of Lansing, Mich., is the name of a new concern, organized to build a dam at Delta, six miles from Lansing, on the Grand River, for the purpose of furnishing heat, light and power in Lansing. S. E. Jarvis of Lansing and Glen D. Smith of Jackson, Mich., are the principal incorporators. The company is capitalized at $50,000.

A large plant for the generation of electricity for power and light is being installed on the McLoud River by the McLoud River Electric Power Company of Redding, Cal. The concern is to supply power, for the present, to the surrounding territory, but its pole lines will eventually be extended as far south as Sacramento. Contracts are now being let for a dam across the McLoud River, a 12-mile canal, and the power house. Some $300,000 worth of machinery is now at Redding awaiting the erection of building for its proper installation. A. F. Johns of Redding is the general manager of the concern.

The Edison Electric Company has been incorporated at Cheyenne, Wyo., with a capital stock of $10,000,000, by Andrew Cooke, Maurice K. Baker and Peter A. Fagg. The company proposes to establish a large power and light plant somewhere in the vicinity of Evanston, in the southwestern part of Wyoming, and in the Uinta oil fields, and to furnish light and power to the hundreds of towns that are expected to spring into existence as a result of the predicted oil boom there. The company will also build and operate electric railways, furnish power to run drills and pumps in the oil fields and also transmit power to distant mining camps, such as Park City, Utah, and possibly to Ogden and Salt Lake City, Utah. The concern will also operate lumber mills in the mountains and prepare material for building.

SOCIETIES AND SCHOOLS.

The talk about establishing a school of technology in connection with Northwestern University at Evanston, Ill., has been revived, and it is reported that plans are now being prepared to this end. President James is known to favor such an addition and it is believed that on his return from the East active steps will be taken toward the establishment of the school.

The semi-annual meeting of the Electrical Contractors' Association of New York State was held at Albany, N. Y., on July 15th. There were 75 members in attendance. After concluding the meeting the delegates visited the state capitol and in the afternoon took special cars to Schenectady, where they inspected the works of the General Electric Company. In the evening many of the party left by boat for New York, en route to the National Contractors' convention in Philadelphia.

On the application of Howard N. Elmer a receiver was appointed on July 16th for the Technical Club of Chicago, an organization composed largely of engineers, architects and men interested in technical pursuits, including many members of the electrical fraternity. The receiver appointed is the Royal Trust Company, and it will keep the club open. The organization has a well-appointed house at 230 Clark Street. Insufficient membership is believed to be one of the causes of the financial difficulties of the club.

PUBLICATIONS.

A catalogue descriptive of the Willey electrically driven tools as manufactured by James Clark, Jr., & Co. of Louisville, Ky., has recently been issued. Among the tools described are breast, bench, sensitive, spindle and radial drills, grinders, saws, armature-disc notching machines and coil-winding machines.

The latest catalogue issued by the Green Fuel Economizer Company of Matteawan, N. Y., gives a very complete description, list of advantages and method of operating and cleaning of this company's well-known type of boiler-fuel economizer. Illustrations are shown of the various parts and of many typical installations. Cuts are also given which show different arrangements of economizers. The catalogue includes a list of users, results of tests, data on the construction of chimneys and several valuable engineering tables.

F. G. Baum of Stanford University, Cal., has published "An Alternating-current Device for the Use of Electrical Engineers," which will be found useful in calculating the regulation of a generator, transformer or transmission line, or any combination of these, for any load and any power factor. It may also be used for making any synchronous-motor calculation. The device consists of a celluloid sheet, suitably marked, which is adapted to be moved over a printed pasteboard chart. Accompanying it is a 22-page pamphlet in which are described methods of making the various measurements. Curves giving practical data on transmission lines are also included. With this device different problems in obtaining the excitation, current, power factor, angular swing, maximum load and percentage of compounding of synchronous motors may be readily determined. The device and accompanying pamphlet are supplied by The Bookstore, Stanford University, Cal.

TELEGRAPH.

The Postal Telegraph Company will build a line from Portland, Ore., to Spokane, Wash., by way of Walla Walla, Wash.

To send to Chicago, Ill., an unrepeated telegram, addressed to Toledo, Ohio, is held by the New York courts to be gross negligence, for which a telegraph company is liable for the full amount of damage caused by the resulting delay, notwithstanding a contract limiting its liability for delay to the amount received by the company for sending it.

SPACE TELEGRAPHY.

It is said that the Marconi Wireless Telegraph Company has notified the De Forest Wireless Telegraph Company that it is infringing the Marconi patents and must desist or legal steps will be taken to adjudicate the matter.

The transmission of messages by wireless telegraphy by day requires more power than by night. Day signals failed to reach Marconi at 700 miles, while night signals were sent more than 2,000 miles. The reason for this difference is, as yet, unexplained.

The Stone Telegraph and Telephone Company has been organized at Portland, Maine, with an authorized capital of $10,000,000. Of the capital stock, $700 has been paid in. The company intends to experiment with and develop wireless telegraphy. The promoters are Alexander Porter Browne and Brainerd Judkins of Boston, John Stone of Cambridge, Mass., and John W. Anderson, A. G. Berry, M. Warren and William M. Bradley of Portland, Maine.

In some recent experiments made on the schooner Eagre, the United States Coast and Geodetic Survey obtained fairly satisfactory results. The experiments were made off the coast of Long Island. "During the night," the report says, " the schooner had taken up a position about 30 miles west of the Marconi shore station, and early the following morning the start was made for New York. Half-hourly communication was kept up with the shore station as the vessel proceeded westward, and continued for some time after the last intelligible message was received aboard, which occurred at a distance of 63 miles."

MISCELLANEOUS.

It is announced that after a series of practical tests it has been demonstrated that a high grade of rubber is obtained from Beaumont oil when put through the refining process. This discovery is to be placed in practical operation by a Texas company, organized with a capital stock of $10,000,000. Cotton-seed oil is said to be combined with the Beaumont oil in the manufacture of this rubber substitute. The refining and manufacturing plant will be located at Beaumont, Texas.

John Stanton, secretary of the Copper Producers' Association, reports that the production of copper in the United States for the month of June amounted to 26,740 long tons, as compared with 25,763 in May, and 21,902 in June, 1901. While June domestic production increased about 1,000 long tons by comparison with May, foreign production decreased over 1,000, amounting to 8,202 long tons, against 9,354 in May and 8,564 in 1901. American exports in June decreased over 1,000 long tons, amounting to 14,027, against 16,283 in May and 9,842 in June, 1901. For the six months ended with June domestic production of copper amounted to 140,449 long tons, against 133,394 in the same period in 1901, an increase of 7,055. The ratio of exports to production during the first six months of 1902 was 62.9 per cent., against 38 per cent., during the first six months of 1901.

TRADE NEWS.

The Swift Cotton Mill of Elberton, Ga., is in the market for an electric-light plant. A direct-connected unit is preferred.

The Railway and Electric Supply Company of New York has been incorporated with a capital of $50,000. The directors are H. M. Shaw, E. E. Shaw and G. C. Moon.

The Quincy Electric Drill Company of Jersey City was recently incorporated with a capital of $500,000. The incorporators are George F. Bradstreet, Richard H. Farries and Mr. Keyes.

The General Electric Signal Manufacturing Company of Newark, N. J., has been incorporated with a capital stock of $50,000 by Morris B. Allen, Edward T. Casebolt and Ernest C. Lenn.

The O. S. Platt Manufacturing Company of Bridgeport, N. Y., has filed a certificate of dissolution. The company was organized in 1896 for the manufacture of castings and electrical appliances.

The G. B. W. Electric Specialty Company of New York has been incorporated with a capital of

$15,000. The directors are Josef Veit and C. F. Lewis of New York, and L. C. Scrymser of Brooklyn.

The Fox & Callahan Phonealarm and Electrical Supply Company has been incorporated at Milwaukee, Wis., with a capital stock of $50,000. The incorporators were Benjamin O. Fox, John D. Callahan, Thomas E. Callahan and W. J. Delaney.

The seventeenth annual outing of the employes of the Jeffrey Manufacturing Company of Columbus, Ohio, was held on Saturday, July 12th, at Idlewilde Park, Newark. Games, dancing, boating, baseball and other amusements were indulged in and enjoyed by all present.

The Keystone Electric Company of Erie, Pa., has been organized by Jerome F. Downing, Frederick B. Downing, Peete B. Clark, Gustave Leve and John W. Leech. The company is capitalized at $400,000 and will manufacture all kinds of electric machinery, apparatus and supplies.

Sealed proposals will be received by the State Capitol Commission at the office of its secretary, in Olympia, Wash., until 3 o'clock p. m. on Tuesday, August 5, 1902, for the furnishing of electric fixtures for the annex to the state capitol, according to plans and specifications prepared by W. A. Ritchie, architect, which will be furnished intending bidders.

The St. Louis Globe-Democrat is authority for the statement that the Emerson Electric Manufacturing Company of that city is preparing to build a large manufacturing plant on the southeast corner of Twenty-first Street and Washington Avenue, for the manufacture of electric supplies. The proposed structure is to have a frontage of 108 feet on Washington Avenue and 150 feet on Twenty-first Street and will be six stories high. The structure is to be completed by January 1, 1903.

Westinghouse, Church, Kerr & Co. announce the removal of their Pittsburg office from its former location on the first floor of the Westinghouse Building to more commodious quarters on the eighth floor of the same building. This change is the direct outcome of largely increased business in that district, and is accompanied by the acquirement of a large reception room, devoted exclusively to the convenience and entertainment of visitors and patrons.

As mentioned in the Western Electrician of July 12th, the Standard Vitrified Conduit Company of New York has been incorporated. This company will have its offices at 39 Cortlandt Street, and has been organized to handle vitrified salt-glazed underground conduits and insulators. The company was recently awarded a contract to supply 300,000 duct feet of its conduit for the municipal conduit system in Newcastle, Pa. The president and manager of the new company is R. W. Lyle, and the vice-president and secretary is B. S. Barnard, both of whom were formerly associated with the American Vitrified Conduit Company. Mr. Barnard, who is very well known to the electrical fraternity and is a conduit man of wide experience, will manage the sales department of the company.

BUSINESS.

Assistant General Manager W. A. Layman, of the Wagner Electric Manufacturing Company of St. Louis, passed through Chicago last week. Mr. Layman came north on a combined business and pleasure trip. He reports the Wagner factory in a very busy condition.

Hall L. Brooks, Tomahawk, Wis., carries a large line of white-cedar poles and can ship to any point, owing to the excellent railway facilities at his disposal. Mr. Brooks states that he is in a position to fill all orders with dispatch and that he will be pleased to hear from those in the market for cedar products.

The Electric Appliance Company, Chicago, selling agent for Gutmann integrating alternating-current wattmeters, announces that it is about to supply these wattmeters with a glass case, instead of the regular aluminum case, where ordered. This allows of a close observation of the meter in operation without exposing the parts to dust or dampness.

The Western Electrical Supply Company of St. Louis reports that it is meeting with unusual success in selling Scheefer integrating wattmeters for direct and alternating currents. This meter embodies a number of improvements, and is said to be one of the best meters on the market. It is dust and bug proof, is very highly sensitive and accurate, and is not affected by alternations or lag in current.

The Standard Steel Car Company is equipping its new plant for electric driving throughout. A recent purchase from the Westinghouse Electric and Manufacturing Company comprises two 375-kilowatt, alternating-current generators, one 400-kilowatt, direct-current generator, and a 300-kilowatt, rotary converter, for use as a connecting link between the two. This company has also purchased about 50 induction motors, which will be used largely for direct connection to machine tools.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 15, 1902.

704,495. Electric Arc Lamp. Arthur M. Arter, Hammersmith, England. Application filed January 12, 1899.

The lamp has an elastically supported rotatable body. Carbons are operatively connected with the body and adapted to be moved thereby in opposite directions when the body is rotated. An electrically controlled actuating means acts against the elastic support of the body and operatively connects with the body to rotate it in one direction. A mechanical means is operatively connected with the body and adapted to rotate it in the opposite direction.

704,496. Automatic Circuit-breaker. Brigham Ballantyne, Sumpter, Ore. Application filed August 8, 1900.

A solenoid of low resistance is electrically connected with the movable contact and with a conductor and a core for the solenoid is connected directly to the lever for positively operating the same to separate the contacts on the presence of an excess of current in the solenoid coils.

704,513. Display Device. Stewart L. Campbell, Kalamazoo, Mich. Application filed August 22, 1901.

Incandescent electric lamps are carried on the ends of arms supported radially on a turn-table.

704,526. Electric Arc Lamp. Harry Etheridge, McKeesport, Pa. Application filed December 30, 1901.

The carbon or carbon-holding rod or tube has spaces on it, and an oscillatable double-jawed clutch engages with and between the spaces in alternate manner. A movable member is arranged to retain the clutch in its engaged position, and a trip releases the clutch and member.

704,543. Electrical Measuring Instrument. Edward B. Jacobson, Pittsfield, Mass., assignor to Thor H. Neilsen, Boston, Mass. Application filed February 11, 1902.

An instrument for measuring the intensity and potential of electric circuits is described. It comprises a pair of electromagnets, the respective circuits of which are connected at one end to a single terminal, and at the other end with an independent terminal.

704,573. Device for Generating Electricity on Running Cars. Richard Pintsch, Berlin, Germany. Application filed November 14, 1901.

In the plant described power is transmitted from the running gear of a car to operate mechanism mounted on the car. The apparatus consists of a power transmission train, an electromagnetic coupling interposed therein, and an electric accumulator furnishing a current for energizing the coupling, with an automatic cut-out so operated as to prevent the electrical storage in the accumulator from falling below a tension sufficient for the purpose mentioned. (See cut.)

704,574. Power-transmission Regulator for Electromagnetic Couplings. Richard Pintsch, Berlin, Germany. Application filed November 14, 1901.

The coupling comprises two members having a common magnetic field, and there are provided means for varying the magnetic field, consisting of an auxiliary opposing electromagnetic field member and means for controlling the field of the same.

704,575. Centrifugal Coupling. Richard Pintsch, Berlin, Germany. Application filed November 14, 1901.

Parts of the device are a contact board having two pairs of contacts, a lever oscillatably mounted on the driven member and having contacts at either end, the lever contacts being adapted to reverse the poles of the current on the reversal of the direction of rotation of the driving shaft.

704,589. Sparking-coil Casing. Charles F. Splitdorf, New York, N. Y. Application filed April 30, 1902.

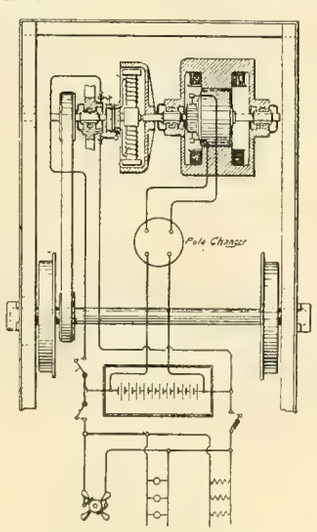
The casing consists of a cylinder composed of tough, non-conducting material, an inner lining therefor composed of a thin sheet of material rolled upon itself in several plies, and possessing the quality of non-conductivity to a higher degree, a cylinder cap, an insulating disk at its inner surface, and a body of plastic insulation interposed between the disk and the coil winding.

704,595. Thermo-electric Element. Charles B. Thwing, Galesburg, Ill., assignor to Louis S. Langville, New York, N. Y. Application filed June 14, 1901.

The thermo-electric couple has iron as the positive element, and an alloy of nickel and copper of the composition Ni_3Cu_2 as the negative element.

704,596. Thermo-electric Generator. Charles B. Thwing, Syracuse, N. Y., assignor to Louis S. Langville, New York, N. Y. Application filed October 21, 1901.

In the generator are a casing open at top and bottom, a burner, a chimney for the burner, and thermo-electric couples the joints of which project into the path of the products of combustion from the burner, the major portions of the couples being located in the casing beyond the burner.



NO. 704,573.—ELECTRIC CAR GENERATING DEVICE.

704,620. Self-winding Electric Clock. Charles M. Crook, Bristol, Conn., assignor to Charles S. Burton, trustee. Application filed September 26, 1901. Renewed May 28, 1902.

An automatically wound clock train is operated by an electromagnet.

704,639. Leaching and Extraction of Metals from Their Ores. Carl Hoepfner, Frankfort-on-the-Main, Germany; Henry Orth, Jr., administrator of Hoepfner, deceased. Application filed September 27, 1899.

The process of treating ores and metallic compounds containing copper is described. It consists in leaching the ores with a cupric-chloride solution containing a solvent of cuprous chloride in quantity less than is required for saturation, and electrolyzing the resulting cuprous-chloride solution while mechanically separating the electrode solutions, thereby depositing metal at the cathode and converting the cuprous into cupric chloride.

704,649. Electrical Furnace for Treating Highly Refractory Substances. Hudson Maxim, Brooklyn, N. Y. Original application filed June 25, 1895. Divided and this application filed October 30, 1901.

An electrical apparatus for making calcium carbide is described. It comprises a carbide conductor included in an electric circuit, whereby the conductor is maintained incandescent, means delivering carbide-forming materials to the heating field, and means uninterruptedly moving the calcium carbide from the heating field as fast as formed.

704,665. Controlling Apparatus for Electric Motors. Walter J. Richards, Milwaukee, Wis., assignor to Niels A. Christensen, Milwaukee, Wis. Application filed November 16, 1901.

In the apparatus are combined a main switch for governing a motor circuit, a magnet for operating the switch, a relay switch controlling the circuit of the main magnet, a magnet for operating the relay switch, an auxiliary switch for breaking the circuit of the relay magnet, means for operating the auxiliary switch, and a primary switch controlling the operation of the auxiliary switch. (See cut on next page.)

704,670. Electrical Connector. Albert J. Wayman, Dubois, Pa. Application filed January 16, 1902.

The device comprises a base having slots in its sides, clamping plates each including spaced members and a connecting web and having one member disposed in a slot and the other member disposed against the under face of the base, and means for holding a wire against the plate.

704,671. Mopping Device. Harmon F. Ackerman, Cleveland, Ohio. Original application filed May 13, 1901. Divided and this application filed November 15, 1901.

The invention consists of an electrically operated machine the parts of which are a current-conductor reel, a standard therefor, a base standard to receive the wheel standard in pivoted relation thereto, and a movable stop secured to the wheel standard, in combination with means on the base standard for limiting the motion of the wheel standard.

704,675. Process of Recovering Metallic Tin. David H. Browne, Cleveland, Ohio, and James M. Neil, Toronto, Canada. Application filed July 27, 1901.

The process consists in subjecting the material to a solution of ferric chloride, thereby forming a solution of chloride of tin and ferrous chloride, and precipitating the tin from such solution by an electric current passing between an insoluble anode and a suitable cathode.

704,694. System of Distribution. John L. Creveling, New York, N. Y. Application filed September 11, 1901.

In a system of distribution for railway trains there are combined generator and current-utilizing devices and a pneumatic device for affording delivery of current to the current-utilizing devices always in the same direction, the pneumatic devices being actuated by a change in the direction of the pressure in a pneumatic system on the train.

704,695. Combined Electric and Gas Car-lighting System. John L. Creveling, New York, N. Y., assignor to the Safety Car Heating and Lighting Company. Application filed January 18, 1902.

See page 53.

704,696. Means for Regulating the Output of Dynamo-electric Machines. John L. Creveling, New York, N. Y. Application filed June 12, 1901.

A shunt-wound dynamo has a regulating device comprised in part by means for regulating the degree of field excitation by the degree of heat developed by the machine. (See cut on next page.)

704,697. Telephone Hook Switch. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed May 9, 1901.

Combined with a single integral metallic support are a hook lever pivoted upon the support, a group of circuit-

changing contact springs and alternately disposed insulating material directly mounted upon the support, and means for changing the springs from signaling position to talking position, and vice versa by the hook.

704,733. Electric Alarm Clock. Walter C. Bethel, Seattle, Wash. Application filed February 7, 1902.

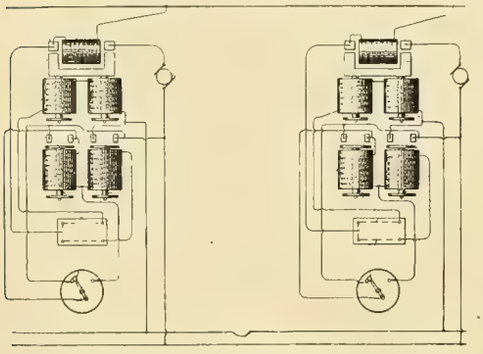
Combined with the hour-hand operating means is an arm carrying a contact brush with contact plates corresponding in number relative to the time indications on the dial of the clock designed to be contacted by the brush. A wheel having radial arms for closing an electric circuit through the plates and brush is provided.

704,739. Secondary Battery. Justus B. Entz, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed October 3, 1900.

A malleated antimonious-lead grid is bent to form keys for holding the active material.

704,744. Electric Accumulator. Hermann Heinicke, Schoeneberg, near Berlin, Germany. Application filed April 28, 1902.

An accumulator electrode comprises a conducting base presenting angular grooves extending from the top downward, and substantially horizontal strips, inclining inward and connecting the outer portions of each groove formed by adjacent walls.



NO. 704,665.—MOTOR-CONTROLLING APPARATUS

704,749. Trolley-pole Attachment. Charles P. Lapham, Houghton, N. Y. Application filed February 7, 1902.

The device comprises a frame or holder, a grooved trolley wheel mounted thereon and capable of a limited oscillatory movement, and a spring having a reduced intermediate portion and provided with a tapered bead extending into the groove of the trolley wheel and adapted to hold the latter normally in alignment with the trolley wheel.

704,750. Tank for Storage Batteries. Hugh Lesley, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed February 8, 1902.

A lead-lined storage-battery tank having channels between it and its lining and having an apertured bottom is described.

704,751. Manufacture of Secondary-battery Plates of the Planté Type. Harold M Martin, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed July 30, 1901.

An improvement in the rapid factory formation process of making peroxide of lead on battery plates which consists in subjecting the plates to an electrolyte capable of producing the rapid formation of peroxide from metallic lead is described, which consists in controlling the temperature of the electrolyte during the formation.

704,759. Storage-battery Separator. Hugh Rodman, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed July 29, 1901.

An imperforate wooden diaphragm is arranged between each pair of plates, the diaphragm having acid wells on both sides thereof. The wells are substantially vertical and open to afford free circulation between each plate and the diaphragm in vertical direction.

704,767. Secondary Battery. Edward G. Steinmetz, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed September 29, 1900.

The active material described consists of a coherent mass of crystalline lead free from blow holes, the crystals of the mass being interrelated according to their law of crystallization.

704,797. Railway Heater System. Samuel H. Harrington, New York, N. Y. Application filed January 3, 1901.

An electric heater is arranged upon the car and derives energy from the source of electric supply. A switch controls the circuit of the heater, and there is operative connection between the brake-operating mechanism and the switch whereby the latter is operated by the operation of the former.

704,800. Signal. Reinhold Herman, Crafton, Pa. Application filed October 11, 1901.

Combined with the signal arm automatically held in the danger position are electrically actuated shifting means to shift the signal arm to caution and danger, with track circuits controlled by train movements, and a separate circuit also controlled by train movements to act as a choke for the signal when shifted to caution or danger position.

704,803. Electric Controller. Arthur E. Hogrebe, Philadelphia, Pa. Application filed December 12, 1901.

The controller has a housing or casing with a suitable cover, and a cylinder or barrel switch carried by the cover.

704,831. Process of Manufacturing Sulphuric Acid From Sulphur Dioxide in Aqueous Solution by Electrolysis. Charles B. Jacobs, East Orange, N. J., assignor to the Ampere Electro-Chemical Company, Jersey City, N. J. Application filed June 1, 1901.

The process consists in passing sulphur dioxide through a porous anode and setting free the oxygen of water by electrolysis upon the anode.

704,851. Electric Lamp. Henry W. Beecher, Jr., Port Townsend, Wash. Application filed February 6, 1902.

The lamp comprises a globe having a number of filaments and a conducting screw collar for the lamp socket with one end of each filament connected to the screw collar and separate insulated contacts arranged on the upper face of the neck of the globe and connected to the other ends of the filaments.

704,859. Electric Accumulator Electrode. Victor Cheval and Joseph Lindeman, Brussels, Belgium. Application filed November 21, 1901.

The electrode comprises a mass of active material, a perforated envelope, inclosing the mass, and radial insulating arms projecting from the envelope.

704,863. System of Electrical Distribution. John L. Creveling, New York, N. Y. Application filed August 30, 1900.

One claim reads: The combination with a generator, storage battery, and translating device in electrical communication one with the other, a field coil, variable resistances and movable members inserted respectively into the work or translating and field circuits, respectively, insulated mechanical means uniting the movable members, and mechanical means for actuating the movable members relatively to the rate of speed of the armature of the generator.

704,864. System of Electrical Distribution. John L. Creveling, New York, N. Y. Application filed December 7, 1900.

Combined with a system of electrical distribution, comprising a generator, storage battery and translating devices in electrical communication through a main circuit, the battery dividing from the main circuit, in effect, a lamp circuit deriving energy directly through the battery, are means for increasing or diminishing resistance in the lamp circuit upon increase or decrease of battery current to the field circuit.

704,865. System of Electrical Distribution. John L. Creveling, New York, N. Y. Application filed December 7, 1900.

Combined with a generator comprising a rotative member, a storage battery and a work or translating circuit are a regulator in the circuit dependent upon the speed of rotation of the rotative member, and independent means of nullifying the effect of the regulator whenever the generator is ineffective.

704,874. Escapement for Electromagnetically Controlled Clocks. Hubert H. Grenfell, London, England. Application filed February 5, 1902.

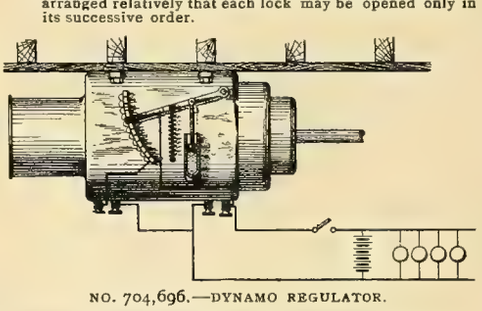
A pin is connected to the arbor and a slotted detent bar forms a stop for the pin, but allows the pin to pass through the slot as the bar is moved to and fro. A spring-controlled armature is pivotally mounted between the poles of an electromagnet, and connected to the detent bar and the electromagnet.

704,917. Transmitting Apparatus for Electric Telegraphs. Thomas D. Penniman and Henry H. Wiegand, Baltimore, Md., assignors to the Rowland Telegraphic Company, Baltimore, Md. Application filed February 18, 1902.

Parts of the apparatus are a source of direct current, a telegraph line, a pole-changer connected in circuit with the line and source of current, the pole-changer having terminals arranged in sets and acting normally to deliver to line through one set a periodic current from the source, and a main-line transmitter adapted to shift the line connection from one set of the terminals to another, whereby an impulse of opposite polarity is sent to line than would have been sent had not the transmitter acted.

704,925. Recorder. Christopher J. Roach, Hartford, Conn. Original application filed October 2, 1901. Divided and this application filed November 27, 1901.

The recorder has controlling mechanism, a series of locks and an electric circuit embracing all the locks and the recorder, the locks having controlling mechanisms so arranged relatively that each lock may be opened only in its successive order.



NO. 704,696.—DYNAMO REGULATOR.

704,927. Keyboard for Use in Telegraphy. Henrietta H. Rowland, Baltimore, Md., administratrix of Henry A. Rowland, deceased, assignor to the Rowland Telegraphic Company, Baltimore, Md. Application filed July 24, 1901.

In the transmitting keyboard are combined a group of conductors leading into the keyboard, a series of electrical contacts of greater number than the conductors, the contacts electrically connected with the conductors in prearranged combinations, and means operating in conjunction with the contacts for operating circuits through the conductors and contacts.

704,928. Telegraphic Distribution. Henrietta H. Rowland, Baltimore, Md., administratrix of Henry A. Rowland, deceased, assignor to the Rowland Telegraphic Company, Baltimore, Md. Application filed July 24, 1901.

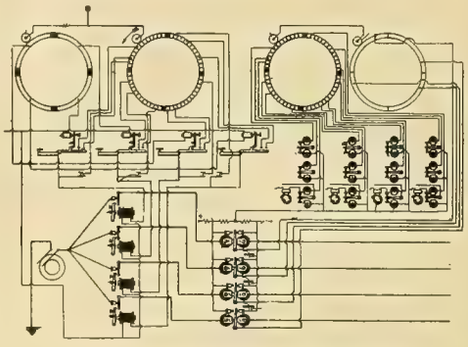
The system consists of a central station and a number of sub-stations, a source of periodic signaling current located at the central station, telegraph lines leading from the central station to the sub-stations and supplied with current from the source, main-line transmitting and receiving instruments located at the central station and at each of the sub-stations, and means located at central and at each of the sub-stations whereby the central and substations may be placed in communication with each other at rapidly recurring periods. (See cut.)

704,929. Means for Producing and Maintaining Synchronous Motion. Henrietta H. Rowland, Baltimore, Md., administratrix of Henry Augustus Rowland, deceased, assignor to the Rowland Telegraphic Company, Baltimore, Md. Original application filed July 24, 1901. Divided and this application filed December 11, 1901.

A circuit-changer controlled by the dynamo, and a circuit-changer controlled by the body to be synchronized are combined with an electric circuit completed from the armature coils of the dynamo through both of the circuit-changers at rapidly recurring intervals, electric energy-absorbing means included in the circuit and exerting a continuous synchronizing effect upon the dynamo, by varying the energy absorbed by the dynamo with every variation in the speed of the body with which synchronism is to be maintained.

704,930. Means for Impressing Periodically Varying Electric Currents Upon Telegraph or Other Circuits. Henrietta H. Rowland, Baltimore, Md., administratrix of Henry Augustus Rowland, deceased, assignor to the Rowland Telegraphic Company, Baltimore, Md. Original application filed July 24, 1901. Divided and this application filed December 11, 1901.

A source of direct electric current and means for producing a periodically varying current from the direct current are combined with an electric circuit, and a transformer by which the periodically varying current is impressed upon the electric circuit.



NO 704,928.—TELEGRAPHIC DISTRIBUTION.

704,948. Automatic Electrical Signaling Apparatus for Railways. James E. Spagnoletti, London, England, assignor to the Electric Railway Signaling Syndicate, Limited, London, England. Application filed May 16, 1902.

A multiple switch for controlling the electric circuits of railway signals is described. It consists of a number of bridging contact pieces carried by a vertically guided rod, a solenoid the movable core of which is carried upon the rod, a collar on the upper end of the rod, a spring-actuated latch adapted for engagement with the collar so as to retain the rod in the raised position, and an electromagnet whereof the armature is connected to the latch so as to cause the latch to be retracted when the armature is attracted by the magnet.

704,956. Electric Generator. Walter H. Cotton, Chicago, Ill., assignor of seventeen-twentieths to Harry L. Peck, Phillip Hickley and William P. Owens, Chicago, Ill. Application filed February 5, 1902.

A sparking apparatus is described which comprises a dynamo having a working circuit through which passes all of the current generated, and a circuit-breaker constructed to break the circuit at periods when the generated current is at its maximum potential.

704,974. Automatic Magnetic Circuit-breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company. Original application filed February 23, 1900. Divided and this application filed June 20, 1902.

Combined with a base are a main terminal, a second main terminal vertically above the terminal, a laminated bridge member pivotally secured to the base and rotatably movable to and away from the main terminals in a plane parallel to a plane including the fixed terminals, and an actuating member having power-multiplying connection between the base and the laminated member.

704,975. Armature. Frank L. Sessions, Oak Park, Ill., assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Application filed May 29, 1899. Renewed March 26, 1902.

The armature comprises end spiders and an intermediate core and windings extending across the periphery of the core and spiders, and provided with ventilating air ducts or channels extending outwardly between the spiders and core and then laterally along the spiders beneath the windings, and an annular flange on the end of one spider for directing the air currents outwardly against the surrounding portions of the machine.

704,986. Telephone Booth. Frank L. Tufts, New York, N. Y., assignor of one-third to Herschel C. Parker, New York, N. Y. Application filed November 5, 1901.

A number of telephone booths are placed in juxtaposition and are provided with curved walls.

704,993. Electric Smelting Furnace. Frederick C. Weber, Chicago, Ill. Application filed January 8, 1900. Renewed May 16, 1902.

A horizontally elongated furnace chamber has several superposed series of electrodes projected laterally into the furnace from opposite sides thereof, each series having a different angle of downward convergence in relation to the other series and toward a central space with an arcing space between the companion downward-converging electrodes of each series and forming an extended horizontal arcing space downwardly projected between the several superposed series of electrodes. A feed or discharge for the material from above is arranged in direct line with the arcing space.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, AUGUST 2, 1902. No. 5

Motor Equipment of a New Buffalo Grain Elevator.

The Iron Elevator and Transfer Company of Buffalo, N. Y., has recently put into service one of the most remarkable grain elevators in the world. This structure, which is shown in Fig. 2, on the next page, is formed entirely of concrete and steel. It is situated on the Lake Shore and Michigan Southern railroad, and all grain passing east over this road is weighed and transferred from western into eastern cars at this elevator, which has an actual working capacity of 60 carloads of grain in and out in a 10-hour day.

In addition to the regular work of transferring grain in transit, the elevator is equipped for cleaning and separating the mixed grains, and, for this purpose, has a storage capacity of 650,000 bushels. The storage space is divided into 90 separate steel bins with a capacity of from 1,000 to 12,000 bushels each. The bins are of rolled-steel plates, cylindrical in shape; they are 65 feet deep and the largest ones are 15 feet in diameter. The foundation is of concrete and is built at a sufficient altitude above the ground to form a working story, or basement, 10 feet high under the bins.

The grain is handled throughout the building by means of endless rubber-belt conveyors and elevating legs, which are driven entirely by induction motors located at various points in the structure. The aggregate power provided amounts to 280 horsepower and is exerted by five Westinghouse type-C induction motors, varying in size from 30 horsepower to 75 horsepower each. The power is transmitted from the motors to the machinery by rope drives in every case. Electric power is received from the Niagara Falls Power Company's circuits in the form of three-phase alternating current at 2,200 volts. This voltage is transformed to 400 volts for distribution in the elevator.

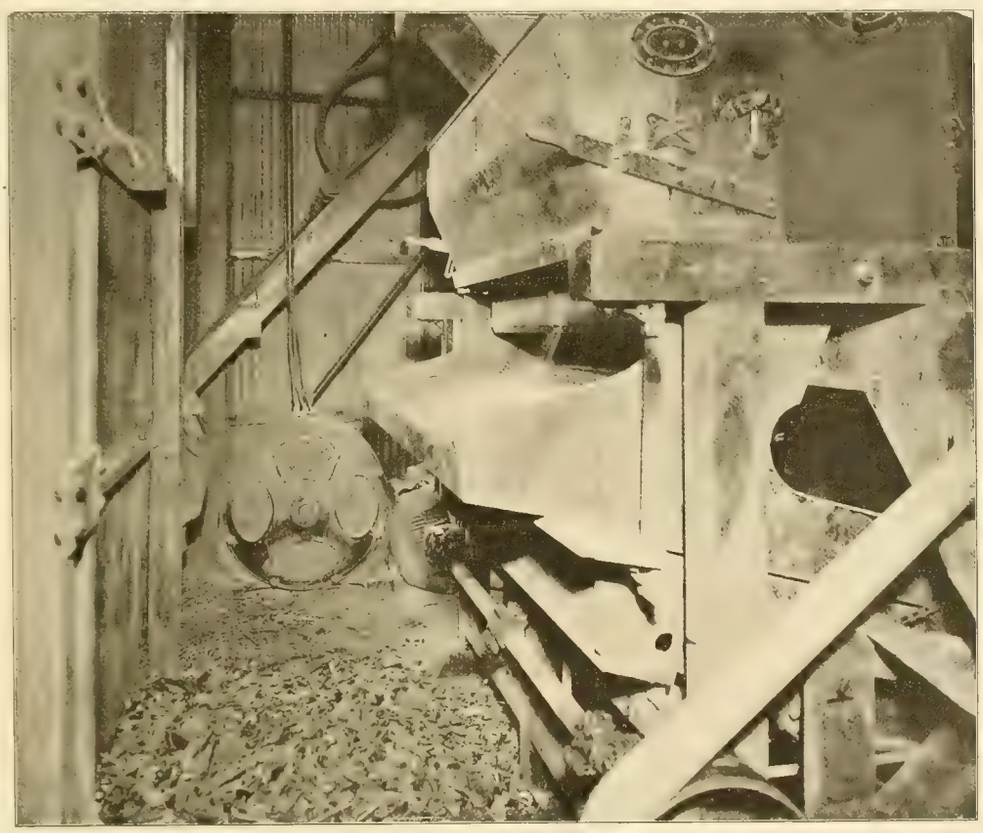


FIG. 1. MOTOR EQUIPMENT OF A NEW BUFFALO GRAIN ELEVATOR.—VIEW IN THE CLEANING ROOM.

All motors are controlled from a fireproof electrical room in the basement of the elevator by means of a switchboard, from which the wires pass through iron conduits to the motors. In this manner all sparks attendant upon the starting and stopping of the motors are confined to this room, and all possible danger of dust explosions and fires originating from the electrical apparatus is entirely avoided.

A view in this room, showing the switchboard, is given in Fig. 3. At the left is shown the primary switching panel equipped with a wattmeter of the two-dial type, with electric-clock attachment, which directs the recording gearing from day to night dials, and vice versa. The panel also contains a plunger-type, double-panel switch for controlling the 2,200-volt current. Lightning arresters are mounted below the switch. The secondary switchboard, comprising three panels, is shown at the right. Each panel is equipped with two three-pole, double-throw, washer-type switches for controlling the motors. As may be inferred from the number of motors, only five of these switches are now in use. Back of the panels are seen the three 100-kilowatt, 2,200-volt transformers, which are delta-connected with taps brought out to furnish voltage suitable to start 400-volt motors.

A typical motor installation in the elevator is illustrated in Fig. 1, which gives a view in the cleaning room. The induction motor shown is of 50 horsepower and operates at 480 revolutions a minute. It drives two Invincible grain cleaners, one of which is shown in the foreground; four Shillin & Richards grain shovels; two 90 by three-foot conveyor belts, running in the basement, each with a capacity of 15,000 bushels an hour, and two 25 by three-foot conveyor belts, each with a capacity of 6,000 bushels an hour, running under the grain pits below the cars.

A view of the scale tower is given in Fig. 4, in which are shown two 75-horsepower induction motors, each having a speed of 480 revolutions a minute. These motors operate 10 separate pieces of apparatus as follows: Four elevating legs, 125 feet between centers, each with a capacity of raising 6,000 bushels an hour; two belt conveyors, 90 feet between centers, by three feet wide, each with a capacity of 15,000 bushels an hour; one 70 by three-foot cross-conveyor, with a capacity of 7,000 bushels an hour; three Fairbanks recording-scale pans, shown on the right. Each of these scales is equipped to weigh 90,000 pounds of grain. A detaining chamber of equal capacity is located directly above each scale. This detaining chamber may be emptied of full load in 15 seconds.

Fig. 5 is a view in the basement and shows in the foreground a 90 by three-foot belt conveyor. This belt is capable of carrying 15,000 bushels of grain an hour. The pipes suspended over the belt are outlets to the bins, and grain empties from the pipes on the moving belt. The induction motor shown is of 30 horsepower and has a speed of 720 revolutions a minute. It operates a car puller (for manipulating loaded grain cars) and the air compressor (used for cleaning dust from motors, floors and beams). It will be noted that the columns, arches and floors shown in this and the other illustrations are made of molded concrete.

The cleaning and clipping machinery, located in the second story of the track shed, is all driven by motors. One 50-horsepower motor is connected by a rope drive direct to a large clipper. A 30-horsepower motor is also used to drive a powerful car-pulling machine in the basement.

Compressed air is distributed to all points of the elevator. This air, at a pressure of 100 pounds per square inch, is available throughout the building, and is used for blowing dust out of the motors, for sweeping floors and beams and for syphoning any water that may collect in the drain pits under the elevator. A blacksmith's forge is also supplied with air from this system.

In addition to the iron elevator just described, the Iron Elevator and Transfer Company owns an older wooden transfer elevator and a very large feed-grinding establishment, known as the Diamond Mills, situated near the wooden elevator. The former is a railroad grain elevator of the old-fashioned wooden-crib type, which has been operated heretofore by steam with great economy, owing to the fact that dust and clippings from the grain were burned as fuel. The Diamond Mills, also, has received power for their operation from the plant of the wooden elevator. In spite of this economy, however, both establishments will hereafter be operated by Westinghouse type-C induction motors, receiving current from Niagara Falls, the change being made as a result of the marked saving in cost of operation of the new iron elevator, as compared with that of the old wooden house.

The power equipment for these two plants is now being installed and will aggregate about 500 horsepower, comprising the following apparatus: Three 75-kilowatt oil-insulated transformers, provided with special tap, from which a suitable starting voltage for the motors can be obtained; a 100-horsepower, three-phase, type-C induction motor, and also the following motors of the same type: Three of 75 horsepower, three of 50 horsepower, and one of 30 horsepower.

All the electrical apparatus above mentioned has been furnished by the Westinghouse Electric and Manufacturing Company. Credit for the engineering and construction work is due to the Macdonald Engineering Company of Chicago.

Marconi Towers Completed at Cape Breton.

The signal towers at Table Head, Cape Breton, were formally taken over from the building contractors on July 16th by the Marconi Wireless Telegraph Company. Everything in the matter of erection of the transatlantic wireless-telegraph station is now completed, and the wire connections between the tower caps and the operating room are being installed by the electricians. The receiving apparatus is ready for operation, and when the wire connections are made the station will be ready for the transmission of messages. Table Head, as its name imports, is a small, barren promontory rising abruptly from the sea to a height of about 70 feet. The land was owned by the Dominion Coal Company, but when Marconi expressed his desire to erect a station there the company at once offered him this property, as well as other sites.

A Spanish company in which the king of Spain is said to be financially interested has ordered a large quantity of machinery from Chicago. The government arsenal at Irubia is to be furnished with electric machinery also from Chicago.

Effect of Electrolytic Condensers in Alternating-current Circuits.[1]

By A. Trowbridge and E. R. Wolcott.

The phenomena observed with electrolytic condensers differ considerably from those of ordinary condensers. In the former the capacity has been shown to be a function of the electromotive force of the concentration of the electrolyte, of the temperature and of the frequency, but independent of the distance between the plates. Used in alternating-current circuits, their action often appears to be anomalous in that they do not produce the phase difference that would be expected from previous determinations of their capacity. In fact, some investigators hold that they do not produce a difference in phase between current and electromotive force, but only a change of wave form. This belief rests upon the facts that though they give a power factor considerably less than unity, they are not at all efficient as "phase splitters." However, it has been shown by Malagoli and others that there is a shifting of phase. Malagoli plotted curves of instantaneous values of current and electromotive force and showed the curves displaced relatively to each other.

In order to examine in more detail the effect of this class of condensers in an alternating-current circuit, the authors made use of an oscillograph of the Duddell type. Pressure and current curves were obtained simultaneously, and by this means the shifting of phase of current over electromotive force could be readily seen. It was also observed that if a sine wave was used, there was no change of wave form, merely the change in phase. A cell consisting of two aluminum plates in a solution of $Al_2K_2SO_4$, gave the best results.

Measurements of capacity have been, for the most part, with currents of less than one ampere, and it seemed advisable to make determinations with large currents. To do this a 4,000-watt transformer was used, the ratio of transformation being 110 to 1.5. In this way the pressure across the electrolytic cell could be kept below the maximum value of the polarization and a large current available.

The electrolytic cell consisted of two sheets of platinum, to which heavy copper leads were attached. These were immersed in sulphuric-acid solution of the desired concentration and were separated usually by only a few sheets of paper. Some 50 amperes were thus obtained without any evolution of gas in the cell.

The method of measuring the capacities was to determine the volts, amperes and watts in the secondary. From these the angle of lead could be calculated, and, hence, the capacity. Instruments for reading volts and watts in the secondary were not available. Accordingly, the watts and volts of the primary side were read. From the ratio of transformation the volts in the secondary could be calculated, and from the transformer losses were determined from each observation, and thus a continual check was kept on the behavior of the transformer. In order to avoid any error due to change of wave form, a dynamo was used, which gave a sine curve, and the observations were made under such conditions. In order to avoid any inductive effects in the secondary, a hot-wire ammeter was used.

In conclusion, it would seem that an electrolytic cell consisting of platinum plates in sulphuric acid behaves in an alternating circuit of electromotive force less than the maximum polarization like a perfect condenser of enormous capacity and a small resistance in series. For the large values of the current strength studied exclusively in this case, the angle of lead is about 45°, and the angle seems to be constant (i. e., independent of variations in current strength, concentration, area of electrodes, distance between electrodes, etc.).

If Warburg's theory may be extended to cover the case of great current strengths, this would mean that the products of electrolysis diffuse with great rapidity away from the electrodes. Since in this case the angle of lead is constant and equal to about 45°, just as much energy is wasted as heat in the cell as is transmitted by condenser-like action. This explains why electrolytic condensers are so inefficient as "phase splitters," especially if used, as is most likely to be the case, in a practical test, on electromotive forces greater than the maximum polarization of the cell used.

1. Abstract of paper read before the physics section of the American Association for the Advancement of Science at Pittsburg, Pa., June 28 to July 3, 1902. The authors are members of the engineering faculty at the University of Wisconsin.

Electrical Equipment of Chicago Tribune Building.

The new Chicago Tribune Building, which has been erected at the corner of Madison and Dearborn Streets, has an electrical and mechanical equipment of the most modern type. All the lighting is done by electricity and all the power, excepting that used for operating the hydraulic elevators, is supplied by electric motors. The Chicago Edison Company provides the current, which is brought into the building through three independent services, so that the probability of total breakdown is very remote. The lighting consists of 4,000 incandescents and 64 arc lights, and the motor equipment aggregates 700 horsepower. Motors are used to drive ventilating fans, stereotype machines, electrotyping machinery, linotypes, saws, etching machinery and the large octuple presses. There will be seven of these presses and each will be driven by a 75-horsepower motor, with two 10-horsepower motors connected for use under light loads or when starting the presses.

Telegraph Messengers' Strike in Chicago.

On July 24th the messengers of the Illinois District Telegraph Company went on a strike for shorter hours and more pay, and materially hindered the company's operations up to July 28th, when an agreement was reached under which the boys returned to work. An eight-hour day and pay at the rate of one dollar a day was asked. The messengers were averaging 11 hours' work a day, and were being paid 1½ cents a message for all messages delivered. Now they will receive 75 cents a day and work 10 hours. The boys of the Postal Telegraph Company walked out during the Illinois company's strike, but were met and satisfied by the company, and were out but one day. Considerable inconvenience was caused by the strike. The company delivered its messages under the greatest difficulties. The Weather Bureau was unable to get its information awaiting delivery at the telegraph company's office, and was compelled to resort to sheer prophecy. All the boys have returned to work and no more trouble is anticipated.

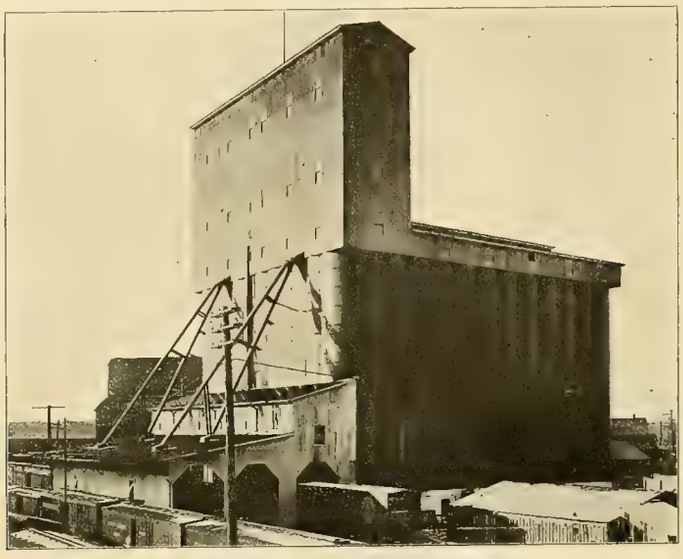


Fig. 2. The Elevator (Steel and Concrete).

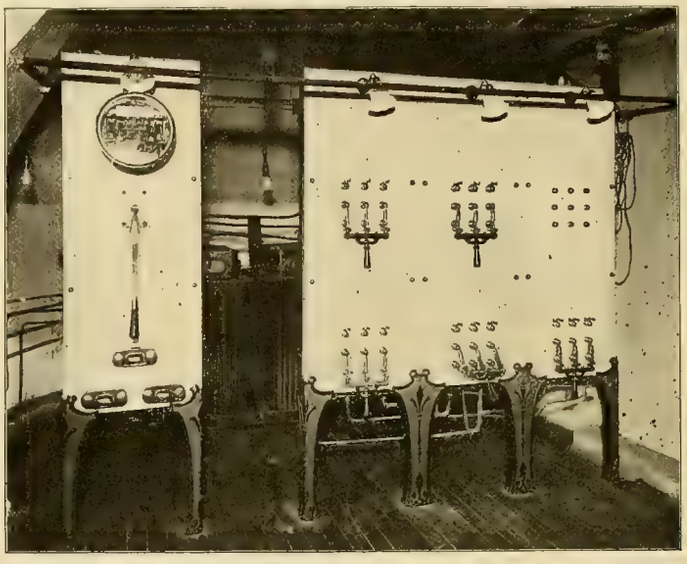


Fig. 3. Switchboards and Transformers.

MOTOR EQUIPMENT OF A NEW BUFFALO GRAIN ELEVATOR. (SEE PAGE 67)

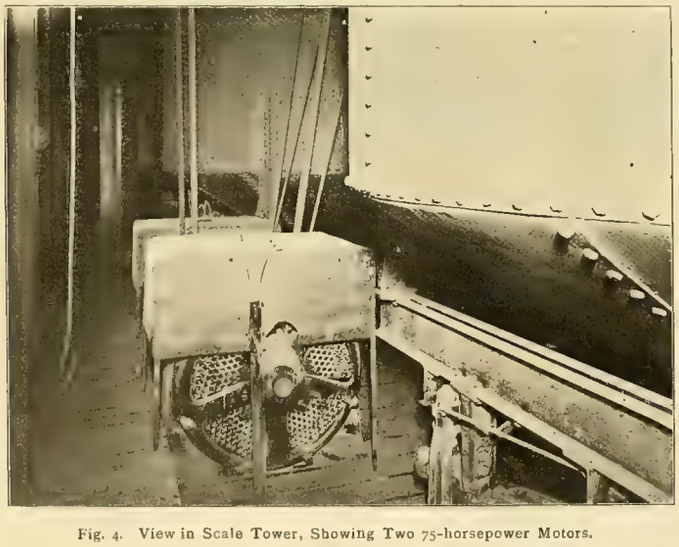


Fig. 4. View in Scale Tower, Showing Two 75-horsepower Motors.

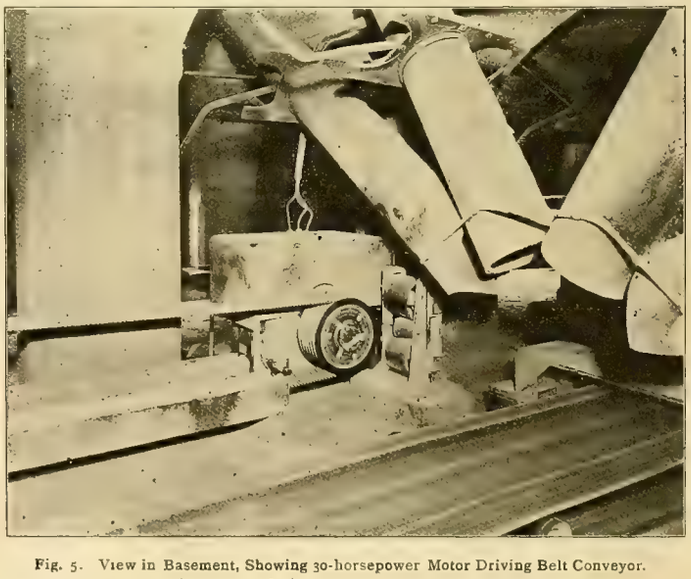


Fig. 5. View in Basement, Showing 30-horsepower Motor Driving Belt Conveyor.

MOTOR EQUIPMENT OF A NEW BUFFALO GRAIN ELEVATOR. (SEE PAGE 67.)

The Cost of Power.

By M. J. Eichhorn.

Part I.

In a recent issue a technical journal, discussing the cost of power, deplores the fact that so few data are published regarding the actual cost in modern central stations, and presents the problem of constructing some kind of a formula that shall give the cost as a function of the station capacity and load factor.

I have been studying this problem for some time and have become more and more convinced that the principal element or factor determining the cost of power is really the load factor of the station. It appears to me that the capacity of the station and the efficiency of the machinery in existing stations are of minor importance in their influence on the final cost, and that the principal advantage obtained by consolidating smaller and inefficient stations into one large station is the opportunity of improving the load factor by various methods which then become feasible, such, for instance, as the use of storage-battery sub-stations.

In the following I shall endeavor to present some arguments and investigations in this line. A well-known fact illustrating this theory is the continual existence of small and inefficient isolated plants in direct competition with the most modern, large and highly efficient central stations. The explanation nearest at hand is that these small stations utilize the exhaust steam for heating purposes, and so are enabled to survive, but when, on closer examination, it is found that perhaps a majority do not utilize their exhaust steam, and further, that the heating season at best is only three or four months in the year, this explanation becomes untenable. The only other possible explanations are that the central-station rates are so high as to permit the isolated plants a margin for existence or that the latter have been established under some local conditions of exceptionally favorable load factor, which latter explanation I regard as the more probable.

Before discussing these matters farther, it will be necessary to give a somewhat closer definition of the word "load factor," as it has been used in the technical press in various senses.

Considering, for instance, a hypothetical daily-load diagram of a station, arranged as usual, with time as abscissa and output in kilowatts as ordinate, I would give the following definition: The load factor of a load diagram is the relation between the actual area enclosed between load curve and base line, and the area corresponding to the load at the point of maximum economy, multiplied by the length of the diagram. If this definition is accepted, it is easily seen that a load factor = 1, can be attained without running throughout the 24 hours if the machinery is run at a capacity above the point of maximum economy during part of the day. I would further give the following definition: The load factor of a station is the quotient obtained when the annual output in kilowatt-hours is the divisor, and the dividend is the total possible output if the plant had been running every day throughout the 24 hours at a capacity corresponding to the point of maximum economy. Used in the former meaning, "load factor" indicates the character of a certain load, and in the latter the result of combining several loads of different character. By distinguishing carefully between these two different meanings of the word, I think it will be possible to avoid confusion.

It is evident that in combining loads of a different character, the load factor of the combined diagram cannot be obtained from the individual load factors. For instance, in combining three different load diagrams, the load factor of which is equal to 0.3, the resultant diagram, in which the ordinates corresponding to the same time of the day are added together, may have a load factor varying between 0.3 and 0.9, depending on what time of the day the maximum occurs in each of the diagrams. This shows that only very insignificant improvement in the load factor can be expected from combination of loads of the same character, such as, for instance, of street-railway loads.

In arranging the following graphical tables I have endeavored as much as possible to make them applicable to widely varying conditions, so that any station manager who has at hand the exact data regarding his own station can see at a glance how the arguments advanced are likely to affect his particular case. I realize that an abstract proposition, in order to carry any weight, must be accompanied by the concrete example, but, as the exact data in nearly all cases are confidential, it is far better if the means are supplied whereby the reasoning can be applied to any special case

In a problem as complicated as this it is, however, next to impossible to cover all cases, and I have limited myself by considering that the present load factor of the special station studied is equal to 0.4. Further, in many of the small stations labor may play a far more important role, and then the formulas would have to be revised in order to apply. I think, however, that the method pointed out will apply to any case.

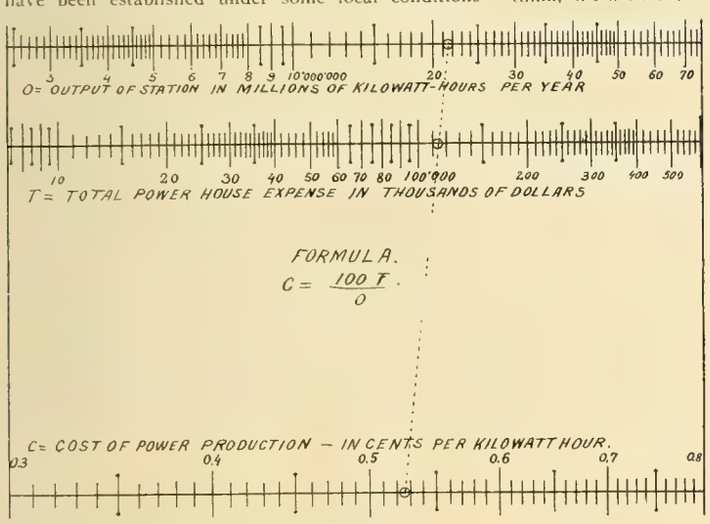


Fig. 1.

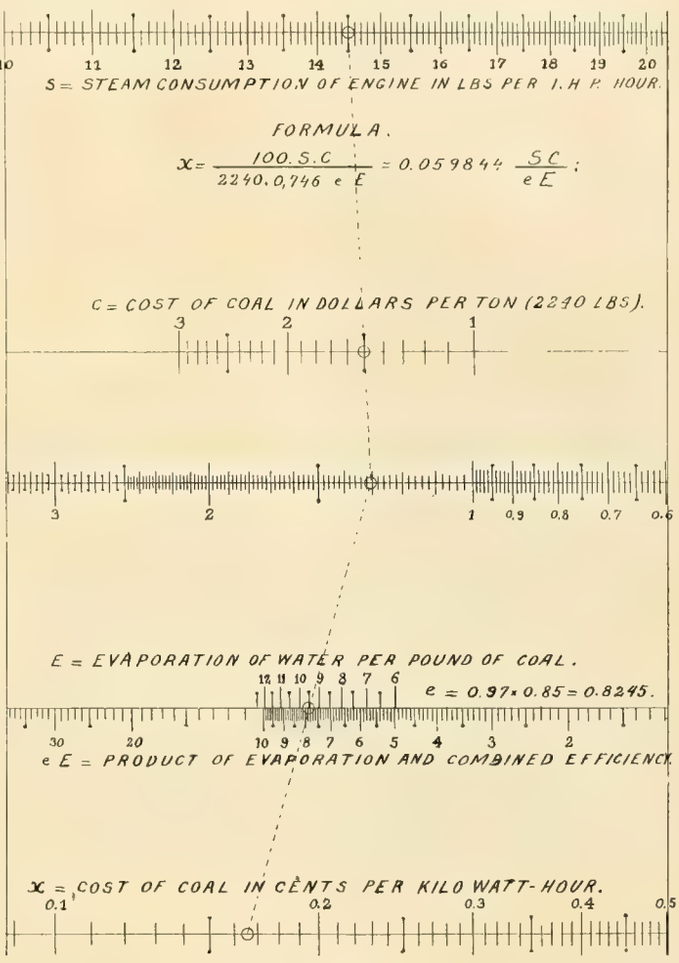


Fig. 2.

THE COST OF POWER.

In order to facilitate rapid comparison of costs, I have constructed the graphical table (Fig. 1), which shows at a glance the relation between total output, total expense and cost per kilowatt-hour. As indicated in the figure, it is used by passing a straight line across the diagram and reading the corresponding values at the points of intersection, according to the D'Ocagne system of numbered points. The dotted line across the diagram shows the solution of a particular example, where the output is 21,700,000 kilowatt-hours per year and the total power-house expense equal to $114,000. The power-house expense per unit is then found to be 0.525 cent per kilowatt-hour.

Fig. 2 shows in a similar manner the relation between the cost of coal per kilowatt-hour and the various factors which influence the same, based, of course, on a load factor = 1, thus showing the attainable minimum. The formula represented by this abacus is derived as follows:

Let S = Steam consumption of engine in pounds per indicated horsepower-hour.

C = Cost of coal in dollars per ton of 2,240 pounds.

E = Number of pounds of water evaporated per pound of coal.

e = Combined efficiency of engine and generator, assumed to be 0.97 × 0.85 = 0.8245.

X = Cost of coal in cents per kilowatt-hour.

Evidently, $\frac{S}{0.746\ e}$ is equal to the steam consumption per kilowatt-hour. Now, if one pound of coal evaporates E pounds of water, then $\frac{S}{0.746\ eE}$ is the number of pounds of coal per kilowatt-hour. Multiplying this with the cost, or $\frac{100\ C}{2240}$ of one pound of coal in cents, gives the complete formula:

$$X = \frac{100\ S\ C}{2240 \cdot 0.746\ e\ E} = 0.059844\ \frac{S\ C}{e\ E}$$

This formula is rapidly solved for all values of the variables, which are apt to occur in large modern central stations, by using the diagram (Fig. 2). It is only necessary to draw a straight line connecting two of the variables and, as it were, deflect it at the point where it meets the middle scale, as indicated by the dotted lines on the diagram. If, for instance, the following data are given: Steam consumption of engine = 14.5 pounds per indicated horsepower-hour, cost of coal = $1.50 per long ton, evaporation = 9.5 pounds of water per pound of coal, and the combined efficiency of engine and generator is assumed to be = 82.45 per cent., then the cost of coal in cents per kilowatt-hour is found to be 0.166. This exceedingly low value could certainly be obtained without difficulty in any modern station, if the load factor could be made equal to unity.

The cost of coal is the principal element of what may be considered as the power-house expense proper, or the direct expenditure on account of running the power house, as distinguished from the total cost of production, which also includes interest on investment, depreciation, taxes and insurance. In a well-designed plant the coal consumption per kilowatt-hour decreases only slightly when the load increases, and consequently the importance of the item of coal increases with the load on the station. The price of coal will naturally always be the dominating influence in the final cost, and it will become more and more important as better load factors are obtained.

The two principal questions which are to be answered in this connection can be formulated as follows:

1. A station being given where the output or load factor and total cost or cost per kilowatt-hour are known, how will these costs be affected when the load factor varies, and particularly when it approaches the value of unity?

2. If the load factor can be increased, by increasing the load and consolidating loads of different character or from outlying districts, how much money can be economically expended in order to

obtain the expected increase in the load factor? Will it pay to abandon all present stations and put up a new one for the total output?

The latter question is, indeed, of momentous importance at the present time, and, to judge from the tendency of the times in the matter of consolidations, one might be tempted to answer offhand that an unlimited amount of money may be expended, if this object can be attained.

In order to arrive at a mathematical solution of the second problem, however, it will be necessary to solve the first problem, and here a difficulty is encountered; it is to find what part of the total expense is affected by a variation in the load factor. In the absence of experimental data, it will be necessary to make several assumptions, more or less justified, and in the final result it will be necessary to make considerable allowance for local conditions. The basis for the assumptions which I will have to make is founded on the actual conditions in several

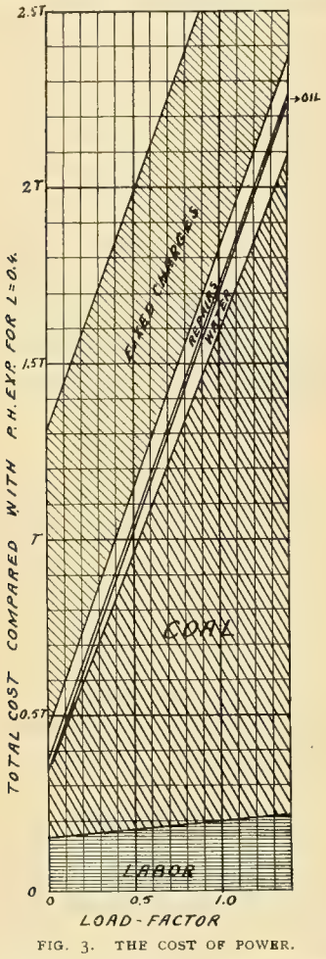


FIG. 3. THE COST OF POWER.

of the larger central stations in Chicago, with which I am somewhat familiar.

It will be necessary to state here that the only costs considered in the present article are costs of production of electric power at the switchboard. The costs of distribution are perhaps greater, but are also more dependent on local conditions, distance of transmission, etc. In considering the former, it is customary to subdivide them into operating expenses and fixed charges. The operating expenses are best considered under the following subdivisions, for which the relative proportions are given for an actual station with a load factor of about 0.4.

Labor	17 per cent.
Coal	68 per cent.
Water	4 per cent.
Oil	2 per cent.
Repairs, supplies, etc	9 per cent.
Total	100 per cent.

If now T designates the total power-house expense and L the variable load factor, each item may be, somewhat arbitrarily, divided into a portion that is independent of the load factor and another that is directly proportional to the same, and there is, of course, room for considerable difference of opinion in carrying out such a division. The item of labor is almost independent of the load factor; the item of coal is, on the other hand, nearly proportional to the same. The item of water may be considered directly proportional to the load, whereas the items of oil and of repairs, etc., are practically constant under varying loads. Expressing these relations in algebraical formulas: Labor $= 0.15T +$ $\frac{0.02\ T\ L}{0.4}$; Coal $= 0.20\ T + \frac{0.48\ T\ L}{0.4}$; Water $= \frac{0.04\ T\ L}{0.4}$; Oil $= 0.02\ T$; Repairs $= 0.09\ T$.

Adding these together, the expression for the total power-house expense, designated by X, corresponding to a variable load factor L, becomes:

$$X = 0.46\,T + \frac{0.54\ T\ L}{0.4} = 0.46T\ (1 + 2.602L).$$

In using this formula it must be kept in mind that the total power-house expense, T, corresponds to an actual present load factor of 0.4, and that otherwise the corresponding value must be substituted in the formula; and, further, that the cost at no load, or 49 per cent. of T, must be considered as the expense necessary to keep the station in readiness to take the maximum load at any moment, with every furnace in condition and every man at his post. An approach to such a condition can be observed in many street-railway plants just before the closing of offices and stores downtown, when the load curve begins to climb up the peak.

Fig. 3 will serve to illustrate the meaning of the algebraical formulas. The ordinates represent the total cost of power as compared with the total power-house expense when load factor equals 0.4, and the abscissæ the various load factors. The fixed charges are assumed to be 84.7 per cent. of T. From this diagram it can be seen that if the total cost for load factor 0.4, is 1.847T, it will be $= 2.117\ T$ for a load factor $=0.6$; or $= 2.387\ T$ for a load factor $= 0.8$, and so forth. This will hold good only for one and the same station if the load factor increases without additional investment. Otherwise the fixed charges will, of course, not remain constant. As the coal consumption in a well-designed plant increases almost proportionally to the output, the item "coal" becomes the most important with an increasing load factor.

[To be continued.]

Advantages of Association for Small Electric-light Companies.

The National Electric Light Association is making famous progress in recruiting its membership from the central-station companies in the smaller cities. In its propaganda it uses a letter addressed to it by Charles E. Scott of the Bristol (Pa.) Electric Light and Power Company. Among other things, Mr. Scott says: "I think the association is really of more use to such a plant as ours than to the big fellows. The rubbing together; the comparing of notes; the broader, better views obtained—all tend to the improvement of the small company, and make life easier for the official who is fortunate enough to meet men who know vastly more than he does, and who—in my experience—are as ready to impart information as to ask for it. We get along by declaring an eight per cent. dividend and laying by about two per cent, per annum besides; but if we had remained shut up in our shell at Bristol, I doubt if we could have made half of it."

During two weeks in July new company members were enrolled from Adrian, Mich.; Corsicana, Texas; Corunna, Mich.; Fond Du Lac, Wis.; Franklin, Pa.; Joplin, Mo.; Kokomo, Ind.; Madisonville, Ky.; Oconto, Wis.; Ottumwa, Iowa; Provo, Utah, and Southbridge, Mass.

The tracks of the Suburban Railroad Company located in the city of Chicago, on Fortieth Avenue, were recently torn up by the citizens as a result of legal proceedings which disfranchised the company. The franchise was revoked on account of insufficient service. It is said that only one car had been run over the company's tracks in the city for some time past, and the court held that such service was insufficient to retain the company's right-of-way.

A Remarkable Lightning Flash.[1]

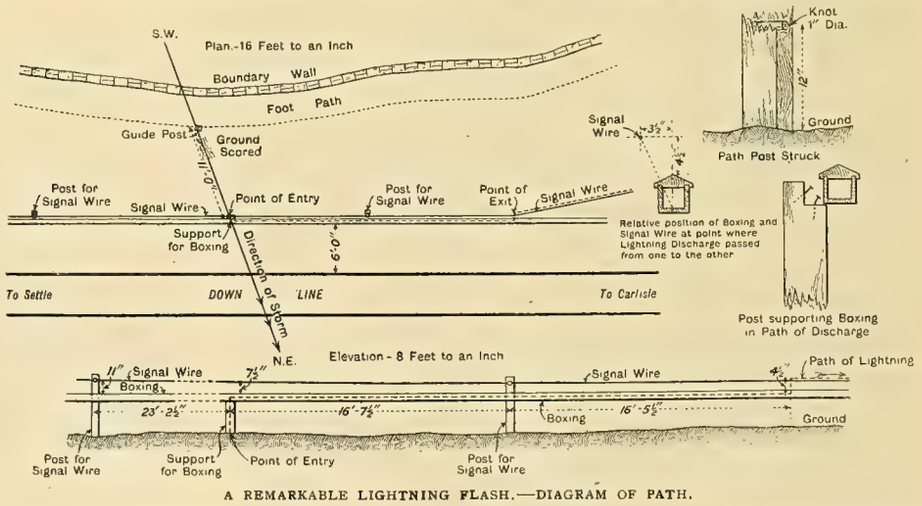
By W. Langdon.

On April 23d a thunderstorm occurred in the neighborhood of Blea Moor, a desolate point [in the North of England] on the Settle and Carlisle line. At this point a number of guttapercha insulated telegraph wires, together with a "quad" paper lead-sheathed cable, traverse some wooden boxing mounted on short wooden (creosoted) pillars about 12 inches above the ballast. This boxing is six feet from the nearest railway metal and nearly 11 feet distant from a guide post which marks the route of a footpath. Near to the boxing is a signal wire—a wire employed mechanically to operate a distant signal. This wire runs nearly parallel with the boxing and at a distance varying from 7½ to 4½ inches.

It would appear that the lightning struck the guide post indicated in the accompanying plan, and which, it is worthy of notice, is the nearest to the boxing of several guide posts. About a foot from the ground line of this post is a hard knot which passes clean through the post, and is about an inch in diameter. The post would appear to have been struck on the top and shivered into fragments—one portion being hurled some 40 or 50 yards in the direction of the boxing, and another portion a similar distance in the opposite direction. The destruction of the guide post did not pass beyond the position of the knot in the post. Apparently, the discharge then passed to the ground, the surface of which for a distance of 10 feet is scored, showing the route it followed to reach the nearest support of the boxing. This support it traversed, rending it, and entering the boxing by the nail which fastened it to the support, displacing the boxing from its bearing. The sides and top of the boxing were split open for a distance of 33 feet as though by internal force. At the extremity of the 33 feet, the point at which the distance between the boxing and the signal wire is least—viz., 4½ inches—it would appear that the discharge left the boxing and passed into the signal wire, which shows signs of fusion at that point. The signal wire, hence in its course, passes under railway metals, with which it is in metallic contact, affording a fairly good earth.

A careful examination of the guttapercha insulated wires and of the lead-sheathed quad cable, as well as the felt placed over the wires to protect them from excessive heat from the sun, displays the following conditions: The felt was blackened for about 14 inches at either end of the route of the discharge. The lead-sheathed cable showed plainly the course of the current, althought careful examination did not indicate that it had been pierced at any one point, nor have the wires which are enclosed in the lead sheath in any way suffered in insulation or otherwise. The impression which the lead sheath offers is that of a hot soldering iron having been applied to it for a distance of about 1½ inches at the end nearest to the post which first received the charge.

Only one of the guttapercha wires presented the appearance of damage—a piece of the tape and



A REMARKABLE LIGHTNING FLASH.—DIAGRAM OF PATH.

percha appeared to be gouged out, but the conductor was not observable, nor has this wire failed in insulation.

All the wires traversing the boxing in question were connected with plate lightning protectors insulated by mica at each end of the covered work. Five of the lightning protectors were put to earth; three of these were wires enclosed in the lead-covered sheathing of the cable. The lightning protectors were badly blistered—globules of metal between the plates being almost the size of a pea. It is probable that the damage to the lightning protectors was due to discharges passing along the open wires, and has no connection with the case related above in which it is clear that the lightning discharge entered the boxing at one point and left it at another near by, which afforded a connection with "earth."

1. From the London Electrician.

Pike's Peak Power Company's Transmission System.

A hydro-electric power development and transmission enterprise of more than ordinary interest is being carried out in the vicinity of Cripple Creek, Colo., by the Pike's Peak Power Company.. This corporation, which is controlled by the Woods Investment Company of Colorado Springs and Victor, Colo., owns land on 12 miles of Beaver Creek and its two tributaries, West and East Beaver Creeks, in Teller and Fremont Counties. These streams are noted for excessive difference in elevation in short distances, and produce sufficient water to make of them valuable waterpower properties.

One of the power stations planned by the company is located on West Beaver, in Fremont County, 2½ miles up the stream from the junction of East and West Beaver, and is known as Station A. The dam and reservoir are 5½ miles east of Victor. Here is located what is said to be the largest steel-faced, granite backfilled dam on record to date. The structure is 405 feet in length along the cap, 220 feet in length of base, 148 feet in cross-section at base and 20 feet in cross-section at cap. To obtain the amount of rock and material necessary to construct this dam, the top of Vesuvius Butte was blown off by an immense dynamite explosion in December, 1899. An illustrated description of this interesting operation, by means of which 110,000 cubic yards of rock was obtained, was given in the Western Electrician of February 24, 1900. The reservoir formed above the dam has a surface area of 130 acres and holds 102,000,000 cubic feet of water.

Water is taken from this dam through a wood stave pipe, 23,200 feet long and 30 inches in inside diameter. The pipe is constructed of 1½-inch redwood stave, banded with one-half-inch steel bands and cast-iron lugs. The pipe line extends over fearfully rough country, about half of the grade being through original granite formation; many curves are on less than 100 feet radius, and there is one compound curve of 35 feet. A typical view of the line is shown in Fig. 1. The wood pipe passes through the Skaguay tunnel, which is 1,535 feet in length, located 21,000 feet from the dam.

From a point 200 feet below the Skaguay tunnel, where the static pressure reaches 220 feet, the line consists of steel pipe 29 inches in diameter in various thicknesses of plates, ranging from one-fourth to three-fourths inch, as required to meet the internal pressure with an ample factor of safety. The total length of steel pipe, including the receiver, is 2,900 feet, and it is on an incline averaging 38 per cent. It passes over grades constructed through a tougher granite formation in respect to roughness than ever was encountered in railroad construction in Colorado. At one point it passes through an inclined tunnel 335 feet in length, just above which is a bridge 70 feet in height, both being on 40 per cent. gradient, and at various points there are extremely deep open cuts. From the south end of the Skaguay tunnel the pipe line is entrenched in the grade on which is constructed a three-foot railway leading from the Skaguay tunnel to the power house, its grade being 1,163 feet vertical in 3,100 feet horizontal. This road is the only means of access to the power house. The cars are operated by a double-hoisting engine.

The upper terminus of the railroad lies under a vertical ledge 70 feet in height, and all machinery, apparatus and materials of all kinds, were lowered by boom and derrick, taking loads from the wagons at the upper landing and lowering them 70 feet over the ledge to the cars. The loaded cars were lowered by means of the friction brake on a hoist, which was equipped with a three-fourths-inch steel cable; 1,400 tons of building materials passed down this peculiar railroad.

The power house is 38 by 98 feet in size, with two side wings of 16 by 48 feet each, and is located (Fig. 2) on the summit of a granite projection surfaced off true to grade. The building is constructed of brick, with a corrugated-steel arch roof, covered with concrete, tar and gravel; it has a concrete floor and is absolutely fireproof. It is provided with a 10-ton traveling crane.

The hydraulic apparatus was manufactured by the Pelton Water Wheel Company of San Francisco. Each unit consists of two steel disk wheels 66 inches in diameter keyed to the same shaft and working in the same wheel house. The connection of the waterwheel and generator shafts is effected by the hub of a 7,000-pound steel cast balance wheel, banded with a rolled-steel tire band four inches in thickness. The wheel is seven feet in diameter. The nozzles used to develop the required power under the 1,160 feet of effective head obtained at the station require to have a diameter of only one inch to furnish 236 horsepower, including losses. Deflecting nozzles are used and the regulation is of the Armstrong type.

The electrical generators now in operation at Station A are four 400-kilowatt General Electric machines, with rotating fields. They deliver a three-phase, 30-cycle current at 600 volts on 450 revolutions a minute. Two four-pole, 30-kilowatt exciters furnish current at 70 volts, each giving sufficient exciting current for all four generators when working at full load. The waterwheels have an efficiency of 83 per cent. and the generators of 94 per cent

The switchboard apparatus is especially liberal in design, and comprises one exciter panel, four generator panels, two distributing panels, two high-tension panels and one paralleling or synchronizing panel. The panels are made of Vermont marble and have a full complement of indicating and recording instruments, switches and regulating apparatus. The transformers are six 250-kilowatt, air-blast of the General Electric make, having 600 volts on the primaries and 12,600 on the secondaries.

Since the early operation of this station, it was found necessary to install some thorough system for combined arc and incandescent lighting, which has been fully accomplished by the introducton of two 200-kilowatt, compensated, three-phase generators, 60 cycles, with their full equipment. These generators have 12 poles and operate at 600 revolutions a minute. Each generator contains its own independent 12-pole exciter, built directly on the revolving-field shaft. These machines are also directly connected to impulse-type waterwheels.

The line transmission from Station A to the center of distribution at the Gold Coin Mine at Victor includes a distance of eight miles by pole line. The circuits consist of three No. 4 B. & S. power wires, and the lighting circuits of three No. 6 B. & S. wires, which are ample to deliver 1,600 kilowatts at less than a five per cent. energy loss These lines are transposed at intervals of one-half mile along the line. The poles also carry for telephone purposes two No. 10 galvanized-iron weatherproof wires, transposed each 120 feet. Porcelain insulators, 5½ inches in diameter are used. The line voltage is 12,600, both on 30 and 60-cycle lines.

The sub-station adjoins the Gold Coin ore house in Victor and contains nine 50-kilowatt oil transformers, changing the current to 115 and 460 volts secondary for lighting and power distribution. A set of three 50-kilowatt oil transformers with 350-volt secondaries, operates a 120-kilowatt rotary converter, furnishing current for a locomotive in the United Mines transportation tunnel for ore hauling, and also for Bull Hill tunnel haulage. High-pressure distributing lines leave the sub-station in various directions and are carried to different mines in the vicinity for power and lights and to the towns of Cameron, Gillett, Goldfield, Anaconda and Elkton for lighting purposes.

It is planned to construct a second station, known as Station B, at a point 200 feet above the forks of the East and West Beaver Creeks. The hydraulic pressure at this station will be 1,257 feet, or 544 pounds per square inch, and a total of 5,500 horsepower will be capable of development. R. M. Jones, engineer and general superintendent of the Pike's Peak Power Company, describes the present equipment of the company in a recent issue of the Engineering Record. He says it is the purpose of the company to construct an independent transmission line from Station B to Station A and possibly an independent line to the distributing stations in Victor, including the connections through Station A, thus permitting the use of the entire energy of both stations to work in parallel over either station's lines or to work each station independently, as desired. It is also proposed that transmission lines will be extended from these stations to other localities within reach. Thus, with two complete pipe lines, pole lines and generating-station systems, the most unquestioned reliability may be counted upon. It is also the intention of the company to install a third station on the combined Beaver streams at a point near the mouth of the canyon and approximately two miles below Station B, to be known as Station C. Here the difference in elevation is but 373 feet, but as the volume of water will probably reach 50 second feet, this would develop 2,100 horsepower, less losses. The company owns also an excellent reservoir site on East Beaver at 1,700 feet elevation above Station B and but 2½ miles distant, which reservoir may be developed to excellent advantage in the near future.

Fig. 1. Wood Stave Pipe Line.

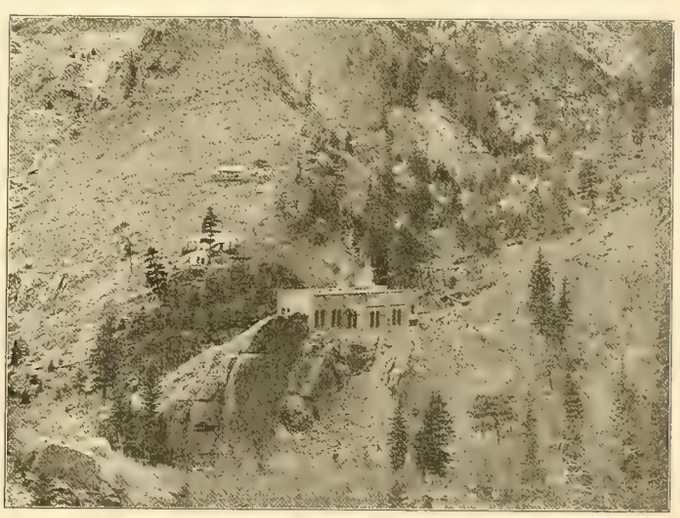


Fig. 2. Power House and Surroundings.

PIKE'S PEAK POWER COMPANY'S TRANSMISSION SYSTEM.

In Memory of John W. Mackay.

Memorial resolutions having for their subject the death of John W. Mackay were adopted by the Commercial Cable Company, the Postal Telegraph-cable Company and the Pacific Commercial Cable Company, of all of which the deceased was president. Those of the Commercial Cable Company, adopted July 25th, read as follows:

It is our sad duty to record in the minutes of this board of directors the death of our beloved president, John W. Mackay, which occurred at his home in London, on Sunday, July 20, 1902, after an illness of five days. In making this record this board desires to record also its high appreciation of the surpassing merit of Mr. Mackay as a man, a citizen and a friend, as well as in his capacity as chief officer of this company. We recognize that the existence of this company is due to his foresight, his courage, his ability and his generosity. We believe that no other man would or could have created a telegraph system of such wide extent and such merit, under the great oceans and throughout our vase continent, in the midst of such difficulties and discouragements as have surrounded these enterprises almost from their inception. We feel the loss of his command, his counsel and his friendly and encouraging presence as a personal affliction to each one of us, and we know that this feeling exists among all officers and employes throughout the service.

Resolved, That this expression of our appreciation, admiration and affection for our honored president be transmitted to his family, with the assurance of our highest esteem and tenderest sympathy.

Clarence H. Mackay, son of John W. Mackay, was a passenger on board the ocean liner Campania en route to England at the time of his father's death and received the news in mid-Atlantic by means of a wireless message sent from the westbound steamer Saxonia, which the Campania passed at sea.

A memorial service for the late John W. Mackay was held July 29th at St. Mary's Church, Cadogan Place, London. Mr. Mackay's body will not be taken to America until late in September, as Mrs. Mackay's health will not permit of an earlier departure.

George G. Ward, the vice-president and general manager of the Commercial Cable Company, was asked in London what effect the death of John W. Mackay would have on the business of the company. He answered: "I do not know who will succeed Mr. Mackay as president. That is entirely in the hands of the board of directors. You can say, however, that there will be no change of policy. The progress of the company, and particularly Mr. Mackay's plans, will be faithfully carried out. The contracts for the Pacific cable have been let and the enterprise will proceed precisely as though Mr. Mackay's death had not occurred."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Motor Equipment of a New Buffalo Grain Elevator. Illustrated	67, 68
Marconi Towers Completed at Cape Breton	67
Effect of Electrolytic Condensers in Alternating-current Circuits. By A. Trowbridge and E. R. Wolcott. (American Association for the Advancement of Science.)	68
Electrical Equipment of Chicago Tribune Building	68
Telegraph Messengers' Strike in Chicago	68
The Cost of Power. By M. J. Eichhorn. Illustrated. Part I.	69, 70
Advantages of Association for Small Electric-light Companies	70
A Remarkable Lightning Flash. By W. Langdon. Illustrated.	70
Pike's Peak Power Company's Transmission System. Illustrated	71
In Memory of John W. Mackay	71
Editorial	72
Waterpower Possibilities in Arizona	73
Boise-Payette Power Plant	73
Marconi and Solari	73
Book Table	73
Parr's "Electrical Engineering Testing"	73
Bell's "Electric Power Transmission"	73
Canadian Connection with Pacific Cable	73
Rules for Motormen and Conductors	74
Possible Combinations of Electrical Manufacturing Companies	74
New York Traction Systems Inspected by Chicago Aldermen	74
Large Electric Jib Crane	74
Steam-turbine Plant for Montreal	74
Mr. Warren's Wemco Wins Interlake Regatta. Illustrated	75
The Drainage-canal Power Situation	75
Electric Goad for Cattle	75
Production of Zinc	75
Development of the Telephone Field	76, 77
Rival State Associations Formed at Rochester	76
Michigan Telephone Company's Affairs	76
Telephone Profits in Indiana	76
Illinois Central Telephone Line Completed to New Orleans	76
A New Selective Party-line System	76
Ohio Telephone Notes	76
Telephone News from the Northwest	76
Southern Telephone Developments	76, 77
Indiana Telephone Items	77
New Companies	77
Telephone Men	77
A Woman Telephone Operator in Texas	77
The Church Telephone Situation at Washington, Ind	77
General Telephone News	77
Manufacturers and Dealers	77
Success in Long-distance Power Transmission. By F. A. C. Perrine, D. Sc	78, 79
Johnny's Poem on the Lightning	79
Steel Smelting by Electricity	79
Power Transmission in the Hudson River Valley	79
Arbitration for Street-railway Wage Question	79
Glass Factory to be Electrically Equipped	79

DEPARTMENTS.

Correspondence	80, 81
New York Notes	80
New England News	80
Canadian Intelligence	80
Southern Developments	80
From the Buckeye State	80, 81
Information from Indiana	81
Northwestern Notations	81
Among the Rockies	81
On the Pacific Slope	81
Personal	81, 82
Electric Lighting	82
Electric Railways	82
Power Transmission	82
Publications	82
Electrical Securities	82
Telegraph	82
Space Telegraphy	82
Miscellaneous	83
Trade News	83
Business	83
Illustrated Electrical Patent Record	83, 84

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

We begin in this issue an article on that very important subject, "The Cost of Power." It is written by Mr. M. J. Eichhorn of Chicago and will be concluded next week. Mr. Eichhorn has given careful study to this vital problem, and his mathematical exposition of it is interesting and instructive. The author's views do not in all cases agree with those of many central-station managers, particularly in relation to methods of charging, but we are sure that an attentive perusal of his contribution will be of value to all interested in the subject.

THE account of the rival telephone conventions in Rochester last week, as given on another page of this issue of the Western Electrician, shows that the western Independents have no monopoly of the irrepressible enthusiasm which has been injected into the telephone business of late years. Independence is in the very air in Rochester (for was it not in the Flower City that occurred the famous "strike" of telephone subscribers in 1886, before the opposition movement was dreamed of?), and it appears that, for the time being, one group of the Independents is quite independent of the other faction. The looks askance grew out of the possibilities of toll-line patronage, and there is little doubt that the difficulties will soon be smoothed out and that the newborn New York State Independent Telephone Association will not long persist in being twins.

TRAIN LIGHTING by electricity is quite general on the continent of Europe, but in considering the various methods in use there it will be noted that storage batteries are relied upon almost exclusively, to the exclusion of the various dynamo systems that have some vogue in this country. This is doubtless due to the fact that train runs are generally shorter in European countries than in the United States, and consequently the practical difficulties in the way of charging or replacing batteries are not so great. In some of the European systems one or two batteries suffice for a whole train; in others each car is supplied with its own battery, and is independent of a train line. Five, six, eight, 10 and 12-candlepower lamps are used, operated on circuits of varying voltages. In Switzerland as low as 17 volts is used, which, as may be imagined, makes the construction of the lamps somewhat difficult. In general, as one gathers from a recent paper on the subject read before the Société Internationale des Electriciens by Charles Jacquin, electricity is considered to be well adapted to train lighting and is used to a rather surprising extent.

Now that the government's fiscal year is ended (June 30th), the decrease in exports from and the increase of imports into the United States for that period are strikingly apparent. In round figures, the drop in the one and gain in the other are $105,000,000 and $79,000,000, respectively. The decrease in exports is caused largely by the failure of the corn crop of 1901, but there was also a decrease of about $20,000,000 in manufactures of iron and steel, and this is of more immediate interest to electrical men, especially as electrical machinery is included under this general head. In considering this item, Mr. O. P. Austin, the chief of the Bureau of Statistics of the Treasury Department, has a ready explanation for the falling off. "This reduction is due in part, it is believed," he says, "to the fact that German manufacturers found it necessary, by reason of the depressed conditions in that country last year, to unload their surplus stocks of iron and steel manufactures at greatly reduced prices, thus temporarily unsettling and reducing prices in foreign countries generally, while, on the other hand, the home demand in the United States for iron and steel manufactures has been larger than ever before, and in many cases beyond the capacity of our manufacturers to supply." So far as the electrical trade is concerned, the contrasted state of affairs in Germany and the United States is correctly stated, although electrical exports have suffered less than those of any other class of machinery.

So far as the increased imports are concerned, Mr. Austin points out that they are mostly raw materials for manufactures and therefore indicative of a healthy growth in the country's commerce. Manufacturers' materials imported during the year will amount to about $420,000,000 in value, or 46 per cent. of the total importations. This is not only the largest importation of manufacturers' materials ever known, but such materials form a larger percentage than ever before of the grand total of imports, notwithstanding the fact that the total imports are the largest in the history of our commerce.

MARCONI'S title to premier honors in space telegraphy is not disturbed by recent revelations. When Maxwell, Hertz, Branly, Lodge, Preece, Popoff, Slaby, Solari and the others are given all possible credit for their work, incidental and otherwise, that assisted in attaining the result, the fact still remains that Marconi brought space telegraphy to pass. Marconi may not even be a great inventor, although the point is not conceded; he is certainly not a great physicist, like Maxwell or Hertz; but he did realize a great possibility and he does possess the ability and other qualities, including a dogged perseverance amid disheartening delays and setbacks, that has enabled him to hammer away at the germ of a great invention until he was able to show the world a practical accomplishment. Did any one anticipate Marconi in doing that? No; Marconi set the pace, and he has had a host of imitators. Of course, space telegraphy, as it exists to-day, is a development, just as the ordinary electric telegraph and the telephone were developments. But unless we are greatly mistaken the name of Marconi will be as closely linked with the later telegraphy as that of Morse with the earlier one, and probably more intimately than that of Bell with the telephone.

DRAINAGE-CANAL power possibilities appear at last to have interested private capital, and this fact has spurred the authorities to action. These authorities constitute the Sanitary District of Chicago, which is the official name of the incorporate body that, representing the people of the territory benefited, built the canal and now controls its operation. It has been suggested that the power be developed and electrically transmitted to Chicago to be utilized in the waterworks pumping stations and for electric street lighting. There are legal difficulties that prevent the city of Chicago from raising the money to do the work, and the Sanitary District, also, is either unwilling or unable to deliver the power in Chicago. In this situation a group of private capitalists took steps, by buying land and in other ways, to utilize the power due to the Drainage Canal, but at a site on the Desplaines River, beyond the District's jurisdiction. Taking alarm, the District commissioners began the erection of a dam in the deepened channel of the Desplaines River that would greatly hamper the utilization of the power at the more distant site of the private individuals and at the same time render it possible to erect a generating plant at some future time. This brought the private capitalists into court, where they secured an order restraining the District from prosecuting work on the dam until the question could be argued on its merits. This is the present aspect of a complicated situation. The Sanitary District does not appear in a very favorable light, for, although the value of the power rights was repeatedly pointed out by City Electrician Ellicott and others, it was not until private capital, lured by the quiescence of the commissioners, undertook the work, that the District tardily awoke to its responsibilities to the public. It is to be hoped, however, now that the project has reached a stage where something has been actually done, that this important engineering improvement will be carried out by one or the other of the parties to the contention.

Waterpower Possibilities in Arizona.

Arizona has several important waterpower projects under consideration or construction. This may seem strange, owing to the fact that it is the dryest state or territory in the Union. The droughty condition of the southeastern portion of the territory serves as a great barrier to the development of water storage and development of waterpowers. In the Salt River Valley the towns of Phœnix, Tempe and Mesa are lighted with electricity, generated by small falls in the valley canal systems. Fifty miles southeast of Prescott, on Fossil Creek, work has been begun on Mrs. Tutt's project, recently mentioned in the Western Electrician. A great power project is in incubation, based upon the damming of Bill Williams Fork, in extreme western Arizona. The new dam that is to store flood waters from the use of the Salt River Valley is to be built largely with the aid of waterpower, and the reservoir may supply as much as 3,000 horsepower for Globe and other central Arizona mining camps. This plant is building by C. M. Clark.

The Grand Canyon of the Colorado River in Arizona affords a great opportunity for the generation of electricity by waterpower. Below the new Santa Fe Hotel on the canyon brink, are Indian Garden Springs, which, in ordinary seasons, have a flow of nearly 100 inches. The water from these springs might be diverted over a cliff 3,000 feet high. In Cataract Canyon the flow, usually approximating 10,000 inches, makes three leaps of 70, 144 and 250 feet, respectively, without reference to several thousand feet of drop from the Indian villages to the Colorado's channel. Many plans have been mooted for developing the marvelous power of the Colorado, a stream which rises as much as 100 feet in flood time within the canyon. Floats, equipped with great paddlewheels, have been suggested, but it is probable that the river will some day be "harnessed" by means of tunnels that will "pick up" the fall of the stream. One such tunnel at a point near Bass' trail, and not over half a mile in length, driven through block granite, would cut off 12 miles of river channel, averaging 12 feet of fall to the mile.

Dr. A. J. Chandler of Mesa, Ariz., is engineering the latest Grand Canyon power plant. He is also the manager of the southwestern interests of Bowen & Ferry, the Detroit capitalists, and has made a success of a power-generating plant near Mesa. He has found an ideal location for power-generating works on the Kanab (Wash.) River, not far from its union with the Colorado, about 70 miles north of Williams. It is believed that even 5,000 feet of fall can be found in a distance of a little over a mile. The water supply is said to be ample and of remarkable regularity of flow. The only question seems to be that involving the carriage of the necessary heavy machinery down into the canyon and across the river, unless it be hauled southward from some Utah railroad point and lowered over the awful cliffs.

Boise-Payette Power Plant.

Work on the Boise (Idaho)-Payette power plant is progressing rapidly, and it is hoped to have it completed by October 1st. The solid concrete walls of the building where the waters of the Payette will turn waterwheels are completed to the first story. The canal, which is 34 feet wide at the bottom and carries water six feet in depth, is 3½ miles long. Five concrete conduits run under the canal at different places to carry off the storm water, which is not allowed to enter the canal. The pole line, which enters the city of Boise by way of Fourteenth Street, is being pushed rapidly toward completion. The line, it is claimed, will be completed the entire distance to the power house, 21 miles, with a two-mile branch to Pearl, by August 15th.

The company has secured a lot in Boise on Fourteenth Street, between Grove and Main, where work will be begun shortly on a brick fireproof building 25 by 50 feet in dimensions. Here the step-down transformers will be located. The current which enters the building direct from the power plant, will have a voltage of 20,000. It will be reduced to 2,000 volts.

The waterwheels are of the horizontal Leffel pattern and will be connected direct with the two generators. The three-phase generators are of 1,500 kilowatts' capacity—each made by the Westinghouse company. Room for a third unit has been provided.

Aluminum is used for the transmission wires. Each conductor is made of seven strands of the metal, twisted and held firm by small bands, also of aluminum. Joints are made by tightly pressing sleeves of aluminum over the lapping ends of wire. Some time ago the company purchased 25 tons of copper wire, but this was sold recently at a neat profit. The three wires are placed to form an equilateral triangle.

Marconi and Solari.

Last week's Saturday Review of London says that a startling denouement followed Professor Silvanus Thompson's attacks on the validity of the Marconi patents, in which the professor said that an Italian naval officer named Solari was the real inventor of the wireless-telegraph system. It continues: "The Official Journal of the Patent Office of July 16th contains a brief notice of a very unusual character. It announces that Guglielmo Marconi, who, September 10, 1901, had filed a patent in his own name for this invention, now seeks leave to amend the application by converting it into an application for a patent for an invention communicated to him from abroad by the Marquis Luigi Solari of Italy."

In view of this rather unexpected development, the Western Electrician may be permitted to reprint a passage from Marconi's recent lecture before the Royal Institution of London. This lecture was given entire in the issues of this journal for July 12th, 19th and 26th last. The passage referred to reads as follows:

"The late Professor Hughes was the first, I believe, to experiment with and receive signals on one of these coherers associated with a telephone. His experiments were carried out as early as 1879, and I regret that this pioneer work of his is not more generally known. Other self-restoring coherers were proposed by Professor Tommasina, Popoff, and others, but one which has given good results when syntonic effects were not aimed at was (according to official information communicated to me) designed by the technical personnel of the Italian navy. This coherer, at the request of the Italian government, I tested during numerous experiments. It consists of a glass tube containing plugs of carbon or iron with between them a globule of mercury. Lieutenant Solari, who brought me this coherer, asked me to call it the 'Italian Navy Coherer.' Recently, however, a technical paper gave out that a signalman in the Italian navy was the inventor of the improved coherer, and I was at once accused in certain quarters of suppressing the alleged inventor's name. I therefore wrote to the Italian minister of marine, Admiral Morin, asking him to make an authoritative statement, to which I could refer in the course of this address, of the views of the Italian Admiralty on the matter. The head of the Italian navy was good enough to reply to me by a letter, dated the 4th inst. [June 4, 1902], in which he makes the following statement, which I have translated from the original Italian: 'The coherer has been with good reason baptized with the name of "Italian Navy Coherer," as it must be considered fruit of the work of various individuals in the royal navy, and not that of one.' These non-tapped coherers have not been found to be sufficiently reliable for regular or commercial work. They have a way of cohering permanently when subjected to the action of strong electrical waves or atmospheric electrical disturbances, and have also an unpleasant tendency toward suspending action in the middle of a message. The fact that their electrical resistance is low and always varying, when in a sensitive state, causes them to be unsatisfactory for the reasons I have already enumerated when worked in connection with my system of syntonic wireless telegraphy."

In a letter to the London Times, dated July 1st last, Marquis (or Lieutenant) Luigi Solari said: "I am glad to be able, by the order of my admiral and with the express authorization of my government, to state that the coherer in question, which was not, as alleged, the invention of Castelli, was offered to Mr. Marconi by myself, acting upon the instructions of my minister, in consideration of the deep affection and gratitude cherished by the Italian navy for our illustrious inventor. * * * The model brought over to England by me had, in fact, been devised in the stations under my own immediate supervision, with which stations the above-mentioned naval signalman Castelli had nothing whatever to do. * * * I think I have shown in the clearest possible way how groundless have been these accusations brought against Mr. Marconi, whose position in the matter could not have been more considerate or more correct."

To this Silvanus P. Thompson made answer in a letter to the London Times, dated July 4th. He said that he had never failed to appreciate the great achievements of Marconi. But what he had said, and what was true, was that the great transatlantic success of last February "was not attained by any use whatever of the system which Signor Marconi had himself described as basic in his patent of June 2, 1896, 'but by a new and totally different system invented by one whose name has not been given to the public.' It will be remembered that Signor Marconi's patented system describes a Righi oscillator as a sender, and, as the receiving apparatus, a telegraph instrument, to which the ethereal waves were relayed by an automatically tapped tube of metal filings, sometimes called a coherer, the automatically tapped coherer being now admitted to be a prior invention of Professor Oliver Lodge. In the transatlantic transmission this telegraphic system was entirely abandoned. A modified Tesla apparatus has been adopted, instead of a Righi oscillator, in Cornwall; and at Newfoundland there was used a telephonic appliance for receiving. Lieutenant Solari's letter relates solely to this telephonic appliance, which he rather inaptly calls a mercury coherer. * * * My point was that, being a telephonic invention, it was not included in Signor Marconi's telegraphic patent, and that it was invented by some one whose name had until then not been given to the public. The storm in the teacup between Solari and Castelli is the veriest detail, and a sordid one."

To a New York World correspondent in Kiel, Germany, Lieutenant the Marquis Solari is reported to have said: "The Saturday Review is not correct. The Newfoundland reception of signals from Cornwall was obtained independently of the use of Solari's coherer."

The attitude of the Marconi people is that the inventor's kindness in crediting a friend in the Italian navy with valuable suggestions in the perfecting of his system has been seized upon by those who do not want to see Marconi succeed and used against him. "The stability of our patents," says C. D. Steedman, secretary of the Marconi Company of America, "has not been injured in the least by this latest attack. Competent attorneys have gone all over the ground and have found everything all right. Marconi stands secure as the inventor of the wireless system."

BOOK TABLE.

Electric Power Transmission. A Practical Treatise for Practical Men. By Louis Bell, Ph. D. Third edition. 1902. New York: Electrical World and Engineer. Pp. (six by 9¼ inches), xi., 632, with 21 plates and 285 illustrations. Price, $3.00.

The first edition of this work appeared in 1897, and the rapid development in the power-transmission field since that time has led to two revisions of the book and the addition of much new matter, although much still remains to be added. Many illustrations of recent plants and apparatus have been included, and a fifth chapter on commercial electrical measurements has been inserted. The last chapter, on "The Present State of High-voltage Transmission," is supposed to present the latest developments in the art. Special mention—somewhat scanty in some cases—is made of some of the famous California and other western high-voltage transmission systems and their apparatus, and the chapter also includes a short mention of the new commercial form of Nernst lamp. The chapter on engines and boilers might profitably have been revised with more care, and the data given about gas engines are so meager as to have little practical value. Still, disappointing in some respects, considering the present state of the art, the book contains a mass of valuable information and is probably the best to be had on the subject of which it treats.

Electrical Engineering Testing. By G. D. Aspinall Parr. 1902. London: Chapman & Hall. Philadelphia: J. B. Lippincott Company. Pp. (5½ by 8½ inches), 474, with 218 illustrations and 31 tables. Price, $3.50.

This book contains much valuable information along the lines of electrical testing. It is intended essentially to cover the electrical-laboratory practice in the second and third years of a complete course of instruction in electrical engineering and also to be of considerable service to the electrical engineer in electrical manufacturing plants and central stations. With a special regard to English practice, this is well carried out, but the book will, nevertheless, be found very convenient for reference by American engineers. The author gives 128 tests covering the calibration and standardization of instruments, efficiency and other tests on lamps and batteries, resistance measurements, efficiency and regulation tests of direct and alternating-current machinery, tests on transformers, rotary converters and generating sets and miscellaneous tests on dynamos and with alternating currents, etc. Several pages are devoted to the jointing of electric-light wires and cables, many of the different joints being illustrated. In an appendix are given the algebraical solutions of the various formulæ met with in the tests, complete descriptions and illustrations of a large amount of the apparatus used in the tests and tables of constants, variables and useful numbers, as well as of logarithms, squares and reciprocals of numbers.

Canadian Connection with Pacific Cable.

The Canadian Pacific Telegraph Company is pushing work on its line from Nanaimo, B. C., to Banfield Creek, at which point the British Pacific cable will end. This will be the connecting line which will be extended to Vancouver and will be part of the great line from England to Australia. The wires will run parallel to the government line from Departure Bay, where the Vancouver-Victoria cable ends, for 27 miles to Parksville on new poles. The government telegraph poles will then be used for the new wire from Parksville to Alberni. At Alberni the Canadian Pacific railroad line will continue on to Banfield Bay. The cost of the line is estimated at $12,000, and it is to be completed by December 1st next. The cable is already laid from Australia to the Fiji Islands, 2,500 miles, and the remainder is on the way.

The Federal Electric Company of Erie, Pa., has been incorporated with a capital of $20,000.

Rules for Motormen and Conductors.

Mr. T. A. Henderson, general superintendent of the Chicago Union Traction Company, has issued an elaborate set of rules and regulations for the guidance of the conductors, motormen and gripmen of the company. The rules are issued in a neat, cloth-bound book of 52 pages, which is provided with an index. Many of the regulations are of general interest to all engaged in electric-railway operation. A few of these are given below:

18—*Keep Your Temper.*—While in the discharge of their duties trainmen will at times meet with trials and difficulties with dissatisfied or captious passengers. Under these circumstances, a trainman will keep his temper always. Be patient, polite, and forbearing. Remember that the company is the servant of the public and that employes are the representatives of the company before the public; that the employe best serves the company who bears this admonition in mind always, and acts in accordance.

21—*Trolley Off the Wire.*—Motormen are positively forbidden to allow their car to run after they have received the bell signifying (or if they know) that the trolley is off the wire. As soon as they are aware of the fact that the power is gone, the car must be stopped at once, and not started again until two bells have been fairly sounded by the conductor.

22—*Signals.*—One tap of the bell to the motorman or gripman is the signal to stop at next crossing; two quick taps to start. Two quick taps of the bell by the motorman or gripman is the signal for the conductor to come to his assistance. Motormen and gripmen must notify conductors immediately by a tap of the bell, of each passenger who boards grip cars or front platform.

23—*Emergency Signals.*—Three quick taps by the conductor is the signal to stop immediately. Three quick taps of the bell by the gripman or motorman is the signal for the conductor to set rear brake of car at once. Four quick taps by the motorman is a signal to pull trolley down to roof. Four quick taps by conductor is a signal for motorman to back up slowly. Conductors must remember that a passenger has a legal right to ring the bell for the car to stop, and this act should not call forth a reprimand or abuse from the conductor, but it is the conductor's duty to discourage the practice of the passengers' ringing the bell to stop, as much as possible. Should a passenger by mistake pull the register cord, intending to pull the bell to stop, conductors must not abuse them or reprimand them for it, but politely ask the passenger's name and address, make a report of same and send it to the general office, and the fare rung up will be returned. When train consists of more than one car, signal must be given first by last trail conductor before starting.

38—*Backing Car.*—Under no circumstances must the car be run backward in curves, switches, crossings, under viaducts, or in any special overhead work, without first reversing the trolley. Both the motorman and conductor are held strictly responsible for this manner of operation. The greater number of wrecks of the overhead work are caused by running cars backward without reversing trolley, and in no instance will a backward movement of car be made without first reversing trolley, unless on straight track, or except to avoid an accident. If the conductor gives motorman signal to back, without reversing his trolley, the motorman is held equally responsible for backing, even after receiving the proper signals. It is his duty to remain where he is until the conductor complies with his duty by reversing the trolley. When one controller is in use the other must be at "off" position. Before placing trolley on wire, examine both controllers to see that controller handle and reversing handle are at "off" position. Always leave controllers in this position and remove handle when leaving the car.

53—*Trolley, and Care of Same.*—Conductors must be on the rear end of their car when passing overhead switch, track crossover or switch. Should the trolley leave the wire, the conductor must at once pull down the trolley and signal the motorman to stop. Motormen must not start their cars until two bells have been distinctly sounded by conductor.

62—*Electric Light.*—The lamps may sometimes refuse to light, which may be due to any of the following causes: A broken or burned-out lamp, poor contact between one of the lamps and its socket, or a blown fuse, the remedies being to replace defective lamp with a good one, to try every lamp, screw them up more firmly in their sockets. If the trouble is not found to be due to any of these causes, report to station foreman. Try your lamps an hour and a half before dark, to see if they are all right. Never remove lamp from its socket while current is on, until turning off the light switch. Conductors of motor cars will not keep lights burning in the morning after it is light enough for the convenience of passengers.

65—*Starting Car.*—Motormen must exercise great care in turning on the current; never move but one point at a time, and that must be quick and decisive. Wait until the car has gained all the speed of the point you moved it to, and then move to the next point, waiting until the additional speed is picked up, and so on, until you get to the point of speed you desire to run. When the current is to be turned off, move the switch handle around to "off point" quickly, never stopping at the intermediate points. The skill of a motorman is always indicated by the ease with which he stops and starts his car.

66—*Car Under Control.*—Car must be kept under control. Motormen running against switch points should slacken speed to allow another car in the opposite direction to pass the switch. Two cars must not strike the switch at the same time. This rule is intended to prevent a collision in case the switch should be thrown for a crossover or curve.

68—*Knowledge of Electrical Equipment.*—Motormen are expected to acquaint themselves with the mechanical and electrical equipment of cars, in order that they may be able to cut out a motor, replace a fuse, or make slight repairs, if necessary. Motormen should familiarize themselves with the sounds made by the car while running, and if any unusual sound is noticed should endeavor to find the cause and report it. They should observe carefully whether the car takes its natural speed on all positions of the controller, and, if not, report same.

69—*Sand.*—In applying sand, care should be taken to prevent the sliding of wheels.

70—*Controller Out of Order.*—In case controller is out of order and power cannot be thrown off, the overhead switch should be thrown and conductor signaled to pull down trolley.

73—*Fuses.*—Each motorman must carry, while on the road, two fuses. Fuse box must not be touched until overhead switch and trolley are both off. If fuse blows, it should be replaced with a new one; if that blows immediately, next car should push disabled car to station. When a fuse is replaced, copper terminals must be saved and turned in at office, together with a report of the circumstances. In replacing fuse, the terminals must be screwed as firmly as possible. Never use heavy copper wire of any sort for a fuse.

77—*Rounding Curves.*—Power must be shut off and brake applied on approaching all curves, allowing car to enter the curve on its own momentum with brake partly on. Before movement is lost, brake should be released and power applied.

78—*Reversing Motor.*—Never reverse the motors when car is moving forward unless to avoid a collision or save life. If there is not time to stop the car with brakes, release brakes, throw the reverse lever and turn power on at the same rate as in going ahead; do not turn power on any faster in reversing motor of car than in going ahead, as it only spins the wheels and reduces the effect of the reversing. Reversing is a severe strain on motors and must not be resorted to except when absolutely necessary. The two motors on a car will be designated as motor No. 1 and motor No. 2, motor No. 2 being the motor farthest from the fuse box, and motor No. 1 being the one nearest the fuse box. When both motors are in working order, the two switches on the bottom of the controllers will be pushed down as far as they will go. When it is necessary to cut out motor No. 2 (motor farthest from the fuse box), throw up the left-hand switch as far as it will go. To cut off motor No. 1 (motor nearest the fuse box), throw up the right-hand switch as far as it will go. When running with one motor cut out, the controller is intended to be used only up to the fifth notch, and no effort should be made to force it beyond that notch.

79—*Stopping Cars.*—In stopping at the usual places and when signaled to do so by conductor, motorman much turn off power and must not, under ordinary circumstances, apply the brake until the car or train has gone at least 20 feet beyond where power was turned off, thereby lessening the friction and causing less strain on the brakes and making an easier and more gradual stop. Always release the brake just before the car comes to a dead stop. The armatures will then be able to take up all loose motion in gears and shafting and will be ready for a smooth start. If the brakes are not released before the car comes to a full stop, loose motion of gears and shafts will be taken up with a very sudden and injurious jerk when car is started.

80—*Ascending Grades.*—Never throw the controlling handle beyond the eighth point when ascending grades. The greatest degree of motive power can be obtained by throwing the handle to the eighth point, but not beyond it. This will prevent the blowing of fuses, the consequent delays, and also protect the motor and machinery of the car. Always run down grade slow, with current off and car under perfect control.

83—*Failure of Power.*—In all cases where there is a failure of power on the line, throw off the power handle and (whether day or night) throw in the lamp circuit. When the lamps show that the current has returned, start only as soon as car ahead has got under way. In case of electric storms, always throw in your lamp circuit, day or night. Motormen and conductors are warned not to leave their respective platforms when a failure of power occurs, except where it is absolutely necessary to do so, in which case they must be sure that the overhead switch is thrown off. Motormen must always take controller handles with them when they leave their cars while on the street.

In assuming charge of the New Orleans and Carrollton Railroad, Light and Power Company of New Orleans, La., the New Orleans Railways Company announces, among others, the following-named officers: President, H. H. Pearson, Jr.; first vice-president, Charles H. Ledlie; second vice-president, Joseph H. DeGrange; general manager railway department, Captain John G. Woods; chief engineer and electrical department, Alexander Black; superintendent power houses, E. B. McKinney; purchasing agent, John R. McGivney.

Possible Combinations of Electrical Manufacturing Companies.

Philadelphia papers seem to think that the purchase of the Electric Storage Battery Company by the General Electric Company is possible. The Telegraph of that city prints the following as an interview with a director of the battery company: "The situation concerning the future of the company is as yet undecided, there being two alternatives before those in control. Negotiations are still going on between Electric Storage and General Electric with a view to the purchase of the former by the latter. On the other hand, there is under contemplation the step of combining the Electric Storage Battery and Stanley Electric Manufacturing companies. This last will only occur should the General Electric Company not offer satisfactory terms. If General Electric takes over Electric Storage Battery, the Stanley Electric Manufacturing Company will, of course, be included in the purchase. In the present negotiations the Westinghouse Company has merely the interest of an onlooker beyond the fact of the close business understanding at present existing between that company and General Electric. Should the negotiations with General Electric be broken off, the combination that would then be consummated between Electric Storage Battery and Stanley Electric Manufacturing would be for the purpose of competition with General Electric and Westinghouse. The decision of the matter rests wholly in the hands of Whitney, who is now in New York, and Ryan. In my opinion the wiser course of the two would be not to sell Storage Battery and Stanley, but to combine and develop them. The heavy electric-machinery business is of immense importance and promises increased growth. Should the two concerns be turned over to General Electric the important electric interests of the Philadelphia and New York stockholders of Electric Storage Battery would remain at the mercy of Westinghouse and General Electric."

New York Traction Systems Inspected by Chicago Aldermen.

The 12 aldermen constituting the local transportation committee of the Chicago City Council who are inspecting the traction systems of the East, arrived in New York city on July 24th and spent the succeeding five days studying the transportation systems of that city. On the first day the party inspected some of the rapid-transit tunnel work and the Metropolitan Street Railway Company's new power house. The following morning various sections of the rapid-transit railway were visited, B. J. Arnold, the engineering expert of Chicago, who accompanies the party, explaining the details of the work. In the afternoon a trip was made over the lines of the Brooklyn Rapid Transit Company in a private car at the invitation of President Greatsinger.

The subway was also visited on Saturday and Monday and a conference was held with H. H. Vreeland, president of the Metropolitan company. Mr. Vreeland freely answered questions about his own system and gave the visitors much information. On Monday evening the aldermen were entertained by James H. McGraw at dinner at the Engineers' Club, at which John B. McDonald, H. H. Vreeland and a number of engineers connected with the New York traction lines were present.

The party left on July 29th for Boston, where City Messenger Leary took charge of their entertainment. After studying the Boston traction systems, it is possible that the trip to Washington will be abandoned, the committee returning direct to Chicago.

Large Electric Jib Crane.

What is said to be the largest crane in the world has recently been built for the Kaiser Dock at Bremerhaven, Germany. The total weight of the crane, including counterbalance, is 474¼ tons. A four-legged tower supports a revolving center post, to which is attached a horizontal jib, one arm of which carries a counterbalance at the extreme end, and the other arm a trolley capable of traveling from its extreme end to the edge of the tower. This crane is capable of carrying a test load of 200 tons. The total length of the jib is 164 feet. The trolley contains the whole of the mechanism for lifting and traversing, the speed of the traverse being about 26 feet a minute. The traveling mechanism is driven by a series motor, and the lifting mechanism by two motors.

Steam-turbine Plant for Montreal.

An expensive new power station is to be established at Montreal by the Lachine Rapids Hydraulic Company. Plans have been prepared, and the company is now asking for bids for a building that will comprise a sub-station, a transformer plant, switchboard and distributing system, auxiliary steam plant and technical offices. The engine room will, it is asserted, contain six steam turbines of the newest pattern, with a capacity of 2,000 horsepower each. It has been the company's intention, since formation, to put up an establishment of this description. Now that the machinery necessary to its equipment has become standardized, and there is no danger of its being relegated in a few years as out of date, the company has decided to proceed with the construction.

Mr. Warren's Wemco Wins Interlake Regatta.

A sailing yacht carrying the 1902 commodore's pennant, bearing the (abridged) name of an electrical manufacturing company and racing for honors at a regatta of the Interlake Yachting Association, is a spectacle of some interest to the readers of the Western Electrician. But when the Wemco, the new yacht built for President C. C. Warren of the Warren Electrical Manufacturing Company of Sandusky, Ohio, carried off the prize after a close and exciting race at Put-in-Bay, Lake Erie, on July 24th, between the Puritana, the Minx and the Wemco, not even Sir Thomas Lipton himself could have been prouder of a well-earned victory than was the master and owner of the "electrical yacht."

For years Commodore Warren has had the inclinations of an enthusiastic yachtsman. The success of his electrical enterprise at Sandusky has resulted in the company's president having more time of late as well as the opportunity to gratify a long-existent taste for this fine sport. When Mr. Warren first made his home along the lakes a comparatively small boat was purchased. The question of a suitable name then came up. Proud, and justly so, of a remarkably successful electrical business, it was not strange that President Warren should sail this, his first yacht, under a name made up of the initials of the words, "Warren," "Electrical" and "Manufacturing" and the abbreviation of "Company." A short time ago the first Wemco was sold, but the new yacht inherited the name.

The race at Put-in-Bay on Thursday of last week was the new Wemco's first speed trial, and the noble manner in which she responded to the owner's ex-expectations proved the commodore's judgment unerring in the choice of both designer and builder, to say nothing of his own skill in seamanship.

The new yawl scored a signal victory over the Toledo schooner Puritana and the Detroit yacht Minx over the 12-mile triangular course off Put-in-Bay, in what was pronounced by those competent to judge, one of the finest races that the Interlake Association has ever witnessed. Never in the history of the association was a prettier start witnessed at Put-in-Bay. As the gun was fired, the three big yachts moved slowly toward the line, pointing well up in the wind, and just maintaining steerageway until the second gun was fired, when, like a flash, the Wemco sailed by Commodore Warren short forward to windward of the three and at once took a short lead.

From the judges' boat the Wemco seemed to be making a runaway of it, and really did outfoot the others rapidly, but the Puritana pointed better and the Minx also worked well to windward of the yawl. As the first stake was reached the Wemco stood well away after passing the mark, and for several moments seemed to be bent on running out into the lake for several miles, but, finally coming about, cleared the buoy by a big margin, and blanketed the Puritana, which had pointed well up to the flag, and wore around in grand style. On the second leg both yachts held their own and sailed bow to bow. Up to the mark the yachts held their relative positions, with the Minx just about holding her own. When about three-quarters of a mile from the mark the Wemco gave the spectators another surprise by suddenly going into stays. She was laid away on the starboard tack, having fallen off to leeward of the stake in the reach.

The Puritana and Minx, however, held their course and seemed to be about to make the mark without tacking, but as the buoy was neared it became apparent that both would have to luff.

The Wemco rounded the second stake and within a minute had broken out a spinnaker, which set as though "cut to the inch." The skillful blanketing by the Wemco of the Puritana at the start and the clever maneuver of Commodore Warren, when at this turning of the last stake he "broke out" with such remarkable celerity and in such beautiful style, his spinnaker—these two exhibitions of seamanship won the commodore much applause.

A stern chase is of necessity a long one, and the Puritana's skipper must have realized this in the long run home, for try as he would he could not catch the flying yawl.

As the finish the wind had died away to a mere calm, and the Wemco had just enough wind to make a decent showing as she crossed the line. The cheers that greeted the victor were well worth having sailed for—they came from the spectators, from the judges' boat, from the accompanying launches, and later from the defeated yachts themselves.

The Wemco was designed by Small Brothers of Boston, Mass., and built by Hugh G. Bishop, Gloucester, Mass. She has a deck length of 67 feet, with a water-line length of 49 feet and a beam of 16 feet. The vessel's draught is five feet 10½ inches with centerboard up. The centerboard is housed in an iron keel and does not come up through the floor. The keel is an iron shoe, 33 feet long by two feet six inches deep and weighs 20,000 pounds. The yacht is yawl rigged, with very lofty sails, and is designed to carry a large sail plan in light winds. The standing canvas is mainsail, staysail, jib, jib topsail, gaff, topsail and jigger sail. The spinnaker and balloon jib each contain about 1,600 square feet of canvas in addition. The accompanying picture gives a very good idea of the general appearance of the Wemco.

In addition to its heavy sail area, the Wemco is provided with an auxiliary power, in the form of a Rochester gas engine of double cylinder and 12 horsepower. This engine is located directly under the cockpit, entirely out of sight from the cabin of the boat, and takes up no useful room. A clutch is provided, so that this engine may be coupled at any moment to the propeller, which ordinarily spins idly beneath the stern of the vessel.

Relative to the yacht's accommodations, it can

THE WEMCO.

comfortably house 14 people. In addition to the berths alongside the main cabin, there are two elegantly furnished staterooms, the larger of which is occupied by Commodore Warren as his home during the summer months. These two staterooms are finished in white and gold, and provided with bathrooms adjoining. The main cabin, and, in fact, generally speaking, the yacht throughout, is finished in heavy polished mahogany.

The Wemco was launched on the 23d of May, left Gloucester June 8th, and proceeded to Boston, and was there completely fitted out. On June 11th she started from Boston under the care of Commodore Warren on her ocean trip around Cape Cod, through Nantucket Sound to Long Island Sound, arriving in New York June 14th. After a delay in New York of about four days to dismantle the rigging for the voyage up the Hudson, the yacht proceeded, without Commodore Warren, on up the river to the Erie Canal; thence to Syracuse, and by the Oswego Canal to Lake Ontario. At Oswego Commodore Warren again took charge of the vessel, this time accompanied by Mrs. Warren and Miss Berenice Warren. With this party on board the yacht proceeded over the lakes and through the Welland Canal, arriving at Sandusky July 5th. During this long voyage the Wemco had the misfortune to catch practically all the storms on the lakes and the ocean at that time. During the entire trip from Boston there was only a single day of good weather. The Wemco's captain is Richard McKean, and she ordinarily carries a crew of five, including the steward and the cabin boy.

During the regatta at Put-in-Bay Commodore Warren had as his guests the officers of the Interlake Association. On the Saturday following Commodore Warren brought over to Put-in-Bay from Sandusky a party consisting of Mrs. Warren, Mr. Hal. Warren, wife, son and daughter, and several officers of the Interlake Association.

Sealed proposals will be received up to August 18th for the furnishing of the labor and materials for the construction of an electric-light plant for the city of Columbus, Ohio, in accordance with plans and specifications on file in the (City Hall) office of Perry Okey, superintendent of lights.

The Drainage-canal Power Situation.

Interest in the development of the drainage-canal power below Joliet, Ill., is being maintained by the actions of the private syndicate and also the Sanitary District trustees. Last week an injunction was applied for in the interests of a taxpayer seeking to restrain the district from going ahead with the building of its dam on the ground that it was exceeding its powers. Judge Tuley of Chicago refused to issue a temporary injunction until the district had had time to make a full presentation of its side of the case.

Robert Gaylord of the private syndicate which plans to build its dam below the district's dam has demanded that the sanitary district's land controlling the waterpower at Joliet be sold to him at a nominal figure. However, no definite answer has been made to his demand, although the trustees have expressed their willingness to negotiate.

Meanwhile, the district is pushing the work at its dam below Joliet. As a further step to protect the available waterpower rights of the canal, work has also been started on the development of the power at Lockport, just below the controlling works. The plans for this work have been in the hands of the engineering department of the sanitary district for some time. The entire cost of putting in the dam, power house and tailrace is estimated at nearly $3,000,000, but the plant would develop 24,000 horsepower with a flow of 600,000 cubic feet per minute in the canal, giving an annual income of $600,000.

On July 29th Judge Hanecy issued, in the interests of a taxpayer, William F. Rice, a restraining order commanding the Sanitary District trustees to cease all work and the incurring of all indebtedness upon the district's Joliet dam until such time as the application for a temporary injunction shall be heard. Condemnation proceedings have been begun by the district against the Gaylord interests to obtain some of its land, and in return similar proceedings have been begun by the Gaylord people against the District.

Electric Goad for Cattle.

Electric shocks, smart enough to tingle but not severe enough to be dangerous, have been suggested, and actually applied in some instances, if racetrack tales be true, to accelerate the speed of horses. A new application of the same idea is reported from the stockyards at Armourdale, Kan., if the National Provisioner is correctly informed. The cattle are urged into the slaughter pens with the help of an electrical stimulus. A stick called a "puncher" is fitted with brass points which are terminals of a 125-volt circuit, the wires being insulated and passing through the stick, which varies from five to six feet in length. About 20 feet of wire is attached to each "puncher," giving a considerable radius of operation. The shock is sufficient to give the animal a sharp, stinging sensation without leaving a bruise on the beef. The journal named says: "The work is done in one-half the time and with half the exertion. The effect on the steer of the magic touch is amusing to see. A steer touched on the left hip immediately throws his hindquarters as far as he can to the right. He cocks one ear straight ahead and one straight back, switches his tail and starts straight ahead, not caring for a second shock. There is a look of surprise in his eyes, and he seems to know that all the trouble lies in the end of that stick. He doesn't stop to get mad or howl. He has urgent business at the other end of the pen. This is exactly where the drivers and knockers want him. It completely does away with all back rushes and dragging in with chains, for just as long as the puncher is behind, the steer is just as far as he can get in front."

Production of Zinc.

In the forthcoming volume of "Mineral Resources of the United States," for 1901, now in press (United States Geological Survey), Mr. Charles Kirchhoff gives the maximum production in the history of the zinc industry in the United States as having been reached in 1901, with an output of 140,822 short tons, as compared with 123,886 tons in 1900, and with 129,051 tons in 1899. The largest gain in production was made by Kansas, with an output of 74,240 short tons, as compared with 62,136 tons in 1900; Illinois also made a considerable gain from 38,750 short tons in 1900 to 44,896 in 1901. The average realized price for zinc in 1901 was $24.21 per short ton, as compared with $26.50 in 1900, with $38.50 in 1899, with $28.44 in 1898, and with $22.28 in 1897. There was a decline of exports of zinc in 1901 to 6,780,221 pounds, valued at $288,906, as compared with 44,802,577 pounds, valued at $2,217,693, in 1900, and with 13,509,316 pounds, valued at $742,521, in 1899. As heretofore, the exports went chiefly to the United Kingdom, the quantity being 5,167,274 pounds for 1901, as compared with 33,378,240 in 1900. The imports of zinc in 1901 amounted to $76,059, as compared with $128,090 in 1900, and with $165,667 in 1899.

The world's production of zinc in 1901 is estimated at 501,494 long tons, as compared with 470,937 long tons in 1900, and with 481,854 long tons in 1899. The United States furnished in 1901 25.1 per cent. of the world's production, 23.5 per cent. in 1900, and 23.0 per cent. in 1899.

DEVELOPMENT OF THE TELEPHONE FIELD.

Rival State Associations Formed at Rochester.

[Special correspondence of the Western Electrician.]

Rochester, N. Y., July 25.—An attempt to form a New York state association of Independent telephone companies at a convention in this city to-day resulted in the breaking up of the meeting at the outset, the holding of two conventions and the formation of two state associations.

About 200 representatives of telephone companies of the state met in the courthouse at 10 a. m., pursuant to a call issued by the Rochester Telephone Company, stating that the objects sought are as follows:

The exchange of views regarding the methods and forms of operating.
The standardizing and uniformity of equipment and construction.
The adjustment of any possible differences regarding territorial rights, etc
A united effort to assist in speedily connecting all exchanges of the state with toll lines.
To give information and advice to individuals or companies contemplating the building of new exchanges.
To generally keep in touch with the new and rapid progress that is being made in Independent telephony.
The giving of moral and financial support in cases of litigation that might affect the interests of all the members of the association.

Special importance was attached to the effort to connect state exchanges with toll lines, and it was upon this rock that the split came. The older Independent companies objected to the attempt of the newer companies to occupy toll-line territory in various sections of the state. When an attempt was made to organize the convention an uproar resulted. George R. Fuller of the Rochester Telephone Company and Martin Carey, counsel for the Frontier Telephone Company of Buffalo, were each declared elected temporary chairman. It was declared by the Carey men that the Rochester Telephone Company, with others, had "cooked up" a constitution and by-laws and an executive committee without authority. The Rochester men said they had prepared a constitution to expedite matters and that this was to be acted upon as the representatives desired. After futile attempts to agree, Fuller's followers withdrew from the courthouse to Powers Hotel and organized another convention, electing these officers: President, George R. Fuller, Rochester; first vice-president, Howard Hendrickson, Albany: second vice-president, Boyd McDowell, Elmira; secretary and treasurer, Charles O. Harris, Rochester; executive committee, S. B. Lawson, Niagara Falls; J. S. G. Edwards, Johnstown, N. Y.; J. S. Brailey, Jr., Utica; Edward Davis, Troy; F. N. Potter, Jr., Syracuse; Dr. C. D. Vernoy, Cortland, N. Y.; W. D. Bernard, Saratoga; E. L. Barber, Rome.

A committee on credentials reported the names of 53 companies. The name "New York State Independent Telephone Association" was adopted; also a constitution and by-laws. During the afternoon articles of incorporation were filed in the county clerk's office, and this fact, more than any other, caused those in the rival convention to discuss plans for an agreement.

The Carey men organized with the election of Martin Carey, Buffalo, as president; C. E. Stinson, Rochester (who was in the other convention), vice-president; Charles H. Blood, Ithaca, secretary; F. E. Lyford, treasurer; executive committee, Messrs. Carey, Stinson and Blood, George N. Orcutt, Hornellsville; T. S. Lane, Jamestown; B. G. Hubbell, Buffalo. The committee on credentials passed upon names of 49 companies. The Carey convention adjourned subject to the call of the president.

President Fuller's association adopted a resolution suggesting that, as there is at present no unity of action on the part of the several state associations of Independent companies, a convention should be held during the coming fall to secure united action, delegates to be elected by each state association upon the basis of one delegate for each 3,000 telephones and one for every 1,000 miles of metallic-circuit toll line.

The cause of the trouble at the opening of the convention was the rivalry for the toll business of the many companies represented, the convention being made up of partisans of the Rawson syndicate, with headquarters at Lockport and Niagara Falls, and the Hubbell syndicate, which is backing the newly formed Frontier Telephone Company of Buffalo. Secretary Harris of the New York State Independent Telephone Association said that more than the mere question of toll service was involved in the state organization. The national association, he said, has heretofore been composed of interests largely representing a certain construction company. It is the desire to organize a national association that shall represent bona fide state associations. It is expected that the Carey men will join the Fuller association. R. T. O.

Michigan Telephone Company's Affairs.

A large majority of the consolidated mortgage five per cent. bonds of the Michigan Telephone Company have been deposited with the Old Colony Trust Company of Boston, as depository, under the bondholders' agreement, dated June 28th. On this account the time for the deposit of bonds has been extended until August 5th, after which no deposits will be received except upon such terms as the committee, through Chairman William Blodget, may prescribe.

N. W. Harris & Co., one of the firms interested in the bonds, are quoted as saying: "The statement of revenue and expenses sent out to the stockholders of the Michigan Telephone Company, showing a deficit for last year, is no doubt correct and is evidence that the company did not earn any dividend on its stock. However, in the statement of expenses were included royalties to the Bell company and interest on $2,500,000 floating debt, so that the actual figures would no doubt show that the company is earning a surplus over operating expenses and interest on its bonds. Assuming this to be a fact, the probabilities are that the bondholders, if they should secure the property under foreclosure proceedings, would not lose any money, but the chances are that the Bell interests, in view of the fact that they are holding the $2,500,000 of floating debt, will step in and redeem the property, as there is evidently an equity of at least $2,500,000 over and above the bonds in the property. The committee will no doubt receive sufficient bonds to be able to foreclose. The majority of the bondholders seem well pleased at the probable outcome, believing that their interests will be fully protected."

Telephone Profits in Indiana.

The first statements ever given to the public by the New Telephone Company and the New Long-distance Telephone Company of Indianapolis have just been given out, and they excite favorable comment. The New Telephone Company reports gross earnings for the year ended February 28, 1902, of $138,439.92; gross expenses, including interest on bonds, and taxes, $114,032.92; leaving net earnings of $24,407. The capital stock is $400,000.

The New Long-distance Company opened for business November 1, 1899, and the earnings for the first month were $1,146.58. In March of this year (1902) the earnings were $6,628.41. The net income for the year ended March 31, 1901, was $12,579.75, and for the year ended March 31, 1902, $25,035.79. The officers of the long-distance company announce that they will within a few days place $150,000 five per cent. 20-year bonds on the market. The money derived will be used for construction purposes, and the extension of the service. By this expenditure, the president asserts that the company will add $25,000 per annum to its net income. The companies hope to be paying dividends upon their stock within a few months.

Illinois Central Telephone Line Completed to New Orleans.

The Illinois Central Railroad Company has completed its telephone line between Chicago and New Orleans, via Memphis, the length of the circuit being 922 miles. It is now possible for the officials of the company in Chicago to talk to New Orleans, but this will not be done frequently at present, as the line is very heavily loaded with local business in the southern district. The company's telephone system, which will eventually extend over 2,000 miles of track, is also being pushed in other directions. Telephone communication can now be had from Chicago with St. Louis and Memphis and other cities and junction points en route. A line being built to Omaha has reached Dubuque, and an extension to Louisville, Ky., has reached Fulton. The work has been going on since February 1st, and is under the supervision of C. F. Annett, superintendent of telegraph for the Illinois Central Railroad Company. The present lines aggregate about 1,200 miles in length.

A New Selective Party-line System.

A new selective party-line system has been devised by two Wheeling (W. Va.) electricians, Frank B. Hall and A. F. Poole, which is said to possess features of considerable merit. By its use as many telephones as are practicable for other reasons may be placed on a circuit, and only the instrument wanted will be signaled, the others being locked out until the communication with the one desired is at an end. A target or register is provided which shows a subscriber whether the line is in use. It is stated that the principle of the system is such that when the line is operated the device at one station connects up the segment of line extending to the next station, and so on. It is said that the system has been successfully tested with 20 telephones on one side of a circuit and five on the other.

Ohio Telephone Notes.

The feat of raising the office of the Youngstown Telephone Company, making such changes and repairs as desired and setting it back on the second story of the Dollar Savings and Trust Company's building, has been accomplished without an accident. The work has caused a great deal of comment.

At a meeting of the directors of the telephone company at Painesville a few days ago, Charles North of the North Electric Company of Cleveland was present and gave an interesting talk on his switchboard and other matters connected with the telephone business.

At the annual meeting of the stockholders of the Bucyrus Telephone Company, Bucyrus, held a few days ago, the following-named directors were chosen: J. A. Chesney, E. Blair, Ed. C. Roehr, J. L. Assenheimer, Benjamin Shearer, H. S. Blair and J. C. F. Hull. They chose officers as follows: President, E. Blair; vice-president, John A. Chesney; secretary and treasurer, J. C. F. Hull; manager, A. J. Unger. The company has had a very prosperous year, and has completed the stringing of 5,000 feet of cable. The line has been extended to Sulphur Springs, and a number of pay stations opened.

The storm of Friday evening of last week did great damage to the Central Union plant at Springfield, more than a thousand telephones having been burned out by lightning. The country lines also suffered very severely. Lines all over the state have suffered the past two or three weeks from the frequent storms.

Work on the reconstruction of the Newark (Ohio) telephone plant will be begun at once. Something like $45,000 will be spent and the plant will be put in first-class condition. The company has 34 toll stations in Licking County, and the lines are connected up with almost all surrounding towns.

The 12,000 shares of common stock and 2,000 shares of preferred stock of the United States Telephone Company have been disposed of, according to plans mapped out some time ago. The money will be available on August 1st. O. M. C.

Telephone News from the Northwest.

Telephone linemen of the Wisconsin Telephone Company at La Crosse, Wis., went on a strike in sympathy with their fellows at Milwaukee, but returned at noon of the same day, concluding that they had no grievance. Later, they struck again, on instructions from the state union.

The Northwestern Telephone Exchange Company's conduit work in the Twin Cities is greatly delayed by rains and by inability to secure the conduits.

The Twin City Telephone Company announces a quarterly dividend at the rate of seven per cent., payable August 1st.

The Interior Telephone Company has decided to extend its long-distance line from Presho, S. D., on to Fort Pierre, S. D., 45 miles.

C. E. Church, manager of the Northfield (Minn.) Telephone Company, has arranged with the Northwestern Telephone Exchange Company so that his company secures the local business and receives toll-line connections with the Northwestern. The latter removes its exchange from Northfield.

The Iron Range Electric Telephone Company of Wadena, Minn., declared a dividend of 12 per cent. on the business of the last six months. The lines are to be extended considerably.

The linemen's strike has crippled the telephone service of the Wisconsin Telephone Company at Beloit, Wis., considerably, as there is a large amount of repair work to be done.

The property of the Owatonna Telephone Company at Owatonna, Minn., has been sold to the Northwestern Telephone Exchange Company. The exchange will be rebuilt.

The Winfield Telephone Company of Winfield, Iowa, has just paid a semi-annual dividend of 11 per cent. The company has been in existence for 18 months, starting with 40 connections. It now has 251 instruments, of which 106 are in town and 145 are on the nine rural lines. R.

Southern Telephone Developments.

The City Council of Chattanooga, Tenn., will be asked for a franchise soon for telephone privileges by a new company, which proposes to enter the field. The company proposes to have the system, which will be an underground one, completed within one year.

At the annual meeting of the People's Home Telephone Company at Birmingham, Ala., a dividend of two per cent. was declared. New officers were elected as follows: President, H. H. Stambaugh; vice-president, Henry B. Gray; secretary, W. H. Hassinger, and treasurer, A. F. Adams.

The Cumberland Telephone and Telegraph Company has filed suit at Hartford, Ky., against the Rough River Telephone Company to enjoin the latter from stringing its wires in certain places, alleging that its own service is thereby interfered with and the lives of employes endangered.

The Chesterfield Telephone Company of Chesterfield, S. C., will soon apply for a charter to build a telephone system in that town. The capital will be $3,000 to begin with. J. A. Welsh, R. E. Rivers

and others are interested. Some long-distance connections are also contemplated.

The Richmond (Va.) Telephone Company has been informed that the new franchise requested cannot be granted, but that the old franchise might be amended so as to meet all requirements and provide for extensions.

The St. Matthews Telephone Company has been organized to build lines in St. Matthews, S. C., and to neighboring points. The capital stock will be $1,000. The incorporators are L. M. Able, J. S. Wanamaker, H. A. Raysor, M. Jaresy and S. Pearline.

L.

Indiana Telephone Items.

The Mooreland Rural Telephone Company was incorporated on July 25th with capital stock of $10,000. It will operate in Henry, Wayne, Randolph and Delaware Counties, with headquarters at Mooreland.

The telephone question threatens serious trouble at Evansville. One of the stormiest scenes ever witnessed in the council took place last week, when a resolution presented by the Board of Public Works to revoke the franchise of the Cumberland Telephone Company in Evansville was presented. After a hard fight, the matter was referred to a committee. The Board of Public Works has passed an order revoking the rights, privileges and concessions granted to the Cumberland Telephone Company by the council 15 years ago. To be effective, the council must ratify it. The order also requires the company to remove its poles, wires, etc., and cease business in Evansville at the expiration of 90 days. The company expresses a willingness to sign a new contract with the city, more favorable to the city than the present contract, but it denies the right and power of the city to disposses it in the Evansville field. Mayor Covert seeks to install a municipal telephone plant, and has a scheme partly perfected for that purpose, but he insists on being certain whether he can get rid of the old tenant before letting the field to a new one. It is believed the council will ratify the order to revoke the franchise, and if the company chooses to do so, it may cease business at once, and Evansville will be without service. The business men fear such a course, and the council may be influenced in the matter.

F.

NEW COMPANIES.

The Chambers Telephone Company of Fostoria, Mich., has been incorporated with a capital of $5,000.

The Canton Telephone Company of Canton, Ohio, has been incorporated with a capital of $75,000. The incorporators were Fred G. Bills, George F. Miner and O. S. Bayles.

The North Texas Telephone Company of Pecan Gap, Delta County, Texas, has been incorporated by W. A. Cockrell, W. R. Johns and J. H. Gorden. The authorized capital stock is $5,000.

The Gillespie (Ill.) Telephone Company has been incorporated with a capital of $5,000 to operate a telephone system. The incorporators are Jonah C. Steere, J. M. Rodnier and Henry R. Williams.

A charter has been granted to the Modern Telephone Company of Hamilton, Ont. The capital stock is $300,000, of which $88,000 is paid up. The incorporators are O. W. Rogers, J. S. King, W. A. Johnstone, J. B. Ecovell, H. A. Drummond, W. Vandusen, Fritz Leoffier, S. C. Biggs, F. Dogger and C. A. Johnson.

The Westerly Automatic Telephone Company of Westerly, R. I., has been organized. John Champlin, Albert B. Crafts and others are directors. The company has adopted the Strowger automatic telephone-exchange system and has ordered 100 instruments and a switchboard with an ultimate capacity of 1,000 telephones. Joseph B. Baker of Boston, for many years connected with the experimental department of the American Bell Telephone Company, is consulting engineer, and O. S. Bowen, formerly with the New Bedford and Fall River Automatic companies, is superintendent of construction.

TELEPHONE MEN.

Thomas W. Hopkins, local manager for the Citizens' Telephone Company at Galveston, Texas, has just resigned his position. His successor has not yet been appointed.

M. R. Haskinson, an employe of the Cumberland Telephone Company at Evansville, Ind., has accepted the position of manager of the Grayville (Ill.) telephone exchange, and will remove there at once.

Professor Alexander Graham Bell of telephone fame is reported to be the inventor of an airship, the construction of which he is said to be supervising at the present time. The machine will utilize many principles of the kite, it is said.

Edward S. Tobey, for the last four years superintendent of the collection department of the New England Telephone Company, died of typhoid fever at his home in Brookline, Mass., last week. He had been sick since June 17th. He was unmarried. He was a son of the late ex-postmaster of Boston and was born in that city 45 years ago. He was at one time assistant postmaster under his father.

A Woman Telephone Operator in Texas.

Probably the largest Independent telephone system in the Southwest is that operated by Mrs. Anney McElroy Brett of El Paso, Texas. Mrs. Brett was present at the recent convention of the Independent Telephone Association of the United States in Philadelphia and when called upon gave an interesting account of the Independent situation in Texas. Following is an abstract of her remarks:

When I took up the work in western Texas the conditions were very much the same as they were in Michigan in the early days. The people had to be educated to know that another company could come into the field and compete with the Bell company. Two years ago, when I started the work in El Paso, the Bell company had 300 telephones in service, and they were charging $3 to $5 a month. When I commenced the work I thought if I reached 600 telephones I would be doing well. To-day we have 1,550 three-year contracts.

Our franchise is rather peculiar. We have a sliding scale. We are permitted to charge $20 and $30 up to 1,000 telephone. In excess of 1,000 telephones we are permitted to increase the price 50 cents a telephone. The contracts with the people also permit this. It was necessary, before obtaining those contracts, to educate the people to the one fact that, in the telephone business—unlike most other kinds of business—the larger the plant grows, the less money there is, unless one is permitted to increase the prices, in proportion. I believe that it would be possible for all companies to obtain these concessions, if the telephone companies would educate the people to know that this has to be done.

The Independent companies, in the pioneer days of the Independent work, made the mistake of cutting the prices of the old Bell company too low; and, not realizing that that would put many more telephones in use, they found themselves with a proposition on their hands that was very hard to handle, unless the City Council would be generous enough to change their franchise and allow them to raise their rates, and, even then, it was hard to educate the people so that they would be willing to pay the new rates. The Independent people should make a point of enlightening the people upon this subject. Everyone who has seen our franchise looks upon it as one of the best in the United States, particularly because of that one clause, and it astonishes everyone that I could secure the contracts in the same way.

My husband organized the old Detroit Independent company. After his death, the company went into the hands of the Erie company; but, in justice to the gentlemen who had control of the company at that time, I will say this: I really think that, if the Detroit company had had a price for telephones at which they could have maintained a good plant, and, at the same time, have made a good profit, that consolidation would never have been made. The price the old Detroit company had to make was one that was not asked for. At the time we were seeking the franchise we asked for $36 and $56; but there was a strong fight made by the local company, and the council—hoping to defeat us—put the price down, and, as it was the best we could do, we accepted the franchise. Starting out with 2,000 or 3,000 telephones, it was a very good proposition; but when the company has 6,000 or 7,000 telephones, it found that it had not a paying investment.

We have exchanges in a number of the small towns around El Paso—one in Alamaguado, N. M., 80 miles distant, with 200 telephones; another in Cloudcroft, a distance of 20 miles, and a third in Deming, a distance of 80 miles in another direction, where we have 150 telephones, and from there we expect to run to Silver City. I received a telegram yesterday saying that our company had just been granted a franchise in Chihuahua, Mexico, across the line from El Paso.

Our distances are quite great, and we have hardly the proposition that you have here; but the people are very nice, indeed, and they are very willing to pay a good price for long-distance service. The gentlemen of the Chamber of Commerce sent me word that if we were ready to go ahead with our long-distance lines, they would be glad to give us the preference, as they felt that we, having the local plant at El Paso, held the key to the situation, and that the long-distance service rightly belonged to us.

We would have had the El Paso plant opened several months ago, but for the fact that the Bell company has never ceased in its fight aaginst us. It has been one injunction suit after another. It has now gotten to a point where the Bell company has just 10 subscribers that we have not on our list.

A new field telephone system, invented by Captain Charollis of the French army, will be tested at the forthcoming French army maneuvers. It is stated by the inventor that moving bodies of troops not more than six to seven miles apart can easily and quickly communicate with each other by his system. The telephone wire is of very small gauge and is laid on the ground. Whether the wire is walked on makes no difference. It will operate so long as the ground is dry, and during moist weather is to be strung along fences, trees, or on any convenient poles. The weight of half a mile of the wire is less than six pounds.

The Church Telephone Situation at Washington, Ind.

Considerable newspaper publicity has been given to a recent use of the telephone connecting a church with exchange subscribers at Washington, Ind. The situation has been somewhat exaggerated by sensation-loving dailies. It is really as follows: The competition in that town between the Central Union Telephone Company and the local Independent company is quite animated, and as a result of this competition the local Bell manager decided to give his subscribers a free church service. Accordingly, a transmitter was placed in the pulpit of one of the churches and the subscribers' lines were cut in in multiple, so that they could all have the benefit of hearing the sermon and the singing. It was reported that the service was to be extended to the other churches, but this has been denied by officers of the Central Union company, who say that it was only an experiment and will not be repeated. The principal disadvantage of such a plan is that it ties up practically the entire exchange for an hour or more, and this cannot be permitted.

GENERAL TELEPHONE NEWS.

Three hundred linemen employed by the Nebraska Telephone Company of Omaha have been granted an increase in wages amounting to from 10 to 25 cents a day.

The Rocky Mountain Bell Telephone Company has asked the city of Ogden, Utah, to extend its present franchise 50 years. The present contract has eight more years to run. The telephone company offers to place many of its lines in the city underground.

The mayor of Ottawa, Ont., has received from the Elektrisk Bureau, Christiania, Norway, a tender for the establishment of a telephone system in Ottawa with a minimum of 2,500 and a maximum of 5,000 subscribers. The tender is merely for the apparatus and central exchange. The figures are withheld for the present by the civic authorities in view of the uncertainty of the telephone situation of the city.

The Philadelphia Record states that a merchant of that city was recently called to the telephone to receive a doctor's announcement that he was the father of a baby girl. Then the doctor proceeded: "Your daughter wishes to speak to you. Hold your ear there while I lift her up." Mr. Smith held his ear there and heard with strange emotion the inarticulate complaining voice of the little daughter whom he had not yet seen.

The strike of the telephone operators of the Iowa Telephone Company at Des Moines still hangs on. The boycott has been resorted to, with some effect, for a number of firms have ordered out the instruments of the company. The boycott, however, introduces an element of complexity, owing to pre-existing yearly contracts. Linemen at Davenport went out on a sympathetic strike, but the operators in that city have flatly refused to strike.

Ernst Ruhmer of Berlin, the well-known electrical inventor, is said to have succeeded recently in telephoning seven kilometers by his wireless method. The speaking voice was stated to be perfectly audible continuously during the experiments. Ruhmer, who hitherto has used a searchlight 35 centimeters in diameter, intends to construct another between 100 and 200 centimeters, expecting to speak 40 kilometers. It is asserted, however, that the apparatus is too large, too expensive, and too delicate to be practicable commercially, but it will be useful to warships in transmitting orders at sea. Ruhmer's invention acts on the principle of the transformation of light waves to sound waves by using a searchlight and a microphone.

MANUFACTURERS AND DEALERS.

The Gilliland Telephone and Supply Company of Adrian, Mich., has been incorporated with a capital stock of $10,000.

The Chicago Record-Herald of July 29th said: "The assets of the Western Telephone Construction Company were placed in the care of the Equitable Trust Company as receiver yesterday by Bankruptcy Referee Frank L. Wean. This was done on the application of creditors, who alleged that the concern is insolvent and that its officers have made preferential payments." This is the reorganized Western Telephone Construction Company. The older company of that name went into bankruptcy in 1900 and has since paid about 50 per cent. on creditors' claims.

The Kellogg Switchboard and Supply Company, Chicago, has recently closed a contract with the Northern Construction Company of Bryan, Ohio, for a common-battery, multiple switchboard for Vincennes, Ind., having 1,500 lines' ultimate capacity, and a framework large enough for 3,000 lines. The present equipment will contain 640 lines. Included in this contract are 600 standard common-battery wall telephones, with quartersawed-oak woodwork, and concealed line binding posts; also all necessary power apparatus, main and intermediate distributing frames, relay racks, and sneak-current arrester equipment.

Success in Long-distance Power Transmission.[1]

By F. A. C. Perrine, D.Sc.

Two elements make success in the long-distance electrical transmission of power—continuity and regulation. Perhaps these are the most important elements in any electrical undertaking and are the most obvious, but in attaining our ideal in long-distance work, there lurk pitfalls about these two elements unknown in other fields of the art. From the outset in the original studies, and down the line to the last switch and insulation, lie unknown problems and problems known, but unsolved. It is the field of the thoughtful, independent engineer; the ground is stony and fit traveling only to the most resourceful.

Hydraulic development is one of the oldest arts, but the amount of human ignorance concerning hydraulic problems and conditions is appalling. Records may have been kept of the rivers whose waters are navigable, or whose rapids and falls are along the railroad lines, or in the manufacturing villages; but an investigation of the records available concerning important powers, even a few miles out of the regular lines of travel, would surprise you by their lack of accuracy and detail. Rainfall has been kept for generations for the benefit of agriculturalists, but the watershed of no one power stream of my acquaintance has ever been completely covered in its essential details by rainfall records.

The water available at any one point where the rainfall can be approximated will be estimated by different engineers from 15 per cent. to 70 per cent. of the total fall, and, apparently, each will be justified by engineering precedents. Such possible variations call for the exercise of caution, judgment and experience in reaching conclusions.

Nor is there less uncertainty in regard to hydraulic construction. The present year has seen the failure of dams built by engineers of the highest reputation and at water pressures for which they were supposed to be safe. The flow in canals, ditches, flues and pipes are still subjects of dispute, and errors in design are continually leading to serious results for the investor. The one lesson to be drawn from all this being that, if continuity only means success, the studies in waterpower location must be made with unusual care, and ample, though never ridiculous, margins allowed in the estimates.

Regulation in direct-current work is a simple problem. Its laws are all known; at every lamp it is quite easy to predict the variation of voltage. The same laws control, whether the lines be long or short. In his transmission plants Thury has met no new difficulties, but has effected regulation at 10 or 20 miles, just as he would have done had the delivery been made only in the next room to his dynamo. Resistance is always resistance, and his dynamo characteristics remain unaltered by its increase. He deals only with current, voltage, and resistance, and encounters problems simple even to Faraday, Henry or Ohm.

It has been said very truly that the introduction of the alternating current raised the electrician above the rank of the artisan. With these currents he is no longer dealing with a few simple independent quantities connected by a primary rule, but must now consider many new elements, some constants and some variables. At every step capacities and self-inductions enter into the solution in complex and involved relations. Regulation can no longer be simply determined for each part of the system independently, and the regulation of the whole obtained by a consideration of the parts separately. Self-inductions and capacities affect each other, and the generators and lines, as well as the transformers and motors must be chosen or designed with this independent relation in view. A simple case illustrates this beautifully.

When the operation of the transmission supplying current to the city of Stockton, Cal., from the power plant at Mokelumne Hill, 46 miles away, was first begun, a curious state of affairs was observed. In operation of the lines alone, the current required on the 2,200-volt side of the step-up transformers was 60 amperes; with the step-down transformers connected, the current fell to about 50 amperes, and when a 100-kilowatt motor was put into operation the current was only 55 amperes. The transmission was designed to be at 25,000 volts, but at the delivery end of the line the voltage was found to be 27,200 volts, and finally the motors consumed full current when running at no load and not much more when operating with full load applied.

I think that all will agree that here are problems enough for one small instance of the difficulties in the regulation of a long-distance transmission plant.

The lines in this case had been calculated for an eight per cent. loss of energy for transmission of 1,000 kilowatts, and capacity played the most important part in these pranks of voltage and current. With the lines alone, the capacity was so great as to absorb an apparent energy of over 130 kilo-volt-amperes. This is reduced when the transformers are connected and some real energy begins to flow and the self-induction of the step-down transformers neutralizes some of the capacity of the line. When the motors are connected, the real energy is increased and the self-inductances of the various parts of the system become more important.

The apparent rise of voltage along the line illustrates the interdependence of the whole system even more clearly, for it is only in a very small part due to the line itself, or rather, while due to the line, it occurs in the step-up transformers and not to any extent along the line.

It is not uncommon to attribute such an effect to resonance, which really only rarely becomes important; in reality, the regulation of the transformer produces this effect. With any transformer fed with a constant voltage at the primary, the secondary voltage falls with non-inductive load and falls still further if an inductive load is applied, but if the load is a capacity load, the secondary voltage rises instead of falls. In this case, therefore, the step-up transformers were delivering a 10 per cent. higher voltage to the line than their transformation ratio accounted for, which necessarily disturbed the regulation seriously. This trouble became even more serious when a heavy induction motor was later operated by the same plant. The load on the motor accounted for a fall of potential amounting to four per cent., but the inductance produced a drop of 10 per cent. at least; and, as the rise of voltage on the line at no load was as much as 10 per cent., it may at once be seen that the voltage varied when the motor was connected from 10 per cent. above normal to 10 per cent. below, and thus a variation exceeding 20 per cent. was produced in place of a variation of four per cent., for which the load allowed.

The effect upon the synchronous motor was also due to this ever-troublesome capacity. The generators were giving nearly a true sine wave of electromotive force, while the motors were designed for a peaked wave, the line capacity so affected the generator wave that the difference between the motor and generator became great, and for part of each wave the motor was absorbing power, and for its remainder delivering power, so that always a great current was flowing.

In this particular case these troubles were corrected by the introduction of a heavy self-induction across the ends of the line which neutralized the line capacity; and this self-induction was used until an inductive load was connected in the shape of induction motors, which rendered the use of an extra self-induction unnecessary.

Whenever this arrangement can be thoroughly carried out and the capacities and self-inductions connected to any line be evenly balanced, the alternating problem can be reduced to the simplicity of the direct-current problem and long algebraic equation abandoned in determination of the expectations.

There is little service which calls for absolutely continuous power. Most plants, which are said to be operating "day and night," shut down at meal times and are rarely operated more than 20 hours of the 24, and even where the operation is continuous through the day, there is a cessation of operation on Sundays and holidays. For this reason, it is difficult satisfactorily to balance the capacity of the line against the inductance of any load. The line-capacity current is constant and is continuously in evidence so long as the voltage is applied to the line; indeed, it varies only with the voltage and periodicity. Its importance increases as the load diminishes, for when the load is heavy it is not only completely overcome by inductance, but also is rendered unimportant by reason of the presence of a large current in phase with the electromotive force. During the time when all loads are diminished, the disturbance of regulation by reason of the presence of a line-capacity current is most apparent, and consequently the counteraction of that capacity effect, by a heavily inductive load which is off during these same periods, is a remedy which only accentuates the disease. This was illustrated in the case described above, where a severe induction load depressed the voltage, and its removal allowed the full rise due to line capacity.

In the case of the Standard Electric Company's transmission and that of the Bay Counties Power Company, where transmission of approximately 150 miles at 50,000 volts and 60 cycles are undertaken, the charging current is approximately 40 amperes; or, in other words, the line requires the full capacity of a 2,000-kilowatt machine for charging it as a condenser. The complete neutralization of this great capacity effect would require the continuous working of something in excess of 5,000 kilowatts of induction motors with average normal power factors.

Up to the present time no load on the Bay Counties lines has ever been applied which is capable of neutralizing this capacity effect. The power house is practically unable to have much knowledge of the loads actually applied on the lines except by observing the wattmeters or the wheel nozzles, since the current from no load up to a load of several thousand kilowatts remains practically constant. As there are many branching lines supplied from this system, it is impossible to operate other than with constant electromotive force at the dynamos, and the regulation of the long lines is affected by the capacity, which influences everything from the step-up transformers to the last motor.

In order to overcome the troubles due to this source the Bay Counties company has arranged to place upon its lines impedance coils capable of practically neutralizing the entire capacity of its long lines; and as soon as these are installed, one of its greatest difficulties in obtaining satisfactory regulation will be removed. With the capacity of the line neutralized, it then becomes necessary to keep the load as nearly non-inductive as possible by continuous care in the balance of synchronous against induction motors in the operation of loads.

It is a great mistake for an engineer to become an advocate of one motor to the exclusion of the other type. Both synchronous and induction motors have their spheres of usefulness, and practically every long-distance transmission demands for its satisfactory regulation the use of both types. Where the powers are small and the loads easily started, the simplicity of the induction motor and ease of installation renders it especially suitable, but as their numbers increase, the effect of the lagging currents they absorb becomes important in disturbing regulation, so that it soon becomes necessary to neutralize this lagging current, either by the introduction of condensers or of synchronous motors.

With a synchronous motor it is possible to counteract the effect of large and variable inductive loads, and, when they are installed in the sub-station at the delivery end of the line, a ready and satisfactory means of controlling the voltage, whether it is disturbed by inductive or non-inductive loads, is provided. Practice with these machines indicates, however, that they are still very useful if installed at points out of control of the sub-station attendants, provided only that their power of controlling voltage be not used maliciously, since they are generally most useful when the exciting current is adjusted to a minimum, a condition for which instructions are easily issued and of which the reasonableness appeals to the most ignorant attendant.

Much has been written and said of the resonant condition of a line, but up to the present time practice in the installation of plants and connection of motors, transformers, and other devices has not led to important interference from this source. What is called the resonant line, or distortionless line, can be obtained in two ways, either by the connection of capacities and inductances in series, or by their connection in parallel.

What has so far been said covers fairly well the question of purely electrical problems of regulation, and to call your attention to the essentials of the problem, it only needs the summary that regulation in a long-distance plant is attained by:

First—A wide possible voltage variation in the generators, with generators and transformers both designed, not for good non-inductive load regulation, but for good inductive load regulation.

Second—Lines designed for the smallest possible capacity current, without reference to any attempt at balancing the line capacity against the load lag.

Third—The use of reactance coils for balancing the constant capacity of the line.

Fourth—The use of synchronous motors as a variable capacity for balancing the variable inductance of the line and the inductive motor load.

Of the elements of design which involve most nearly the question of continuity, supreme importance attaches to the insulators, the switches and the lightning arresters.

To be sure, the entire problem of continuity is also the whole problem of design. Everything must be built to withstand the strains, and the methods of accomplishing this are neither easy nor obvious; many of the well-established methods of conveying and controlling water must be abandoned in favor of those which are more enduring. Open ditches and flumes are giving way to enclosed and lined trenches and tunnels.

For station structures, the extreme of strength and fireproof character must be resorted to, and the whole transmission line must be built for the greatest permanence. Spans are shortened, even in some cases to only one-third of that used in telegraph and telephone construction. Heavier poles are employed, most carefully set, and braced against even the slightest increase of strain. Rights-of-way are secured and cleared, so that these transmission lines stand up against the storms and fires that lay waste the countryside.

But, returning now to the purely electrical part of the problem with which we are most directly concerned, for the present, and directing our attention to the insulators, which present the first and most difficult problem, we find at the outset a royal battle waged between the insulating properties of glass and porcelain. In this country glass has for many years been the king of the insulators; abroad, for an equal length of time, porcelain has remained pre-eminent.

For potentials up to about 25,000 volts, where an insulator of seven inches diameter is sufficient, there seems not much reason for the employment of anything except glass, unless the lines reach a size above half an inch in diameter, when its strength is deficient. For these lower potentials and lighter lines the good properties of glass are easily summarized. In the first place, it is cheaper by far; while not so strong as porcelain, it is, as has already been said, sufficiently strong for the purpose; its inspection is easier and surer, since it requires only a visual examination and a few taps of a hammer to ascertain its soundness in place of the tedious high-potential test necessary in the examination of porcelain. But having said this much, all has been said that is possible in favor of glass.

It is not true that glass is a better insulator than sound porcelain, nor is its surface so good

1. Abstract of paper read before the Society of Arts of the Massachusetts Institute of Technology at Boston, Mass., on May 8, 1902. Dr. Perrine is the well-known president of the Stanley Electric Manufacturing Company.

in damp weather against surface leakage. The mechanical strength does not equal one-half that of porcelain, as has been proved by a long series of mechanical tests performed by dropping a steel ball from a height upon insulators of the two materials; temperature also affects it much more than porcelain, and it is often found to crack simply from the effect of extreme changes of temperature.

The insulators for high-voltage lines must be very large, for the reason that with a striking distance through the air of from four to six inches, great gaps must be provided in the path of the current. But, above all, a great creeping distance is essential.

Insulators that are a perfect protection in the hardest rains fail utterly in clear weather when covered by smoke and soot, which allow small amounts of current to escape and char away the pins or cross-arms. The compound insulator is very attractive, for the reason that it is easier and cheaper to make and handle two or three small parts rather than one large one, and in some cases the additional advantage has been sought of securing the good properties of both glass and porcelain by making parts of an insulator of each; but there is both a theoretical and practical fallacy in this type of design. In the first place, no dielectric is so strong as one entirely homogeneous. As the stress is passed from glass to porcelain, or vice versa, at the two surfaces, the stress piles up, as it were, and it is better if one believes in glass, to rely upon it; or, on the other hand, to show faith in the porcelain used by employing it entirely.

Switching and switching devices are most important and most difficult. Step by step the switch has improved in the electrical art from the simple commutator used by Faraday and Henry, which generally consisted of copper wire dipping into mercury cups, until, as you know, up to the present time a great amount of ingenuity devoted to the study has resulted in the production of elaborate and beautiful electrical and mechanical mechanisms. Switching for high powers, whether at low potential and great currents or at high potential and small currents, seems to be an altogether different art from switching where the spark that may follow can do but little destruction, and its heat is readily dissipated. Almost all low-power switches are designed with the idea that a spark may occur at the break, but as the energy of the spark is small, the mass of the switch will carry away the heat, or the portion of the switch destroyed will be inconsiderable and may be easily replaced; but as soon as it becomes impossible to contemplate the destruction of a portion of the switch in the rupture of the current, switching becomes impossible by such simple devices, the whole art of switching is changed, and designs along entirely new lines must be produced. The great pneumatically controlled switches in the large power stations of New York and Boston exemplify this principle. Hardly anything in switching for small currents is similar. They are not simple switches, giants in size, but their method of operation is based upon a new principle, and they involve in their construction much ingenuity and engineering study. A satisfactory switch must leave the circuit undisturbed as far as possible, and must introduce no new difficulties by reason of changed values of the constants. Furthermore, if a switch could be built which would simply instantaneously stop the current, the effect would be an immediate and great rise of potential due to the sudden fall of current through the capacities and self-inductions of the system. The open-air switch which, in its essential particulars, is simply that of the ordinary knife or snap switch as used for low potential, draws an arc at almost full current value, which arc, being rapidly oscillating in character, effects an increase of the periodicity on the line, and thereby brings about great potential rise. We see, therefore, that a switch to be satisfactory on a high-potential circuit must neither rupture the circuit too suddenly nor draw an oscillating arc.

Of course, no wire-wound or carbon rheostat can be introduced into these switches, and the only resistances that are available are liquid and gaseous resistances. It is almost too soon to say that any particular type of switch has resulted from the experiments of the past two years which will be considered for all years to come the final type; but the successful work that has been done is along the line, as I have said, in the introduction of liquid and gaseous resistances. These resistances are the only ones that are high enough in value to be enclosed in the small space of a switch and which do not introduce additional complexities into the station system. The gaseous resistance is obtained in the oil switch by the carbonization of the oil as the switches open; provided there be a sufficient amount of oil above the switch contact, so that as the circuit is opened the production of gas does not blow the oil out of the switch, a very satisfactory type of switch is produced, and one which our present experiments seem to indicate will gradually cause the rupture of a circuit without the production of excessive rise of potential.

The vaporization of metallic oxides has also been successfully used for this purpose, but when these oxides are vaporized in the switch it is difficult to retain them within the switch and they scatter their dust through the whole station. The liquid switch is one of the comparatively new developments, and seems in many respects to be the best of all, since the liquid is always prepared as a resistance under all circumstances and does not depend upon the energy of the current to make it the imperfect conductor required. Therefore, the disadvantage of the occasional failure of the switch from too rapid or too slow production of the vapor, as is the case with the vapor switch, is avoided. An incident in the difficulty of obtaining the proper switch for high-potential working is the difficulty of insulating its moving parts and operating mechanism.

Lightning protection for long-distance transmission lines is, as one can readily see by the slightest consideration, of the utmost importance. The lightning protection of a transmission line is not against strokes of lightning, but against the induced currents in the line by reason of neighboring lightning strokes. Furthermore, any transmission line must be protected against variation of atmospheric potential in clear weather. One of the most effective devices that has been used is the erection of a continuous lightning rod along the entire line. For this purpose barbed wire, grounded at the poles, has been employed. Where it is not used, reliance is placed altogether on the lightning arresters, through which the line may be grounded, these being installed either at the ends of the line or at the ends and at intermediate points. No mechanically operated lightning arresters are ever used for this purpose in alternating long-distance transmission work, the devices employed being either of the non-arcing metal type or of a type where the air current produced by an incipient arc between the parts of the arresters blows out the arc before the machine current has an opportunity of following and affecting destruction. In some devices the combination of these two effects is to be found.

The experiments which have been tried up to the present time seem to indicate that a resistance or an impedance, or, resistance and impedance combined, must be installed in the path of the ordinary lightning arrester in order to enable the induced charges on the line to pass away readily without noticeably increasing the effective line potential and without grounding and short-circuiting the wires. The handling of this problem has been one of the last to be solved and one of the most troublesome questions involved in the engineering of transmission lines.

I have this evening been endeavoring to call to your minds the problems met by the transmission engineer and the difficulties he has to solve, which are not presented to his brethren in handling ordinary electric lines and currents; and though I may have given you the impression that there are many questions yet to be solved in order to bring about success in long-distance transmission, when success is measured by practically perfect regulation and practically absolute continuity, still it would be incorrect for me to have given you the impression that the engineers are still groping in the dark for a solution of their problems for the attainment of success as measured by the criteria I have laid down. The limitations I have placed upon the solutions that have been already applied relate only to the question as to whether present solutions are in their final form, and it would be a wonder of the world if, with long-distance transmission beginning in 1894, with a small plant at Portland, Maine, and a small plant at Housatonic, Mass., the solution that had been reached in 1902 for the problem as extended to 200 miles were in the final form; and if I have given you to-night some of the inside history of the difficulties to be encountered by transmission engineers, you would be doing me and those engineers an injustice to believe that I have been doing anything excepting calling to your attention the difficulties that have been met and the construction which still remains to be improved, while at the same time announcing the triumph in practically and successfully transmitting power up to 215 miles, and practically and successfully building at least two plants for the permanent distribution of energy at distances in each plant exceeding 150 miles.

Johnny's Poem on the Lightning.

[From the Cincinnati Commercial Tribune.]

One time A Lightning came down from
the sky, ten Miles or More
and Said "i Think I'll make a strike
were I ain't Striked before."

an' Then the Lightnin' hit a track—
a Streetcar Track, it wuz
and went a hummin' up the rail,
which soon begun to buz!

But When that Lightning reached the place
Wher all the Cars Turnt round,
It tried to step off of the rail
and git into the Ground,

but, no sir! that Trick wouldn't work—
The Track It Helt him Down,
and so he started Back agin
'bout 'leven miles to Town.

he Found it was the Same thing there,
and then he Spit and Cried,
But Motormens they made him work,
though he tried Hard to hide;

they've named him E-lec-trix-i-ty,
they've got him by the Tail,
and I'll bet you he's Sorry that
he Ever Struck that Rail!

Rev. F. L. Odenbach's thunderstorm indicator and recorder, fully described in the Western Electrician of November 30, 1901, has been experimented with by the government and may be installed in the Weather Bureau of Duluth, Minn. The invention is regarded by the government as one of considerable value.

Steel Smelting by Electricity.

The problem of smelting steel by electricity has for some time attracted the attention of inventors, and many experiments have been made to achieve the desired end. In the beginning of the year 1900 an electric steel furnace, without electrodes, was built at Gysinge, in Sweden, and its action watched with considerable curiosity as to its successful operation. After a few experiments, the first ingot was produced and the steel was found to be of an excellent quality. Thus, the problem was solved in a technical way, although considerable progress was necessary before the process could be considered a commercial success. In November, 1900, a larger furnace was built on the same lines as the first one and proved much more successful than its predecessor. In August, 1901, both furnaces were ruined by fire and the firm experimenting with them decided to build a steel works.

This information comes from the Trading and Shipping Journal of Gothenburg, Sweden, and is not as complete, electrically, as might be desired. However, it is stated that in the new works a 300-horsepower dynamo, direct-connected to a turbine, will furnish the current. The new furnace will hold 3,970 pounds, and its yearly output is estimated to be in the neighborhood of 1,500 tons if charged with cold, raw material. The steel made under this process is said to be of a superior quality, characterized by strength, density, uniformity, toughness and the ease with which it can be worked in cold, unhardened condition, even when containing a very high degree of carbon. Tungsten steel manufactured by this process is said to make stronger magnets than other tungsten steel and does not warp in the hardening. Microscopic experiments have shown that the electrically made steel is not different in any way from crucible steel.

Power Transmission in the Hudson River Valley.

The capital stock of the Hudson River Electric Company has been increased from $1,000,000 to $3,000,000. This company has acquired a controlling interest in the stock of the Hudson River Power Transmission Company, which company owned the concrete dam at Mechanicsville, N. Y. The Hudson River Electric Company is in turn controlled by the Hudson River Power Company, builder of the dam at Spiers Falls, which is nearly completed. The Mechanicsville plant has a capacity of nearly 7,000 horsepower and furnishes power to the General Electric Company of Schenectady and to the United Traction Company of Troy and Albany. The Spiers Falls dam, when completed, will be able to furnish electricity for power and light to any city within a radius of 50 miles. The same interests which control the above power companies figure very largely in the control of the Hudson Valley Railroad Company.

Arbitration on Street-railway Wage Question.

Employes of the Chicago City Railway Company, who are members of a newly organized union, recently asked for a raise in wages, and, failing to get the full amount sought, 28 cents an hour, agreed to submit the matter to arbitration. The arbitration committee decided to recommend that the wages of the conductors and motormen be raised to 24 cents an hour, an increase of three cents, and also recommended a minimum working day of eight hours and a maximum day of 11 hours. The union decided to delay accepting the decision until a request for an increase in the wages of barn and shop men be granted. This demand may also have to be settled by arbitration. The arbitration agreement in respect to the motormen and conductors provides that there shall be no strike or cessation of work for the period between August 1, 1902, and October 1, 1903.

Glass Factory to Be Electrically Equipped.

Electrically operated glass factories are not common, and therefore the announcement that the Illinois Glass Company of Alton, Ill., has purchased, through W. R. Pinckard, material for an extensive power-transmitting plant, is of some interest. The electrical apparatus is all of Westinghouse make and will be used for the operation of the machine, blacksmith and mold shops, blowers, etc. It includes two two-phase, 440-volt, 60-cycle belted generators of 120 and 250 kilowatts, respectively; 20 induction motors, 38 transformers and arc and incandescent lamps. Charles A. Chapman of Chicago is consulting engineer for the Illinois Glass Company.

A company has been formed in London, England, with a nominal capital of $875,000 for the purpose of exploiting the Armstrong-Orling system of wireless telephony and telegraphy. It is stated that the company will soon begin operations on a large scale and will erect factories in England and France. The company proposes to furnish at moderate prices handy wireless-telephone and telegraph apparatus for private installation and use. It is expected that these devices will operate to a distance of 20 miles, the electrical impulses being transmitted through the ground. The receiver used is said to be 50 times more sensitive than Thompson's syphon recorder.

CORRESPONDENCE.

New York Notes.

New York, July 28.—The Rapid Transit Commission on Thursday, by an unanimous vote, awarded the contract for the tunnel under the East River, by means of which the subway rapid-transit system is to be extended to Brooklyn, to the Belmont-McDonald syndicate, which is now building the subway in Manhattan. The contract provides that the tunnel shall be built for $2,000,000 and the terminals for $1,000,000 additional. The syndicate also offered to build for $1,100,000, less than half its cost, a subway under Broadway from Forty-second Street to Union Square, but this plan was rejected. The only other bid considered was submitted by the Brooklyn Rapid Transit Company, which offered to build the tunnel for $7,000,000, with $1,000,000 additional for terminals. The construction of the tunnel will cost from $8,000,000 to $10,000,000, but it is explained that the Belmont-McDonald syndicate can afford to do the work for $3,000,000 as it has an enormous quantity of building equipment on hand and because it needs the Brooklyn tunnel to connect with its Manhattan system. The Rapid Transit Commission at its meeting also directed the chief engineer to prepare plans for a second tunnel to Brooklyn, on which the Brooklyn Rapid Transit Company, if it chooses, may bid.

On Tuesday, by a vote of 56 to 10, the Board of Aldermen rejected the contract made by the rapid-transit commissioners with the Pennsylvania, New York and Long Island Railroad Company for the construction of tunnels connecting New Jersey with Manhattan and Long Islands. Many of those voting in the affirmative said they were not opposed to the tunnel, but did not think the municipality has been properly safeguarded. As the matter now stands, the contract goes back to the Rapid Transit Commission for revision and modification with special regard to the question of union and resident labor, compensation, and the real purposes of the railroad corporations. It is announced that the Pennsylvania company will submit a new ordinance.

Preliminary work for the introduction of wireless telegraphy at the New York navy yard has been completed, and messages will be received as soon as the instruments are put in place. The first trial will be from the station now being set up at the Atlantic Highlands, which will be one of the connecting links that will go to make up the system of wireless telegraphy along the coast.

Charles B. Thwing, professor of physics at Syracuse University, has sold to L. S. Langville of this city his patent on a thermo-electric generator. A company will be formed for the manufacture of the generator, Mr. Thwing retaining an interest. The purpose of the generator is to convert heat power directly into electric power.

It is announced that the army has ready for use at the coming naval maneuvers on Long Island Sound an instrument by which the approach of a steel-armored battleship, cruiser or gunboat can be detected at a distance of 50 miles. This device is known as a "magnetic balance." It is extremely delicate in mechanism, and, it is claimed, so sensitive in the body of water in which it is immersed that the size of the vessel which causes its indicator to fluctuate can be estimated with a fair amount of accuracy.

The Rapid Transit Commission has decided to have three tracks instead of two on the elevated section of the rapid-transit road in the Borough of the Bronx. The elevated portion will begin at Brook Avenue and extend to Bronx Park. Plans for the third track are in hand, and the building of it is to be classed as extra work. The difference in the cost of the section with a third track is $400,000.

The first extended report of the Rapid Transit Commission ever compiled has just been sent to the mayor. There are 299 pages and several maps in the report. More than half of the volume is devoted to a historical résumé of rapid-transit undertakings. Data and tables are given showing the cost of the subway and the expenses of the commission. Chief Engineer Parson's division of the commission's report deals with the engineering problems of the subway, including sewer removals, digging in sand and gravel, rock mining, shifting of pipes and conduits. He states that the total number of miles on the road is 20.81. Pipe galleries and other difficulties undertaken or abandoned are dealt with fully. The volume has many illustrations showing scenes along the road, and there is attached to the main section of the report a list of the commission's employes.

Mayor Low has received from the officers of the New York Central and Hudson River Railroad Company an offer to change the motive power of all its lines within the city limits from steam to electricity. This includes the Park Avenue tunnel and the open railway to a point in the Bronx not yet determined upon. M. L. G.

New England News.

Boston, July 26.—The incorporators of the New York and Berkshire Street Railway Company have perfected the company's organization by the election of the following-named officers: President, R. C. Taft of South Egremont, Mass.; treasurer, William C. Dalzell of South Egremont; secretary, O. C. Bidwell of Great Barrington, Mass.; consulting engineer, H. F. Keith of Mount Washington, Mass. The company has accepted the charter granted by the last Legislature and proposes to build an electric railway between Springfield, Mass., and Copake, N. Y., a distance of 65 miles, covering a territory with a population of 92,000 people. The charter allows the company to carry freight.

The Weather Bureau and telegraph office at New Shoreham, R. I., was burned July 17th, in a fire that destroyed property valued at $50,000. The Weather Bureau's loss was $1,500.

Spontaneous combustion recently started a fire in a pile of excelsior in the General Electric Company's factory Q, at West Lynn, Mass., and caused a loss of $500.

The J. L. & T. D. Peck Manufacturing Company of Pittsfield, Mass., has ordered the necessary machinery for installing a plant to make cotton finishing thread for covering copper wires for electro-magnets, dynamo armatures, etc.

The Andover (Mass.) selectmen have granted a new franchise to the Haverhill and Andover Street Railway Company, which is to build between that town and Haverhill. The company will macadamize a street through which its tracks will be laid.

The electric railway between Warren and Swansea, R. I., was opened for traffic on Tuesday. The cars of the Providence and Fall River line are being used.

The West End Street Railway Company of this city has sold four per cent. bonds amounting to $300,000, dated August 1, 1900, and maturing August 1, 1915, at better than 104. The proceeds are to be used in refunding a matured issue of Highland Street Railway Company's 5½ per cent. bonds amounting to $300,000. B.

Canadian Intelligence.

Toronto, July 25.—The Ontario government is installing electricity, both for mechanical and lighting purposes, in the insane asylum at Orillia, Ont. The power is to be transmitted from Ragged Rapids, on the Severn River, 18 miles from Orillia. At this point 1,500 horsepower has been developed, and there is still 2,500 horsepower to be "harnessed." The government is to pay $18 per horsepower, and can use the power continually.

The Canadian Pacific Telegraph Company is stringing 2,000 miles of new wire from Sydney to Halifax, from Montreal to St. John, from Montreal to Sault Ste. Marie and from St. Thomas to Watertown, Ont. The new lines will require 200 tons of No. 9 copper wire.

The Canadian government has reduced the telegraph rate between Ashcroft, B. C., and Dawson from $4.50 to $3 for 10 words.

The waterpower at Kingston Mills, Ont., is to be utilized for the purpose of furnishing power to Folger Bros., with which to operate the street-car service in Kingston and to supply residents along the line.

J. Buntzen, general manager of the British Columbia Electric Railway Company, states that, owing to the difficulty in purchasing cars in the United States, owing to the demand there, his company has been obliged to establish shops at New Westminster and build its own cars, the first lot of which will be finished and running on the lines by October 1st.

C. W. Spencer, vice-president of the Hull Electric Railway Company, since the line has been taken over by the Canadian Pacific, states that he finds the electrical department of the system in first-class order, but that immediate steps will be taken in the direction of improving the whole line, including the roadbed, buildings and cars.

The Ottawa (Ont.) Electric Railway Company has been reported to the City Council by a subcommittee appointed by that body, as having used 40-pound rails on parts of its system. It is asked to replace them with 56-pound rails. The motormen and conductors do not take kindly to the refusal of the company to increase their wages, and the success of the men on the Montreal and Toronto railways in getting an increase is causing secret midnight meetings to be held for the purpose of organizing and forcing their demands on the company through a citizens' committee. H.

Southern Developments.

Charlotte, N. C., July 25.—The Kent and Cecil Light, Power and Railway Company has opened books of subscription at Chestertown, Md. Judge E. R. Cochran, Jr., of Delaware and others are the incorporators. The proposed line will be started at once. It will extend from Rockhall to the Delaware and Cecil line.

The Winnsboro and Rock City Electric Railway Company has been commissioned in South Carolina by Thomas H. Ketchin, W. R. Rabb, T. K. Elliott and others to build a line from Winnsboro to the granite quarries in Fairfield County. The capital stock of the company is placed at $50,000.

The Old Dominion railway of Portsmouth, Va., with many miles of extensions, has been sold, and the Gould and Williams syndicate is reported to be the purchaser. The amount involved will probably reach $1,000,000.

J. W. Minor has been granted a franchise to build an electric line at Ensley, Ala. Work will be started at once.

The Hillsboro Electric Company of Hillsboro, Texas, has been chartered with a capital of $50,000. The incorporators are O. Goodwin, W. C. Ross and others.

The street-railway strike declared in Knoxville, Tenn., nearly a year ago has finally been settled by the Knoxville Traction Company's agreeing to take back into its employ the men who struck as fast as vacancies shall occur in the service.

The Anderson Electric Company of St. Louis, Mo., will erect a six-story factory building, costing about $125,000. The building is to be completed by January 1st.

On August 12th the plant of the Ettrick Manufacturing Company at Ettrick, Va., will be sold under the hammer. The property embraces a large factory and a fine waterpower.

The North Carolina Corporation Commission has completed the assessment of the electric lines, telephone, and similar corporations for the present year. The result shows an increase in value of $370,000 over last year. The street railways are assessed at $1,199,000; the telephone properties at $389,484; the telegraph companies at $905,000, and the electric-light companies at $260,000. L.

From the Buckeye State.

Cleveland, Ohio, July 26.—The Everett-Moore people have sold their holdings in the Scioto Valley Traction Company of Columbus to Cyrus Huling, president of the Columbus Savings and Trust Company, who represents a number of capitalists of Columbus, Cincinnati and Dayton. The syndicate owned about 90 per cent. of the stock of the company. W. B. Woodbury of the United States Telephone Company represented the Columbus people in the deal at the Cleveland end of the line. The roads under construction have been graded from Columbus to Lancaster, and from Columbus to Chillicothe. They will be laid with heavy steel and will be equal to any steam roads. It is the intention to make an average speed of 30 miles an hour. It is possible that the lines may be extended from Lancaster to Athens and the Ohio River and from Chillicothe to Portsmouth.

The Lake Shore Electric Railway Company made a good showing for June. There was an increase of net earnings over the same month last year of $6,238.68, while the increase in expenses was $3,496.24. The system was operated on a percentage of 50.9 of the total receipts, which is considered very good.

Detroit United Railway stock has arisen from $70 to $83 in the markets in Cleveland and New York. While this has always been good property, the clearing away of the fog in regard to the Everett-Moore matters has given it a boom, and the tendency is to go still higher. More than 1,100 shares changed hands in one day this week.

There is a rumor current that there is to be a combination of a number of the electric railways about Columbus, and that Gay & Co. of Boston are interested in the proposed syndicate. It is supposed that the consolidation will be made up very largely of the Appleyard companies, in which case it cannot make much difference in the policy or operation of the roads. It is also said that A. B. Vorheis, president of the Union Savings Bank and Trust Company, Cincinnati, is interested in the matter and that the securities will be underwritten by that institution.

The village of Columbus Grove has sold $15,000 worth of bonds, and with the proceeds will purchase the electric-light plant now in operation there.

The local boards of underwriters in various Ohio and Kentucky towns have been making investigations as to the wiring of factory and business buildings. It is claimed that in some places they have found some very bad work, and that in some instances they have advised that the towns employ an electrical inspector.

The Central Market Street Railway Company of Columbus has increased its capital stock from $500,000 to $1,500,000, of which three-fourths is preferred stock. This company is now constructing lines and becoming quite active in railroad circles. Dr. S. B. Harman is president of the company and F. W. Merrick, secretary.

The Mansfield, Wooster and Canton Traction Company of Mansfield has been incorporated with a capital stock of $10,000. George H. Billman, J. M. Downey, M. S. Abel, George H. Taylor and John C. Dynes are the incorporators. They will build a line from Mansfield to Canton.

The officers of the Toledo, Fostoria and Findlay Electric Railway Company have increased the wages of their motormen and conductors from 15½ cents per hour to 17½ cents.

The Everett-Moore syndicate has sold half its holdings in the London (Ont.) traction property to Claude Ashbrook, the well-known broker of Cincinnati, who represents a number of capitalists. The price paid is $61, and Mr. Ashbrook has agreed to take half the holdings of any other stockholders if they will agree not to sell any of the remainder for less than $70 before the first of next January.

The Dayton and Kenton Railroad Company will build a power house at DeGraff, according to an interview which President E. M. Hopkins gave out a few days ago. The line will be something like 120 miles in length and the company now has rights-of-way deeds to 80 miles of the line. General Manager D. H. Rannells has resigned his position to

accept a place with one of the lines running out of Cincinnati.

Judge C. R. Grant, C. H. Wheeler and Senator George W. Seiber, all of Akron, are interested in another proposed line between Akron and Cleveland, which will cut down the running time to one hour, 40 minutes less than it is now made on the Northern Ohio Traction line. This is to be done by a more direct line, for which rights-of-way have been secured, and the use of a heavier steel than is ordinarily used on electric lines.

H. B. Camp of Akron, president of the Cleveland, Richfield and Akron Transit Company, has resigned his office. He is reported as stating that it will be impossible for a corporation to secure a franchise in Akron without the use of "boodle," and that he will not be a party to such a transaction.

Edward Spellman of Cleveland has been appointed superintendent of the Ohio Central Traction Company's lines.

An understanding has been arrived at between the Cincinnati Traction Company and the Cincinnati and Columbus Traction Company, by which the cars of the latter company will enter Cincinnati over the traction lines. O. M. C.

Information from Indiana.

Indianapolis, July 28.—The Muncie, Hartford City and Fort Wayne Traction Company has increased its capital from $100,000 to $1,000,000.

There is a double-track belt railroad 27 miles long around Indianapolis and the interurban lines all experience trouble in getting into the city, always meeting with objection and injunction proceedings. The Shelbyville company and the Belt Railway Company had agreed to construct a subway, but the county commissioners refused to grant the right. A viaduct is impracticable, and the question now is how the traction company is going to cross the Belt tracks?

The first electric car was run over the Indianapolis and Martinsville line to Mooresville last week. An hourly service will be given between the two points.

The Fort Wayne and Southwestern Traction Company, now operating a line between Fort Wayne and Wabash, has doubled its capacity in its power house in Huntington. It now has two 750-horsepower engines in service. The company will next build to Marion, by way of Warren.

Three stockholders owning 11 shares of the Union Traction Company's stock have brought suit to enjoin the consolidation of the Union Traction Company and the Northern Traction Company. Plaintiffs allege that the Indianapolis Northern is a paper road, and that the funds of the Union Traction Company are to be and have been used in promoting the Indianapolis Northern; that the latter has issued $5,000,000 in bonds, which it is unable to sell, and that in order to make the bonds marketable, the officers of the Union Traction Company entered into a conspiracy with the Indianapolis Northern officials in order to consolidate and make the Union Traction Company responsible for the liabilities of the other company. The petition also asks for a receiver for the Union Traction Company. This action was a great surprise to Mr. McCulloch, who says that the suit will not in any way delay the rapid construction of the Indianapolis Northern.

The Richmond City Council has accepted the $300,000 municipal electric-light plant erected by the Varney Construction Company of Indianapolis. The plant will be operated by three commissioners, appointed by the mayor. This enterprise has had a troubled experience, encountering suit after suit

The city of Crawfordsville is experiencing difficulty in compelling consumers to pay for electric lights. Under the new management if the tax is not paid monthly the current is cut off and a fee of 50 cents exacted to get it back after the delinquency is paid. The city owns and operates the plant, and it said delinquents were not cut off for political reasons.

The Indianapolis Light and Power Company paid the city last week $9,811.39, which is five per cent. of the gross receipts of the company for six months. The gross receipts were $196,227.85.

It is now almost a certainty that the city of Indianapolis will hold the new public-lighting contract over until the meeting of the Legislature, when the law will be changed so as to allow a 10-year contract. It is thought electric-light companies will not care to bid on a one-year contract, such as is provided by the charter. F.

Northwestern Notations.

Minneapolis, July 26.—The mayor of Sioux Falls, S. D., will oppose any attempt to sell the municipal electric-light plant to H. H. Natwick and associates.

A. G. Whitney and eastern associates have purchased the business of the St. Cloud Light and Power Company of St. Cloud, Minn., which they will merge with the Light, Heat, Power, Transit and Public Service Company, which is already controlled by the purchasers. In due time the two plants will be consolidated, but for the present both plants will be conducted as in the past.

Steps will be taken at once to form a lighting company at Mankato, Minn., to install a new plant and to give competition in commercial and city lighting.

Ballard, Wash., voted to install an electric-lighting system, but the council, after considering the matter, proceeded to shelve the proposition, in spite of the vote of 167 for to 82 against. Citizens now talk of raising a fund to take legal action to compel the council to carry out the expressed will of the voters.

A survey is in progress near Black River Falls, Wis., for the new power dam to furnish electricity for the electric railway to be built between Black River Falls and La Crosse. Another dam is projected at Council Bay, near Galesville, 40 miles away. With these two power stations, the company expects to be able to generate an abundance of power to operate the system.

Frank P. Mansfield of Lake Mills, Wis., has been granted a franchise at Shell Lake, Wis., for an electric-lighting plant.

The light and water company of Valley Junction, Iowa, has compelled the City Council to accede to its terms and grant a 10-year franchise and enter into a contract for light and water for the same term at increased rates. The council and the company have been deadlocked on the proposition for some time, and the company finally shut off the water and light from the city.

The new electric-power station at Appleton, Wis., is in use to furnish power for the street cars while the old station is still furnishing the power for the lighting system.

It is proposed to operate the swing bridges at Oshkosh, Wis., by electric power. R.

Among the Rockies.

Salt Lake City, July 24.—The De La Mar Mining Company has placed an order for $30,000 worth of electric machinery with the agent of the General Electric Company at Salt Lake. This mining company will build a large power plant in Nevada to supply the company's mill and mines.

Citizens of Trinidad, Colo., have raised $10,000, by public subscription, to further the project of building electric-railway lines outside of the city limits.

The electric-light company of Park City, Utah, will put in meters, abandoning the flat rates.

Albion, Idaho, has given up the idea of building an electric-light plant. Under the present conditions the plant would cost $6,000, which is considered too much for this small town to spend.

Construction work on the large power plant in Beaver Canyon, Utah, to be built by the Majestic company, will be commenced at once. Bids are invited on the construction of three dams. This is the heaviest piece of hydraulic work ever undertaken in Southern Utah. The company has located two more power sites, in addition to those noted, the upper one, or dam No. 5, being for a storage reservoir. When the plant is completed possibly 3,000 horsepower will be developed. Power will be transmitted to the surrounding mining camps and to the Cactus mine at Copper Gulch, 50 miles away.

The Consolidated Railway and Power Company of Salt Lake City is spending a large amount of money in the betterment of its tracks and rolling stock generally. Commencing July 1st, the company is hauling the mails between Salt Lake and Murray.

The electric-light company of Lewiston, Idaho, has decided to enlarge the capacity of the power plant. The cost of the betterment now going on will aggregate some $16,000. This includes a new 500-horsepower Pelton wheel, a large penstock to take water from the high flume, new street arc lamps for Lewiston, new transformers, and extensions of the company's lines. It is thought the company will secure the contract to furnish power for pumping to the city waterworks.

It is reported that a 5,000-horsepower plant will at once be erected at Malta, near Leadville, Colo. Power will be sold to the mines at $136 per horsepower per annum. The miners are now paying $240 and using coal. Power will also be supplied the proposed electric road connecting Twin Lakes, Evergreen Lakes and Leadville. A. W. C.

On the Pacific Slope.

San Francisco, July 23.—H. L. Adams, superintendent of the Stockton Gas and Electric Company, who was in San Francisco last week attending the annual meeting of the Pacific Coast Gas Association, states that the company's electric plant at Stockton, Cal., is now being considerably enlarged. Two boilers, 72 inches in diameter, are being installed. An additional 250-kilowatt alternating-current generator will be direct-connected to a direct-current generator, and used as a motor. Current from the Standard Electric Company's lines will drive the combination, producing direct current for street-railway use. The 1,000-horsepower steam plant will be shut down before the end of the month, but will be held in reserve for use in case of accident. Mr. Adams states that the Stockton Gas and Electric Company will still have the sole right to distribute the electric current of the Standard in Stockton. The demand for power in that city is increasing rapidly. Among the enterprises calling for large additional electric power are the extension of the street-railway system and the erection of the glass works.

J. B. Miller, treasurer of the Edison Electric Company, Los Angeles, Cal., states that the company's plant at Los Angeles now has a total capacity of 8,000 horsepower, and that the 3,000-horsepower plant at Redland is being brought to completion. The company's new plant at Los Angeles will not be completed until the end of the year. This is a steam plant, in which crude oil will be used as fuel. When this plant is completed the company will have at its disposal about 20,000 horsepower generated by waterpower and 6,000 horsepower generated by steam, which will be held in reserve. Mr. Miller states that in addition to the street-railway consumption of electricity, there is a demand for fully 12,000 horsepower along the company's lines. This includes the cities of Los Angeles, Santa Ana and Redlands.

Work has commenced on the new power plant of the Siskiyou Electric Power Company, near Yreka, Cal. The power will be generated from the waters of Fall Creek at a point where it flows into the Klamath River. The installation of the plant will require 4,700 feet of flume and 2,837 feet of pipe line. The water will have a pressure of 700 feet and will develop 2,500 horsepower. The purpose of the company is to furnish power and lights for the various mines in the neighborhood and to furnish light for the town of Yreka. E. H. Steele, Yreka, is the manager of the company.

The Board of Trustees of the city of Alameda, Cal., is now advertising for bids for furnishing electric current to the municipal electric-light plant of that city, for two years. Bids will be received until August 4th. The current to be supplied is to be alternating, of 7,200 alternations and 2,300 volts at the switchboard in the municipal central station; and to be available any hour of the day or night, in such quantities as may be required, not to exceed 150 amperes. The city of Alameda has a steam-generating plant, which is comparatively new, but it is believed that the big power companies will be able to supply the required current at a less cost than the current could be generated at the city plant.

The Breck Electric and Manufacturing Company has been incorporated here with a capital stock of $25,000. The incorporators are G. Breck, E. D. Bullard, B. Heinrich, L. Bories and H. N. Beatty.

The board of trustees of the Lewiston Electric Light Company at Lewiston has decided to enlarge the capacity of the power house of the company. The cost of the betterments now under way will aggregate $16,000. These include a 500-horsepower Pelton waterwheel, a large penstock to take water from the flume, an enlargement of the flume, an entire new set of street arc lamps for Lewiston, new transformers, and some minor changes. The proposed enlargement in the capacity of the plant will include a new generator, and larger transformers. It will involve an expenditure of about $15,000. A.

PERSONAL.

A dispatch from Italy says that the czar has decorated Mr. Marconi with the Order of St. Anne.

Frederick B. Rounds, once general superintendent of the Metropolitan street railway of New York city, committed suicide in Hoboken, N. J., on July 24th.

Sigmund Bergmann, a well-known electrical manufacturer of Berlin, Germany, it is announced, will soon visit the United States to confer with Thomas A. Edison.

E. H. Millington of St. Thomas, Ont., has been appointed superintendent of telegraph of the Michigan Central Railroad Company, to succeed E. E. Torrey, at Detroit, Mich.

General A. W. Greely, chief of the United States Signal service, has sailed for Alaska, where he will superintend the building of the government telegraph from Valder to Eagle City.

Charles Louis Yorston, an electrician, and president of the Pernaux Electric Company of New York city, died in his home in Whitestone, Queens Borough, N. Y., on July 25th, at the age of 39 years.

General Morris Schaff of Pittsfield, Mass., has been reappointed a member of the Massachusetts Gas and Electric Light Commission, to serve three years. General Schaff has been a very popular member of the commission.

Hugh J. McGowan, president of the Indianapolis Street Railway Company, has subscribed $10,000 to the fund now being raised to secure the Arsenal grounds in Indianapolis for a technical institute. Mr. McGowan says such an institute will prove to be the solution of the social problem.

Fred W. Horne, formerly a well-known Chicago electrical man, was in town last week. Mr. Horne has been engaged in the general machinery trade in Yokohama, Japan, for several years. On leaving Chicago on the occasion of his latest visit he said he was bound for India on a business mission.

An article on "Electrical Problems of Main-line Railway Traction," written by the late Charles T. Child, appears in the Engineering Magazine for August. The writer takes a conservative position, believing that the present equipment of steam locomotives on most railways will probably be worn out in service.

Assistant Superintendent Horace Porter of the Cincinnati Traction Company has resigned his position to become superintendent of the street railway at Paducah, Ky. The company owning the Paducah system has just been reorganized, and the property will be improved and the lines extended. Albert Benhem will probably be Mr. Porter's successor at Cincinnati.

The engagement of Miss Blanche Estabrook of Chicago, daughter of H. T. Estabrook, general solicitor

of the Western Union Telegraph Company, and a niece of Colonel Robert C. Clowry, president of the same company, to Karl G. Roebling of Trenton, N. J., has been announced. Mr. Roebling is a son of Ferdinand W. Roebling, and a director of the John A. Roebling's Sons Company.

A breakdown of Thomas A. Edison's automobile was accountable for his appearance recently before a United States commissioner in the phonograph litigation. The plaintiff in the suit had been trying for some time to get Mr. Edison on the stand, but had been unable to subpœna him. The breakdown furnished the opportunity to serve the writ, as the young man who had been attempting to serve it happened to be on the spot and recognized Mr. Edison.

ELECTRIC LIGHTING.

Danville, Ky., is to erect an electric-light plant.

The Vandalia (Mo.) Electric Light Works has been destroyed by fire.

Troy, Ill., has authorized a bond issue of $3,500 to improve its electric-light plant.

Rayne, La., has voted to issue $20,000 for the construction of a waterworks and electric-light system.

Centerburg, Ohio, has voted to build a waterworks and electric-light plant. Mayor Bishop may be addressed.

In its new boiler plant the Pacific Light and Power Company of Los Angeles, Cal., will use oil as fuel.

A company is being organized to operate an electric-light plant in Jackson, Ga. O. A. Thaxon is interested.

The electric-light and ice plant of William Curry & Sons of Key West was recently destroyed by an explosion.

The Granite City and Venice (Ill.) Light and Power Company has been incorporated with a capital of $160,000.

The Rouge River Electric Light and Power Company of Rockford, Mich., has been incorporated with a capital of $12,000.

The City Council of Yazoo, Miss., has ordered the issuance of $200,000 in bonds for waterworks, sewerage, and electric-light plants.

The Wisconsin Light, Heat and Power Company of Milwaukee has increased its capital from $10,000 to $1,000,000. John I. Beggs is president.

The Fort Dodge (Iowa) Light and Power Company is under new management and the plants of the company will be extensively improved.

The Roswell (N. M.) Electric Light and Power Company has been incorporated with a capital of $40,000. The incorporators are C. M. Bird, C. F. Bode and others.

The West Seneca (N. Y.) Light, Heat and Power Company has been incorporated with a capital of $200,000. The directors are E. B. Smith, C. A. Hahl and H. N. Kraft.

The Carbine Lighting Company of Huron, S. D., has been incorporated with a capital stock of $500,000. The incorporators are Charles Selden, Henry J. Bredy and Philip Lawrence.

The Peru-LaSalle Gas, Light and Power Company of Peru, Ill., has changed its name to the Citizens' Lighting Company, and has increased its capital from $130,000 to $250,000.

The Empire Light and Power Company of Huron, S. D., has been incorporated with a capital stock of $500,000. The incorporators were F. W. Richart, C. E. Anderson and Phillip Lawrence.

The Mill Creek Electric Light and Power Company, North Dansville, N. Y., has been incorporated with a capital of $200,000. The directors are F. A. Owens, J. E. Crisfield and W. J. Beecher.

The Electric Light Commission of Marquette, Mich., is considering a change in the light system from direct current to alternating current. If the change be made, new machinery will be needed.

The City Council of Charles City, Iowa, has passed an ordinance granting a 25-year franchise to the Charles City Lighting and Heating Company, to erect poles and wires for a system of lighting and heating.

It is said that Clark Bros. of Philadelphia, owners of the East St. Louis (Ill.) street railway, have purchased the Citizens' Electric Light and Power Company's plant of East St. Louis. The consideration is reported to have been $600,000.

The Harvey Water and Light Company of Harvey, Ill., has conveyed its plant to the Calumet Gas and Electric Company. The consideration was nominal. The plant is security for an issue of $200,000 first-mortgage bonds payable in five years.

The Independent Electric Light Company of Kewanee, Ill., has been incorporated with a capital of $5,000. The purpose of the company is to furnish light and power. The incorporators are G. A. Anthony, John P. Brady and Julius Vancoutrain.

ELECTRIC RAILWAYS.

The Clarinda College Springs and Southern Railway Company of Clarinda, Iowa, has been incorporated by William Anderson, Edson G. Rich and others.

The Monterey and Pacific Grove Street railway of Monterey, Cal., has been sold to the Monterey Gas and Electric Company and will be converted into an electric road.

The People's Traction Company of Audubon, N. J., with a capital of $175,000, has been incorporated by Josiah K. Bougher, I. A. Sweigard and W. D. Parry to operate an electric railway.

The Intervale Traction Company of Newburg, N. Y., has been incorporated with a capital stock of $300,000. The local directors of the enterprise are Hiram O. Odell, J. A. P. Ramsdell and W. J. McKay.

Incorporation papers have been filed by the Western Illinois Electric Railway Company of Milan, Ill. The capital stock is $15,000. The incorporators were Franklin H. Caldwell, Robert E. Little and Elmer E. Reynolds.

The Kent and Cecil Light, Power and Railway Company of Elkton, Md., has been granted a charter to construct a trolley line between Elkton, Chestertown and Colchester Beach, touching the Delaware line near Middletown.

An extensive power plant is being erected at Auburn, N. Y., for the Auburn City Railway Company, the Citizens' Light and Power Company and the Auburn Interurban Railway Company. Merrick Bros. of Syracuse have the contract.

The Whitney-Widener syndicate is reported to be trying to purchase the properties of the Fair Haven and Westville Street Railroad Company in New Haven, Conn., and the Hartford Street Railway Company, and the Hartford Electric Light Company of Hartford, Conn.

A line of electric railway from Jonesboro to Johnson City, Tenn., is projected by Hugh H. Kirkpatrick, who was in Cincinnati to meet capitalists a few days ago. It is said that the line will pass through a very populous territory and that the district is becoming more important from the fact that a national soldiers' home will be erected on the route.

The Atlantic City (N. J.) and Suburban Traction Company has been incorporated with a capital of $500,000 to construct an electric railway from the Board Walk in Atlantic City, N. J., to Baltic Avenue in the same city, and thence to Pleasantville, with branches from the latter place to Absecon, Linwood and Somers' Point. Edward R. Sponseer, Harrisburg, Pa., and C. Taylor Leland of Philadelphia are chiefly interested.

The Macon Consolidated and the Metropolitan Street Railway companies, operating in Macon, Ga., which have been controlled by Boston men since 1894, have been sold to Nashville (Tenn.) and Savannah (Ga.) people. The Macon company controls the Metropolitan company. The system comprises about 20 miles of railway. The bonds amount to $350,000 and the stock amounts to $500,000. The controlling interest was sold for about $500,000.

The report of the New York Railroad Commission shows that there are now some 1,700 miles of electric-railway lines in operation in the state of New York. The number of long-distance electric roads competing with steam railways is not yet large. The 42 most noteworthy lines, authorized, under construction or completed, aggregate 1,232 miles of electric roads, of from 15 to 120 miles each. These lines generally parallel existing railways.

POWER TRANSMISSION.

The W. T. Weaver Power Company of Asheville, N. C., has executed a mortgage for $150,000 on its power plant, located five miles below Asheville, on the French Broad River.

The Alpha Portland Cement Company of Phillsburg, N. J., has secured a controlling interest in the Lehigh Power Company of Easton, Pa., and now controls the big power plant of the latter company on the Delaware River, six miles below Easton. The Delaware Canal, between Easton and the plant is being widened 10 feet and deepened four feet. Ths will add 1,000 horsepower to the plant.

A. H. Brooks, chief of the party, which, under the United States Geological Survey, is exploring and investigating in Alaska, has called attention to the extensive waterpowers existing in the southwestern portion of Alaska. This is the narrow portion of the country extending southward along the Pacific coast upon which Juneau, Sitka and Skagway are located. Low-grade ores in large bodies are found and can be worked to advantage by making use of excellent waterpowers which abound in the region. In the Ketchikan mining district the waterpowers are available for the entire year.

PUBLICATIONS.

The installation of Chloride accumulators for the Hasting's Sons Publishing Company, Lynn, Mass., by the Electric Storage Battery Company of Philadelphia is described in a recent bulletin issued by the latter company.

The first volume of transactions of the newly organized American Electrochemical Society has just been published by the society, under the supervision of the secretary, C. J. Reed. The volume comprises 250 pages. It contains a historical sketch of the society, proceedings of the Philadelphia inaugural meeting last April, the constitution and the text of the papers and discussions presented before the meeting. The frontispiece is a portrait of the president, Dr. Joseph W. Richards, who contributes an introductory sketch to the volume. Lists of charter members, arranged alphabetically and geographically, are given, and an obituary of the late Charles T. Child is also included. For convenience in reference a separate pamphlet is issued, containing the list of officers, constitution and lists of members.

ELECTRICAL SECURITIES.

The Western Electric Company is to increase its capital stock by $3,000,000, making the total $13,000,000. The new stock is to be issued at par to shareholders this month. The company was authorized at the last annual meeting to increase the capital from $8,000,000 to $15,000,000, and a stock dividend of $2,000,000 was declared shortly thereafter.

The terms offered by the General Electric Company to holders of Sprague Electric Company securities having been accepted by holders of 74 per cent. of the capital stock and 88 per cent. of the bonds, President Markle of the Sprague company declares that the sale to the General Electric Company has become operative. The General Electric Company has deposited the cash necessary to carry out the contract with the United States Mortgage and Trust Company of New York.

First-mortgage 40-year 4½ per cent., gold bonds of the Municipal Gas and Electric Company of Rochester, N. Y., to the par value of $650,000 are offered at 101 and interest. Principal and interest are guaranteed by the Rochester Gas and Electric Company, which has acquired all the property and franchises of the Municipal company. The Rochester Gas and Electric Company, which now controls the entire gas and electric business of Rochester, operates under franchises unlimited as to time. The power utilized is taken from the Genesee River, which has a fall of about 260 feet within the city limits. Of the power available, the Rochester Gas and Electric Company takes about 90 per cent.

TELEGRAPH.

The lease of floor space in the Rialto Building, Chicago, to the Postal Telegraph-cable Company has been recorded. The company will occupy 10,248 square feet of floor space on the ground floor and 9,388 square feet in two stories to be added to the building, besides 1,500 square feet in the basement. The lease runs for 25 years from May 1, 1905, at an annual rental of $30,000.

The Canadian government telegraph wire from Dawson to Ashcroft, giving the Klondike region connection, through the Canadian Pacific and other lines, with the outside world, has been down most of the time since the latter part of May. The trouble has been chiefly from spring freshets washing away trees and banks and allowing the wires to fall. In many places storms have blown trees over the wires. The government will, perhaps, lay a land cable over the most difficult mountains.

SPACE TELEGRAPHY.

The De Forest Wireless Telegraph Company makes the announcement that it has received a contract from the War Department at Washington for the installation of four complete wireless-telegraph stations. The stations are to be in readiness for operation in time for the army and navy maneuvers.

As the Navy Department has decided to equip the fighting ships of the American navy with a system of space telegraphy, a board, consisting probably of five members, is soon to be appointed to investigate the whole subject, to decide upon the system to be installed, and to work out plans for the education and training of men to operate it aboard the ships.

As the North German Lloyd steamship Kronprintz Wilhelm was passing the Lizard not long after she had left Southampton on her westward trip, a wireless message was sent from the Marconi station at the Lizard to one of her passengers and received successfully. This is the first time on record, it is said, that a wireless message, sent from a shore station, has caught an outgoing liner.

The Postal Telegraph-cable Company has arranged with the Marconi Wireless Telegraph Company of America for the exchange at Sagaponack, L. I., of messages to and from vessels equipped with the Marconi wireless apparatus, so that it is now possible for passengers to telegraph friends on shore either farewell messages or notice of arrival. The arrival of steamers may also be reported from Sagaponack several hours in advance of their being sighted at Fire Island, or Sandy Hook.

MISCELLANEOUS.

The Union Electric Company of Dubuque, Iowa, has been incorporated with a capital stock of $1,000,000.

The Hudson Valley Electric Company has filed a certificate of increase of its capital stock from $30,000 to $3,000,000.

During a recent electrical storm on the Potomac River, lightning struck a small powder house, burning up 58,000 pounds of smokeless powder. No one was injured.

The Warner Electric Purifier Company of Huron, S. D., has been incorporated with a capital of $5,000,000. The incorporators were Charles F. Warner, B. E. Helman and Philip Lawrence.

TRADE NEWS.

It is said that there is a great demand for gas engines in Northern Spain. Julius G. J. Lay is United States consul-general at Barcelona.

Ray D. Lillibridge, the technical advertising expert, announces the removal of his office to larger quarters in the new Maiden Lane Building, 170 Broadway, New York city.

The Tuggle Electric Supply and Construction Company of Waco, Texas, has been incorporated with a capital stock of $25,000. The incorporators are G. W. Tuggle, E. L. Bacon and J. F. Keith.

Bids will be received by the public lighting commissioner of Detroit, Mich., until August 29th for furnishing one 900-horsepower engine, one 600-kilowatt alternator, one 60-kilowatt exciter, and 320,000 pairs of carbons.

The Eastern Insulation Company of Hoboken, N. J., has been incorporated with a capital stock of $100,000. The company's office is at 423 Hill Street, West Hoboken. The incorporators are Robert W. Taylor, Rudolph Brummerhop and Louis P. St. Clair.

Sealed proposals are being invited for an indefinite period for furnishing the United States Indian School at Genoa, Neb., with a quantity of electrical supplies, etc. A full list and specifications will be furnished bidders upon application to W. H. Winslow, superintendent of the school.

The Walter Motor and Power Company of Pontiac, Mich., has been incorporated with a capital stock of $1,000,000. The company is organized for the purpose of buying, selling, renting and dealing in motors for water, steam and electricity. The incorporators were S. W. Smith of Pontiac, Mich., W. L. Walter of Port Huron, Mich., and Charles H. Fred and Alexander W. Bell of Washington, D. C.

Owing to the rapid increase in its business, the C. J. Toerring Company of Philadelphia has been compelled to take more extensive quarters in the Warden Power Building at Nineteenth Street and Allegheny Avenue, which is now the company's address. In this new location the company has three times as much space as formerly and is in a position to fill all orders for arc lamps promptly.

The Illinois Electrical Manufacturing Company of Peoria, Ill., was recently incorporated to deal in second-hand electrical apparatus (particularly dynamos and motors); also to do general electrical repair work. Although in business only a few months, the firm has been successful beyond the expectations of the organizers. A. C. Ault and A. H. Crawley, who constitute the company, are well known in the electrical field, having been in the business for many years. F. S. Kline is superintendent of the company.

The Magnetic Improvement Company has been incorporated with authorized capital stock of no less than $50,000,000 for the purpose of manufacturing and dealing in electric motors, automobiles, etc. The company is to have South Dakota headquarters in Mitchell. The incorporators are A. A. Honey and C. A. Ballard of Chicago, and T. J. Spangler of Mitchell, S. D. The company will have a branch office in Chicago.

The Westinghouse Electric and Manufacturing Company of Pittsburg, Pa., has brought out a new automatic circuit-breaker for use in charging automobile storage batteries. This device is designed to meet an objection sometimes urged against the electric vehicle, viz., the care, time and attention required to charge the battery properly. The instrument protects the battery from all injury due to overcharging and is said to be absolutely certain in this connection. The principle of operation is the automatic opening of the circuit when the charging voltage across the battery terminals rises to a predetermined point, dependent upon the nature of the battery and its voltage or number of cells. For convenient adjustment of point of cut-out, the device is graduated in volts and calibrated at working temperature of coil. There are two varieties, differing only in the coils, which interchange with each other. By the intelligent employment of this device it is possible to insure that the battery is as full as the available time admits without requiring any special knowledge and without probability of risk of injury to battery.

BUSINESS.

The Reynolds Electric Company, Chicago, manufacturer of the well-known improved new Reynolds flasher, reports a very prosperous business. Flashers are coming into more general use, and the Reynolds company says that it is receiving a large share of the business. The company also makes a specialty of repair work and maintains a staff of expert mechanics for this purpose.

The Helios-Upton Company of Philadelphia and Chicago has secured an order for a 3,000-ampere storage battery from the Grand Rapids Edison Company of Grand Rapids, Mich. This is the second large contract for storage batteries secured from Edison central stations by this company. The other contract referred to was for a large battery installed at the Edison station, Kansas City, Mo.

For the August meeting of the Knights of Pythias in San Francisco the Chicago, Milwaukee and St. Paul Railway Company is making an excursion rate of $50 for the round trip, good between Chicago and San Francisco or Los Angeles, and with a final return limit of September 30th. The Chicago, Milwaukee and St. Paul railway is known as the Short Line between Chicago and Omaha. Two through trains are run daily in each direction, with the best sleeping-car and dining-car service. Time tables, maps and information are furnished on application to F. A. Miller, general passenger agent, Chicago.

The Packard lamp is reported to have been largely sold during the last year, particularly among street-railway companies, and under competitive tests. It is said that the use of the packard lamp has saved one large street-railway company 33⅓ per cent. and another 20 per cent. in lamp renewals. The manufacturers of the Packard lamp stick to standard lamps and avoid novelties and freak lamps. They make good lamps, and among them a special street-railway lamp based upon their knowledge of street-railway conditions. The Electric Appliance Company, Chicago, is the selling agent for Packard lamps.

Among the recent contracts awarded to the Buffalo Forge Company of Buffalo, N. Y., is one from the Continental Coal Company of Glouster, Ohio. This company has ordered three 250-inch fans, to be installed in its mines for the purpose of ventilating and exhausting fumes, smoke and all dangerous gases constantly met with in coal mining. The fans are 250 inches in diameter, with housing of the three-fourths type and of the special width of 72 inches. The sides are built of extra heavy steel plate, and are thoroughly braced with angle irons of ample size, effectually preventing all vibration. The blast wheels of the fans are of the usual centrifugal type. The fan shaft is supported independent of the housing by two standard Buffalo self-aligning, chain-oiling outboard bearings, mounted on masonry pedestals. This plant is similar in many respects to that of the Modoc Coal Mining Company, located at the same place, and recently installed by the Buffalo Forge Company.

Westinghouse, Church, Kerr & Co., during the last month, have received a large number of orders for Westinghouse steam engines and turbines, including two of the largest engines in existence for power service. The New York Edison Company has ordered two more 6,000-horsepower vertical three-cylinder, compound engines, in addition to the eight engines of this same type now running and under course of erection at its Waterside station. The Rapid Transit Subway Construction Company, New York, has just placed an order for three 1,250-kilowatt, turbo-generator sets for installation in its new power house, and also two 400-horsepower, vertical marine-type, cross-compound engines. The turbines will be used for lighting the power station, subway and stations, and the compound engines, which are built to run on high-pressure, superheated steam, direct-connected to Westinghouse generators, will be used as the main exciter units for the power station. The Hartford (Conn.) Street Railway Company will install complete engine and generator equipment, consisting of one 1,750-horsepower horizontal, cross-compound Corliss direct-connected to a Westinghouse railway generator, and switchboard. Among recent turbine orders are the 1,000-kilowatt turbo-generator outfits for the DeBeers Consolidated Mines, Ltd., South Africa; two 1,000-kilowatt outfits for the Cleveland, Elyria and Western Railway Company; three 1,000-kilowatt outfits for the West Penn Railway and Lighting Company; two 400-kilowatt outfits for the Roslyn Light and Power Company, Roslyn, L. I.; one 400-kilowatt unit for the Johnston Harvester Company, Batavia, N. Y.; one 400 and one 750-kilowatt for the E. F. Goodrich Company of Akron, Ohio. The largest turbines in existence at the present time are under construction for the two large railway systems of London, England. These turbines will furnish power for operating an underground-train service, and the seven units ordered aggregate 41,000 kilowatts, the largest unit being 5,000 kilowatts. A large number of orders have also been received for compound, junior and standard engines.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 22, 1902.

705,016. Train-control System. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 16, 1898.

The system comprises a controller, automatic means for preventing the operation of the controller whenever the current in the motor circuit rises above a predetermined value, and means for modifying the operation of the automatic means. (See cut on next page.)

705,020. Safety Contact Interrupter for Electric Wires. Gaston Bellangé, Arcachon, France. Application filed September 9, 1901.

The interrupter is provided with casing having a quantity of mercury therein. Conductor wires extend entirely through the ends of the casing and engage the mercury. The device is suitably supported, and a plate carrying a V-shaped projection is mounted on the under face of the casing for engagement with the trolley wheel.

705,026. Interior-conduit Outlet Box. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Construction Company, Utica, N. Y. Application filed May 8, 1902.

A cover for an outlet box is described.

705,055. Brush Holder. Hermann F. T. Erben, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 20, 1900.

The holder has a curved resilient arm, one end of which bears on the brush, and a pivot by which the other end of the arm is supported, and about which a portion of the arm is coiled in an inverse direction to the curve.

705,073. Device for Preventing Humming of Telephone Wires. Mason Grover, Bidwell, Ohio. Application filed September 6, 1901.

The device comprises a split flexible body of dampering material having a passage to receive and hold a wire and with which the split communicates to permit of entrance of the wire to the passage, the body having a peripheral groove to receive an attaching band.

705,076. Manufacture of Carbon Electrodes. Charles M. Hall, Niagara Falls, N. Y. Application filed February 19, 1902.

The method of baking carbon electrodes is described. It consists in placing them in proximity to a conducting path or core, insulating the electrodes or groups of electrodes, piling other electrodes outside the first-named electrodes, heating the latter by heat transmitted through the inner electrodes, and subsequently placing them next to a core to receive final baking. (See cut on next page.)

705,082. Surface-contact Electric Railway. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 20, 1897.

In the electromagnetic switch described are combined a contact, a movable support, an electromagnet for moving the support toward the contact, and a second contact on the support, one of the contacts having a ball-and-socket joint, whereby it can adjust itself to the other contact when the magnet moves the support.

705,083. Electric Railway. Frederic W. Hild and Samuel B. Stewart, Jr., Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed November 30, 1900.

In a railway having a closed conduit containing a conductor arranged to be engaged by a car-collector traveling through a comparatively narrow longitudinal slot, are combined a cover for an opening into the conduit at a place where it is desired to remove the collector from the conduit, and underground mechanism connected with the cover, and constructed and arranged to be operated by the car to move the cover.

705,090. Advertising Device. Charles E. Johnson, Malden, Mass. Application filed November 15, 1901.

The device consists of a resilient board or card having upon its outward face the words of the advertising matter. Means for vibrating the board or card comprise an electrical circuit-breaker or buzzer, with resonant appliances, as bells, rigidly attached to the board.

705,092. Supervisory Relay. William Kaisling, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed February 4, 1901.

Combined with an electromagnet are an armature situated opposite the pole thereof, and a mounting for the armature comprising a spring passing across the inner face of the armature and secured at one end to the armature and at the opposite end to a suitable support.

705,096. Method of Amalgamating Metals. Paul A. Knappe, Grantville, Ga., assignor to the American Amalgamating Company. Application filed March 7, 1902.

A part of the process consists in causing the passage of an electric current through pulp intermingled with the mercury.

705,102. Electric Circuit-breaker. Harry W. Leonard, New York, and Henry P. Ball, Mount Vernon, N. Y., assignors to H. Ward Leonard, Bronxville, N. Y. Application filed April 4, 1896.

Briefly the invention consists of the combination of a number of electric switches designed to be moved manually and independently into normal position, and a single controlling device for automatically controlling the movement of the switches after manual adjustment.

705,111. Electric Gas-igniting Device. John A. Mosher, Chicago, Ill., assignor to the Adams & Westlake Company. Application filed July 23, 1901.

In the igniter are a pair of stationary electrodes, a contact piece, a gas-cock and a wiper moved by the cock for making and breaking an electric circuit with the contact piece and inducing a spark at the electrodes, the engaging face of the wiper being beveled in order to facilitate its passage across the contact plate.

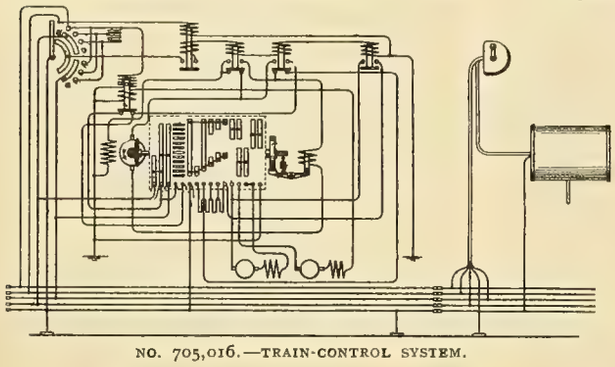
705,112. Rheostat. John A. Mosher, Chicago, Ill. Application filed August 16, 1901.

The rheostat has a plate with one face spirally grooved, a refractory lining for the groove, an electric conductor seated in the groove, a binding post to which each end of the conductor is connected, a filling of non-conducting refractory material covering and submerging the conductor, and a covering plate secured to the first-named plate.

705,122. Electric Arc Lamp. John S. Nowotny, Madisonville, Ohio, assignor to the General Electric Company, Schenectady, N. Y. Application filed June 28, 1897.

The lamp combines a carbonholder, a tube which incloses the holder, an armature, a solenoid magnet, a core which incloses the magnet, an extension on the core, and means for adjusting the armature so that its position with respect to the extension may be varied to compensate for different lengths of arc.

705,136. Electromagnetic Switch for Surface-contact Electric-railway Systems. William B. Potter, Schenectady, N. Y., assignor to the General



NO. 705,016.—TRAIN-CONTROL SYSTEM.

Electric Company, Schenectady, N. Y. Application filed October 11, 1897.

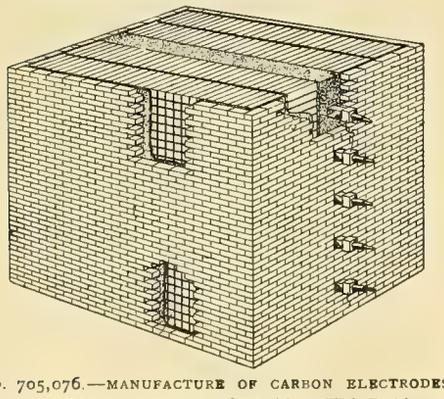
Switches for completing the circuit from the feeder to different surface contacts consist of three stationary and three moving contacts arranged at three corresponding points around a central core supporting the moving contacts, the moving and stationary contacts being free to adjust themselves and compensate for wear. A magnet is provided for lifting the moving contacts into engagement with the fixed contacts.

705,137. Electric Switch. William B. Potter, Schenectady, N. Y.; assignor to the General Electric Company, Schenectady, N. Y. Application filed July 27, 1900. Renewed April 23, 1902.

In an electric switch, the contacts of which are liable to stick owing to arcing, there is combined with the movable switch portion an actuator therefor, having a lost-motion connection therewith, whereby in opening the switch the actuator can have a free movement at first, and will then, if the contacts are stuck together, impinge against the switch portion to force the switch contacts positively apart, against their tendency to stick.

705,138. Blow-out Magnet. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed October 11, 1897. Divided and this application filed February 28, 1901. Renewed April 23, 1902.

Combined with a circuit in which the current strength is subject to considerable variance are a switch therein, any arcing at which it may be highly desirable to avoid, a permanent magnet of hard iron having a large amount of residual magnetism and coercive force, and an energizing coil for the magnet which is connected in the circuit, whereby the permanent magnet co-operates with the coil, to blow out small destructive arcs at the switch when a small current is flowing through the circuit.



NO. 705,076.—MANUFACTURE OF CARBON ELECTRODES.

705,148. Electric Battery. Martin W. Robinson, Medford, Mass. Application filed May 11, 1901.

The cathode is composed of a nickel-plated copper plate and has non-conducting buffers secured thereto in combination with intermediate zinc plates alternately arranged.

705,161. Connecting Plug for Electrical Switchboards. Arthur T. M. Thomson, East Dulwich, England. Application filed December 18, 1899.

Within the casing of the plug, at the end projecting from the switchboard, is provided an electric lamp, which is connected by wires, inside the plug, to the casing of the plug and to the sleeve of the plug. The sleeve is also joined to one of the communication wires of the plug, whereby a signal current of electricity sent through that wire and the casing of the plug will cause the lamp to be illuminated and serve the purpose of a signal.

705,186. Galvanometer. Anthony Zeleny, Minneapolis, Minn., assignor of one-half to C. E. Thayer, Minneapolis, Minn. Application filed January 20, 1902.

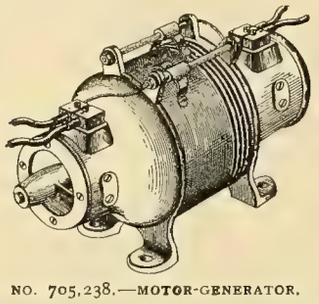
Combined with a thermo-electric couple is a galvanometer having a reading scale graduated in degrees of temperature and set, when the circuit is open, so as to indicate the temperature of the "known-temperature junction," whereby, when the circuit is closed, the temperature of the opposing junction will be directly indicated, in degrees, on the scale.

705,187. Multiplex Electric Thermometer. Anthony Zeleny, Minneapolis, Minn., assignor of one-half to C. E. Thayer, Minneapolis, Minn. Application filed January 20, 1902.

A galvanometer and a switch are combined with a number of thermo-electric circuits having individual thermo-electric junctions and a common thermo-electric junction, which common junction, by the switch, may be connected with any opposing individual junction, to complete the thermo-electric circuit.

705,227. Printing Telegraph. Theodore M. Foote, Brooklyn, N. Y., assignor to the Western Telegraph Typewriting Machine Company. Application filed March 11, 1901.

Means are provided with the printing mechanism for connecting it electrically to another similar machine at a distant station, and a keyboard is provided with a plurality of circuit-closing keys and with electric severed but contacting wiring connecting the keyboard detachably with the printing machine.



NO. 705,238.—MOTOR-GENERATOR.

705,238. Electrical Machine. Tracy B. Hatch, Menomonie, Wis., assignor to the Submerged Electric Motor Company, Menomonie, Wis. Application filed November 15, 1901.

A motor-generator is described which has a motor resistance winding for high pressure wound about and exposed upon the frame of the machine, and a regulating resistance low-pressure winding for the generator exposed upon the machine. Switch devices on the frame of the machine are connected respectively with the motor and generator circuits and are movable along the resistance windings. (See cut.)

705,241. Electric Controller. John C. Henry, Denver, Colo.; Susie A. Henry, executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Application filed April 1, 1901.

An electric motor having a number of pairs of poles with magnetizing coils connected in series, is provided with a switch arranged to cut out a pair of the coils, thereby increasing the current through the other coils and changing the motor from an ordinary multipolar machine to a consequent-pole machine.

705,264. Electrolytic Apparatus for the Production of Chlorine and Alkali. James Mactear, Westminster, England. Application filed September 3, 1901.

A cathode cell has a plate arranged to form a space between the same and the walls of the cell. An anode cell is mounted upon the plate and engages in the recess. A propeller is mounted in the wall and has a spindle extending through the anode cell.

705,291. Train-controlling Apparatus. Jonathan D. Price and Alexander C. Miller, Aurora, Ill. Application filed December 9, 1901.

The apparatus combines a track having one electrically continuous rail serving as a main and one rail electrically divided into sections corresponding to blocks, a third rail or conductor electrically divided into sections corresponding to blocks, a fourth rail or conductor which is electrically continuous and serves as a main, an electric generator connected with the first-named track rail and the fourth rail, connections between the fourth rail and the sections of the third rail through which the sections are energized, instruments connected with both the track rails and controlling the last-named connections, and connections for supplying current to the instruments.

705,373. Electric Railway. Walter Behrens and Jean P. Tihon, Paris, France. Application filed October 10, 1901.

An arrangement for collecting current for electric railways is described. It comprises a plurality of depressible spring pedals, contact-breaking commutators carried on shafts, disks mounted on the shafts and adapted to be operated by the pedals, a two-armed spring-pressed lever having a projection or pawl at one end adapted to engage each disk, a connection from one arm of each lever to the preceding disk, and a connection from the other arm to the succeeding disk whereby the placing in circuit of one commutator involves the placing out of circuit of the preceding and succeeding commutators. (See cut.)

705,379. Thermostatic Circuit-closer. Albert M. Butz, Oak Park, Ill. Application filed February 5, 1902.

An expansible member consisting of a compound bar is placed within a tubular expansible member, and the circuit-closer is attached to the compound bar.

705,391. Cable Clip. Huber R. Davis, Cardington, Ohio. Application filed June 2, 1902.

The cable-grip consists of a link, a strap and a lever-cam hook.

705,421. Water-level Testing Device for Boilers. Herman Moore, Moundsville, W. Va. Application filed December 9, 1901.

Local circuit-closing connections attached to a gauge tube comprise plugs having binding posts for the attachment of the circuit wires, one of the plugs being provided with a contact-piece forming a guide and the other with a pivoted contact-piece carrying a float. An electric circuit includes the conducting wires connected with the plugs. A bell is in the circuit, and a normally open switch is also in the circuit.

705,424. Electrical Panel-board Attachment. Ernest W. Müller, Brooklyn, N. Y., assignor to Hubert Krantz, Brooklyn, N. Y. Application filed March 12, 1902.

The board has circuits and concealed fuses therein with an electric lamp, flexible conductors therefrom and a contact plug on the conductors, adapted to be applied to the binding posts of the circuits to test the fuses.

705,429. Electric-light Sign. Mortimer Norden, New York, N. Y., assignor to the Norden-Bittner Electric Company, New York, N. Y. Application filed April 14, 1902.

The sign combines with a base or support and a series of lamp sockets secured thereto, a plate adapted to be connected to the base and having a series of apertures coinciding in position axially with the sockets, and tube sections secured at one end to the plate concentric to the openings and receiving and surrounding the electric-lamp bulbs as secured to the sockets.

705,456. Iridescent Coating of Copper, Bronze, or Like Surfaces. Duncan Sinclair, Coalbrookdale, England. Application filed December 31, 1900.

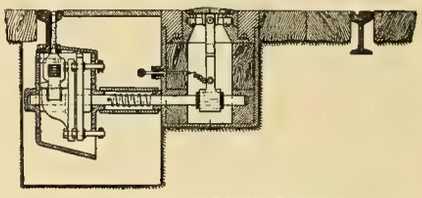
The process of coating articles having a surface of copper or its alloys is described, which consists in thoroughly cleaning the surface, immersing it in an electrolytic tank containing alkali, oxide of lead, water and a little electro-coppering solution, and passing an electric current through, and then quickly drying and heating.

705,480. Safety Device for Elevators. Samuel D. Strohm, Philadelphia, Pa., assignor to the Strohm Elevator Safety Device Company, Philadelphia, Pa. Application filed April 4, 1896.

Parts of the invention are a controlling rope for operating the controlling mechanism of the car, a clamping or locking device on the car normally out of engagement with the controlling rope, a solenoid or magnet for operating the locking or clamping device, a partial or incomplete circuit carried on the car, a series of corridor doors, a separate partial electric circuit for each of the doors, a closer in each of the circuits operated by the corresponding doors, and means whereby the partial circuit on the car will connect with the partial door circuits when adjacent to the latter.

705,482. System of and Apparatus for Transmitting Movements and Indicating the Position of Indicators or the Like. Wilhelm A. Thiermann, Hanover, Germany. Application filed November 12, 1901.

The system is operated by means of electric currents, and combines apparatuses, each consisting of a bipolar rotor, having no coils, and a stator having primary and secondary coils, the primary coils of the stators being connected with one another and also to a source of electricity, while the secondary windings of all stators are connected at corresponding points.



NO. 705,373.—ELECTRIC RAILWAY.

705,487. Automatic Dynamo Regulator. William A. Turbayne, Buffalo, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed January 13, 1902.

Combined with a driving element are a generator mounted to move relative to the element, drive connections between the driving element and the generator, means for moving the generator, and electrically controlled mechanism for actuating the moving means and which operates upon a variation of the speed of the generator.

705,490. Means for Dissipating Static Electricity. Robert O. Vandercook, Evanston, Ill. Application filed March 13, 1901.

As a means for obtaining non-electrical atmospheric conditions in a press-room or apartment for like uses, there are provided cooling means at the top of the room or apartment and means for introducing water vapor into the room or apartment at a point distant from the cooling means, the cooling means being disposed uniformly throughout the area over the space to be maintained in non-electrical condition.

705,511. Multiplex Telesig. William S. Burnett and William H. Goodall, Milwaukee, Wis. Application filed April 6, 1900.

A circuit-closing mechanism for electrical stations is described in which are combined a circuit-closer at each station having individual characteristics, a carrier located at each station and provided with a series of elements adapted to be adjusted in accordance with the individual characteristics of the circuit-closer at such station, an electromagnetic device controlling the movement of the carrier, and means for definitely limiting the length of the carrier movement for any one electrical impulse.

705,541. Electric Arc Lamp. John S. Nowotny, Madisonville, Ohio, assignor to the General Electric Company, Schenectady, N. Y. Application filed November 29, 1897.

In the lamp are arranged a clutch for holding and feeding the upper carbon, a cylinder, a piston therefor, elastic material forming a peripheral portion of the piston and adapted to yield laterally, means for adjusting the diameter of the piston, a connection between the clutch and the piston, and a holder for the upper carbon.

REISSUE.

12,015. Toll-collecting and Call-recording Device for Telephone Systems. James B. Gill, San Francisco, Cal. Application filed September 6, 1900. Original No. 635,378, dated October 24, 1899.

A recording mechanism is described which includes a rotatable record card, a marking device, means projecting the marking device against the face of the card, means for moving the card to space the markings, means for setting and locking the marking device for action, and electric means controlled from the central station for releasing the marking device at will to impinge against the card.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, AUGUST 9, 1902. No. 6

Proposed Drainage-canal Waterpower Developments Near Joliet, Ill.

Ever since it was completed—indeed, from the inception of the project—the waterpower possibilities of the Chicago Drainage Canal and of the deepened channel of the Desplaines River, virtually a part of the Drainage Canal, have excited the greatest interest in Chicago. Lately this interest has been stimulated by the efforts of a syndicate of private capitalists to utilize a portion of the available power and by the somewhat belated exertions of the Sanitary District of Chicago to accomplish a similar work, the two attempts being naturally in opposition.

The canal, as is quite generally known, was constructed to divert the sewage of Chicago from Lake Michigan and leave a purer water supply for the city. This was accomplished by cutting a channel through the watershed in Northern Illinois that divides the rivers flowing into the lake from those that flow into tributaries of the Mississippi River and reversing the eastward flow of the Chicago River. By means of this channel there has been created the largest artificial waterway yet constructed. It extends from the South Branch of the Chicago River at Robey Street to Lockport, a distance of 28.05 miles, and is largely cut through solid rock. The width varies from 160 to 290 feet, and the depth being 22 feet the canal is navigable throughout its entire length. The length of the Chicago River from Lake Michigan to the beginning of the canal is six miles, making a total length of 34.05 miles. This channel at present provides for a flow of 300,000 cubic feet of water a minute. As soon as the river portion of the canal inside of Chicago is widened the flow will be increased to its allowable capacity of 600,000 cubic feet a minute. The utilization of this considerable quantity of water for the development of power is the stake for which eager contestants are now striving.

The Drainage Canal was built by the Sanitary District of Chicago, through its board of trustees, which has the power under legislative grant to manage and control all affairs of the District, even to the extent of levying taxes and issuing bonds, buying real estate, etc. The canal proper ends at Lockport, where a dam and special controlling works are erected. Below these works the construction completed by the District covers the work necessary for conducting the flow from the channel in conjunction with the waters of the Desplaines River down the declivity to and through the city of Joliet, and the making of such changes in the Illinois and Michigan state canal as the new conditions developed rendered necessary.

Outside of its powers to provide for the drainage of the district and to build docks, the board of trustees of the Sanitary District has the power "to control and dispose of any waterpower which may be incidentally created in the construction and use of said channels or outlets, but in no case shall said board have any power to control water after it passes beyond its channel, waterways, races or structures into a river or natural waterway or channel, or waterpower or docks situated on such river or natural waterway or channel." It is also provided that "such channels or outlets may extend outside of the territory included within such Sanitary District, and the rights and powers of said board of trustees over the portion of such channel or outlet lying outside of such district shall be the same as those vested in said board over that portion of such channels or outlets within the said district."

Between the controlling works at Lockport and Lake Joliet (a widened portion of the Desplaines, located south of the city of Joliet) the bed of the Desplaines River has a considerable slope. The addition of the water from the Drainage Canal has therefore created valuable waterpower sites on the river. At present the only power utilized is that derived from a fall of water ranging from nine to 15 feet formed by a dam at Jackson Street in Joliet that is owned by the state of Illinois. This waterpower, which is capable of a total development of 8,000 horsepower, is leased to the Economy Light and Power Company, and the electricity generated is used for light and power in Joliet and to operate the Chicago and Joliet electric railway. A portion of the current is also utilized by the Commonwealth Electric Company of Chicago, it being transmitted over a high-tension, three-phase transmission line. Illustrated descriptions of the Economy company's plant appeared in the Western Electrician of September 20, 1900, and October 5, 1901.

In addition to this point there are two favorable locations on the river channel where power may be developed. One of these is just below Lockport and will be mentioned later. The other is 2½ miles below the state dam in Joliet. In 1898 the Sanitary District bought lands on both banks of the Desplaines River within the limits of Joliet, with a view to controlling this second waterpower. Plans were drawn the following year, and in 1899 and 1900 they were partially executed, the work consisting chiefly in dredging a part of the channel and building a stone embankment 15 feet high from the state dam along the east side of the river to a point near the mouth of Hickory Creek, a tributary to the Desplaines River. The map on the next page (Fig. 2) shows the topography of this region. The work was then allowed to cease, the board of trustees deciding to wait until it had sufficient idle funds for the work or until the sentiment of the Chicago people should demand a resumption of the waterpower development. This time came three or four weeks ago, when the trustees discovered that a private syndicate had been quietly laying its plans with a view to developing the same waterpower, only at a point about a mile and a half below the District's proposed dam and power house.

FIG. 1 PROPOSED DRAINAGE-CANAL WATERPOWER DEVELOPMENTS.—SITE OF SANITARY DISTRICT'S PROSPECTIVE DAM ON DESPLAINES RIVER AT JOLIET, ILL.

This private syndicate, so far as the public has been informed, consists of two young men, Robert Gaylord and Charles A. Munroe. Mr. Munroe is an attorney, the junior member of the firm of Eddy, Haley & Munroe, while Mr. Gaylord was formerly a stock broker. The names of several well-known capitalists have been mentioned in connection with the syndicate's movements, but thus far the two gentlemen mentioned are the only ones that have been identified with the enterprise. It is stated that the syndicate will eventually incorporate under the name of the American Power Company.

Messrs. Gaylord and Munroe are carrying out their project with the aid of an old state law which gives any man or company owning land on both sides of a stream, and wishing to build a "grist mill, sawmill or other public mill or machinery," the right to condemn the property of other people along

the stream which it "shall be necessary to take or injure" in the process of the construction of the dam and pool. They have purchased or have options on some of the land on the two sides of the river for a mile below the Sanitary District's property (see Fig. 2), which virtually ends at the mouth of Hickory Creek, just at the southern limit of Joliet. The first public notice of their plans was given when they filed condemnation suits on July 12th against the Sanitary District for its land as far up stream as the state dam and also against two landowners farther down stream. Immediately the trustees of the District awakened to the fact that the valuable acquisition of this waterpower might slip from their hands, and they decided to resume operations at once on the work stopped two years ago; also to begin work on the Lockport development. Chief Engineer Isham Randolph at once ordered materials, and the work was put under the direct supervision of G. M. Wisner, assistant chief engineer of the District. Preliminary work was started, but the men were forced to stop on July 29th by reason of a restraining order issued by Judge Haney in the interests of a taxpayer of the District.

A good idea of the plans at issue may be obtained from the map (Fig. 2). The proposition of the Sanitary District is to throw a dam across the river from the embankment already constructed, building the power house directly on the dam. The western end of the dam would be used for a spillway. This plan would give, it is estimated, about 11,000 horsepower. Then, by constructing a deep tailrace to the lower waters, an increased fall would be created, which would give an additional 4,000 horsepower, making 15,000 horsepower in all. It is planned to build the east half of this dam first, and as a beginning of the work three stone jetties have been thrown out into the stream. These are clearly shown in Fig. 1, which also gives a view of the river and embankment, looking up stream. A pile of lumber for the cofferdam, an office building and a tool house are seen at the right. The cofferdam will be constructed between the two jetties shown in the foreground.

The engineering features of the private syndicate's power development are a little more complex. The plans have been prepared by C. E. Sedden and consist of the extension of the District's embankment for over a mile, to what is known as Patterson's Island. As indicated in Fig. 2, a dam would be thrown across the river from the south end of the island, and the water impounded in the whole valley above. The power house would be erected on the south end of the island adjoining the dam. This island, which is shown in Fig. 3 (page 87), is low, and the filling in and other engineering work would involve considerable expense. This plan, it is estimated, would make possible a development of 15,000 horsepower, the head of water being practically the same as what is obtained by the District at its dam.

One difficulty that will have to be surmounted in executing this plan will be to divert the water of Hickory Creek, which in times of heavy rains is apt to overflow its banks and cause considerable damage. Messrs. Gaylord and Munroe propose to accomplish this by building for the creek a new channel, as indicated on the map. This channel would be about a mile in length. The first part of it would be 150 feet in width, but for the lower half it could only be 80 feet wide, as the Atchison, Topeka and Santa Fe Railroad Company owns the adjoining land. This throttling of the creek is regarded by many as a bad engineering feature, as it would tend to make the water back up in times of floods. In fact, injunction proceedings have already been commenced against Mr. Gaylord by a gentleman owning property on Hickory Creek, which he says would be endangered by the construction of the artificial channel proposed. At present the only work done by the private syndicate has been to dig a few test holes on Patterson Island and the west bank to determine, evidently, the nature of the ground. The stone and earth taken from one of these holes is shown at the extreme left in Fig. 3.

The Lockport Development.

The plans of the Sanitary District for the development of the waterpower available at Lockport are somewhat indefinite, but the general features which have been decided upon are very interesting. It is proposed to extend the drainage channel at the present level above the controlling works south 7,000 feet to a point about 2,900 feet below the old Lockport wire-mill dam and about a mile north of the Elgin, Joliet and Eastern railroad bridge. At this point will be built the big new dam, the power house and a large lock that will transfer vessels from the channel above to a deep tailrace below that will be excavated and carried down the valley to Joliet. To make these improvements will necessitate the changing of the flow of part of the river, and work on that much of the plan is now being carried out. Fig. 4 shows the probable site for the Lockport dam and the scene of the work that has already been started. As this portion of the valley is considerably lower than the channel at the controlling works, the extension will necessitate building up the channel with embankments. It is estimated that it will cost $3,000,000 to build this dam and power house, construct the tailrace and put in the necessary machinery, but in return the District will have a constant waterpower capable of developing 24,000 horsepower when the full flow of 600,000 cubic feet a minute is sent down the channel.

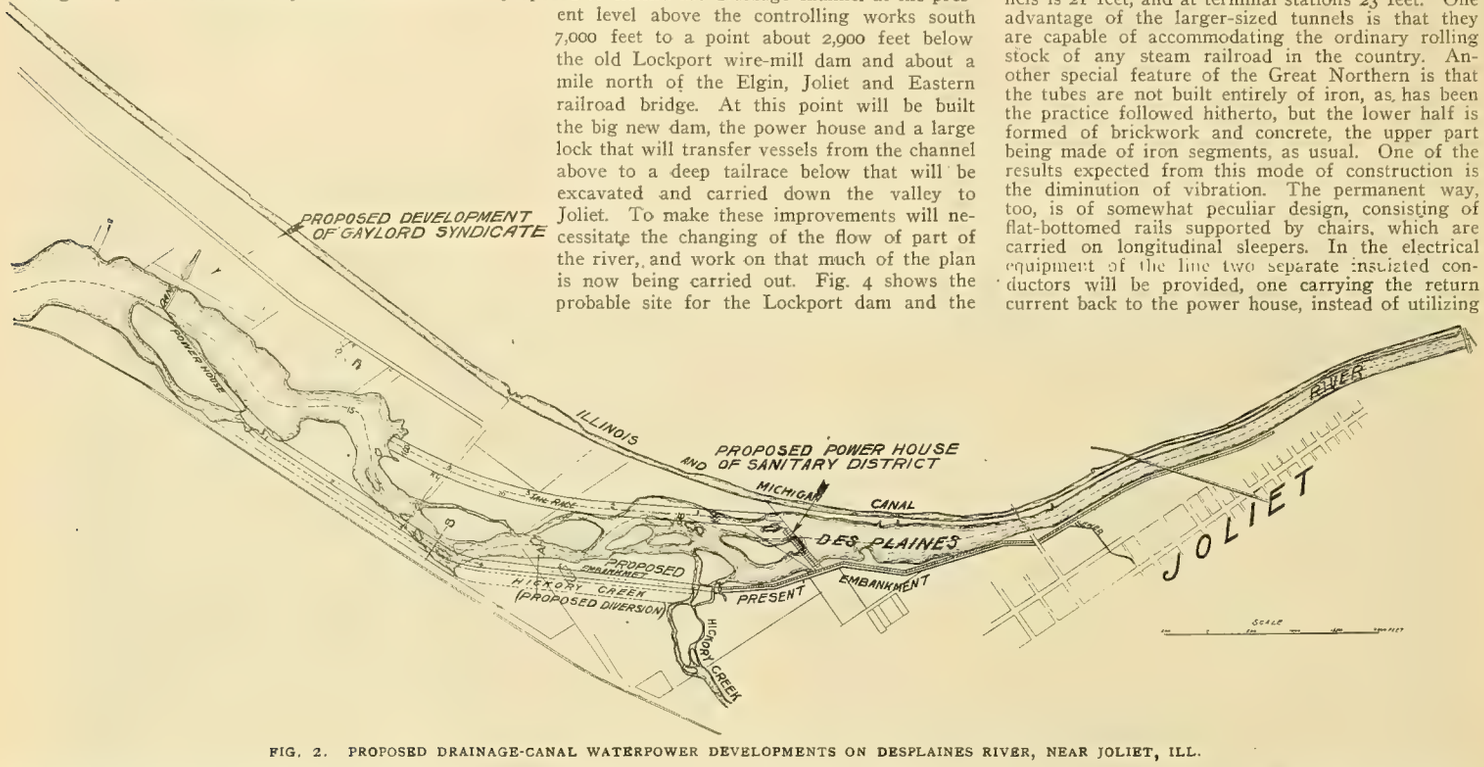


FIG. 2. PROPOSED DRAINAGE-CANAL WATERPOWER DEVELOPMENTS ON DESPLAINES RIVER, NEAR JOLIET, ILL.

No information has been given out in relation to the hydraulic and electric equipment that will be placed in either of the Sanitary District's power houses or in that of the private syndicate, and it is more than likely that the question of apparatus has not been seriously considered by the projectors themselves. At present the contest is more of a legal one, except that the Sanitary District has made an effort to carry out its plans by actual work at both its sites. One feature of the power-house designs, however, may be regarded as definitely settled in respect to all three power houses, and that is the nature of the hydraulic equipment. On account of the low head at each site, a large number of turbines will have to be installed in as many separate bays, the wheels being coupled together in groups as may be desired. In this respect they will be similar to the turbine equipment of the Economy Light and Power Company at Joliet.

The New Home Gas Company of Pontiac, Mich., is to build a gas house and electric-light plant.

Great Northern Underground Railroad in London.

London has two electric tunnel railways in actual service. Perhaps a dozen of projects for similar lines are in various stages of discussion or construction. One line that is nearly completed is that of the Great Northern and City Railway Company. It is worthy of a brief description. The railway extends over a length of 3½ miles from Finsbury Park, in the northern outskirts of London, to Finsbury Pavement (Moorgate Street), in the City. The company was incorporated in June, 1892, but after this nothing was done to further the project until the year 1898, when the contracting firm of S. Pearson & Son floated the company with a capital of $10,400,000. Immediately after the issue of the stock work was begun and the road, which possesses some distinctive features, is now almost ready to be opened to the public.

The company built two tunnels throughout the entire route with the exception of crossovers at different points, where one large tunnel is provided. Each tunnel is fitted with one track, and the average depth of the roadbed below the surface is 60 feet. The tunnels of the Great Northern company are of considerably larger size, measuring 16 feet internal diameter, than that suggested as a standard by the Board of Trade, which was 13 feet, and which figure has not been exceeded by any other road. At wayside stations the diameter of the tunnels is 21 feet, and at terminal stations 23 feet. One advantage of the larger-sized tunnels is that they are capable of accommodating the ordinary rolling stock of any steam railroad in the country. Another special feature of the Great Northern is that the tubes are not built entirely of iron, as has been the practice followed hitherto, but the lower half is formed of brickwork and concrete, the upper part being made of iron segments, as usual. One of the results expected from this mode of construction is the diminution of vibration. The permanent way, too, is of somewhat peculiar design, consisting of flat-bottomed rails supported by chairs, which are carried on longitudinal sleepers. In the electrical equipment of the line two separate insulated conductors will be provided, one carrying the return current back to the power house, instead of utilizing the track for this purpose. The power house occupies a central position on the Regent's Canal, and will supply direct current at 550 volts to the motors on the trains. In the first instance four generating units, built by the British Thomson-Houston Company, which has charge of the entire electrical equipment of the system, and each capable of an output of 800 kilowatts, will be installed. They are direct-connected to vertical cross-compound engines of 1,250 horsepower each, made by Messrs. Musgrave of Bolton. Ten boilers, of Messrs. Davey, Paxman & Co.'s "Economic" type, which will constitute the battery of the plant, are in place. The cars are wider and loftier than any in use on other lines. They will be made up into trains of seven, capable of accommodating 500 passengers. Three cars in each train will be equipped with two motors each. These motors are of 125 horsepower each, and will give a train a maximum speed of 33 miles an hour. The trains will be worked on the shuttle principle at the termini. They will complete the double journey of seven miles in 30 minutes. The service will require 11 trains, each of which will weigh about 200 tons when normally loaded. This is a very large capacity, compared to anything in electric railways in London hitherto. The tunnels and cars are lighted by separate circuits, fed by special lighting dynamos situated in the power station. The voltage is the same as that in use for power purposes, and in case of accident to the light dynamos, the power circuit can be made to feed the lamps. The terminal stations are lighted by five-ampere enclosed-arc lamps, together with 16-candlepower incandescent lamps. The latter are used in the tunnels. The terminal station on the street and rail level are connected by elevators, operated by electricity. These convey the passengers to and from trains.

The Effect of Daylight upon the Propagation of Electromagnetic Impulses Over Long Distances.[1]

By G. Marconi.

During some long-distance space-telegraphy tests carried out toward the end of February last between a transmitting station situated at Poldhu, on the coast of Cornwall, and a receiving station on board the S. S. Philadelphia traveling from Southampton to New York, I had the opportunity of noticing, for the first time in my experience, considerable differences in the distances at which it was possible to detect the received oscillations during daylight, as compared with the distances at which the effects could be obtained at night.

Before describing the results obtained, it may be useful if I give a brief description of the nature of the apparatus used at the transmitting and receiving stations. The transmitter at Poldhu was similar in principle to that used by me in previous work, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged at the peak of each electrical oscillation very much in excess of any that had been previously employed. The transmitting elevated conductor consisted of 50 almost vertical naked copper wires, suspended at the top by a horizontal wire stretched between two poles each 48 meters high and placed 60 meters apart. These wires were separated from each other by a space of about one meter at the top, and, after converging together, were all connected to the transmitting instruments at the bottom. The potential to which these conductors were charged during transmission was sufficient to cause sparking between the top of the said wires and an earthed conductor across a space of 30 centimeters.

The general engineering arrangements of the electric-power station erected at Poldhu for creating the electric waves of the frequency which I desired to use, were made by Dr. J. A. Fleming, F. R. S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by me and my special system of syntonization of inductive circuits, have provided an electric-wave-generating plant more powerful than any hitherto constructed.

At the receiving station on the ship, one of my receivers was employed, and the signals were recorded on the tape of a Morse recording instrument. A receiving transformer accurately tuned to the period of the electrical oscillations radiated from the transmitting station at Poldhu was connected to the coherer in the usual manner. The receiving elevated conductor was constituted of four almost vertical wires sustained in position by the ship's mast, the summit of which wires was about 69 meters above the sea level. At their lower end they were all connected to the receiving instruments.

My assistants at Poldhu had received instructions to send a succession of "S's" and a short message at a certain prearranged speed every 10 minutes, alternating with five minutes of rest, during the following hours: From 12 to 1 a. m., from 6 to 7 a. m., from 12 to 1 p. m. and from 6 to 7 p. m., Greenwich mean time, every day from February 23d to March 1st inclusive. On board the Philadelphia, I did not notice any apparent difference between the signals received in the day and those received at night-time, until after the vessel had reached a distance of 500 statute miles from Poldhu. At distances of over 700 miles, however, the signals transmitted during the day failed entirely, while those sent at night remained quite strong up to 1,551 miles, and were even clearly decipherable up to a distance of 2,099 miles from Poldhu.

It is interesting to note that at the time of the year at which these experiments took place, daylight at Poldhu was rapidly increasing between the hours of 6 a. m. and 7 a. m., and on the Philadelphia I noticed that at distances of over 700 miles from the sending station the signals at 6 a. m. were quite clear and distinct, whereas by 7 a. m. they had grown weak, almost to total disappearance, their strength thus apparently diminishing in proportion as daylight increased at Poldhu. No such weakening of the signals was noticeable between the hours of 12 midnight and 1 a. m.

With a view to further tests in this same connection, I carried out other experiments between the station at Poldhu and a receiving station (in all respects similar to the one on the Philadelphia) situated at the North Haven, Poole, Dorset. The distance between the North Haven and Poldhu is about 152 statute miles, of which 109 are over sea and 43 over high land. It was found that the signals from Poldhu could be perfectly well received at the North Haven during the night when four vertical wires 12.1 meters high were used in connection with the receiving instruments, while, all other conditions being the same, during the day the height of the wires required to be 18.5 meters, in order to receive the same signals with equal clearness.

The cause of these observed differences in the effects obtained by night, as compared with those noticed by day, may be due to the diselectrification of the transmitting elevated conductor, operated by the influence of daylight. The electrical oscillations in the transmitting elevated conductor may thus be prevented by the discharging influence of light from acquiring so great an amplitude as they attain during darkness. The diselectrification of negatively charged metallic bodies by light has been noticed by many observers, and as each alternate half-oscillation in the transmitting elevated conductor must necessarily charge it negatively, the dissipating effect of light on each alternate oscillation of the electrical wave in the transmitting wire may be sufficient to cause a material decrease in the amplitude of the oscillations. Other tests were instituted with the object of ascertaining whether the illumination of the spark gap of the transmitter had any effect upon the impulses transmitted, and, accordingly, the ball dischargers were enclosed in a box opaque to light. No perceptible difference, however, was noticed in the strength of the signals received, whether the spark balls were or were not exposed to daylight.

It would be interesting to ascertain whether the same effects are to be observed when using transmitting elevated conductors covered with insulating material opaque to ordinary light. I have never noticed any appreciable difference in the distances over which signals are obtainable during the day and the night respectively in the course of all the other numerous experiments which I have carried out with installations not designed for very long distances, and in which the electrical power used at the sending station has been small compared with that used at the Poldhu installation. Probably the much higher potential to which the elevated conductor at Poldhu was charged may have greatly increased the facility with which losses might occur, due to diselectrification through the influence of daylight. I hope to be able to make a complete study of the effects described in this note in the course of further long-distance tests which are likely to be undertaken shortly.

1. Paper read before the Royal Society, London, June 12, 1902.

FIG. 3. PROPOSED DRAINAGE-CANAL WATERPOWER DEVELOPMENTS.—VIEW ON DESPLAINES RIVER, SHOWING PATTERSON'S ISLAND, SITE OF THE PROSPECTIVE GAYLORD-SYNDICATE DAM.

FIG. 4. PROPOSED DRAINAGE-CANAL WATERPOWER DEVELOPMENTS.—THE SCENE OF THE WORK AT LOCKPORT.

Chicago Aldermen Complete Investigation of Eastern Traction Systems.

The Chicago aldermen comprising the committee on local transportation of the City Council completed their eastern tour of street-railway investigation last Monday, when they returned from New York city. The committee spent the last four days of last week in Boston, arriving there on Wednesday morning. That day was spent chiefly in inspecting the Boston Elevated Railway Company's system, President William A. Bancroft and the Boston transit commissioners having special charge of the entertainment. In the evening a dinner was given to the committee by President Bancroft. On Thursday the city officials took the committee down the bay, visiting many points of interest. B. J. Arnold, the city's engineering expert, accompanied the aldermen throughout the entire trip.

The general result of the trip is said to have been most valuable, as all of the members of the committee have gained many interesting facts concerning the transportation question in New York and Boston that will prove useful in their handling of the problem in Chicago. They are said to favor strongly the construction of a subway in the downtown section of the city and are universally of the opinion that one can be built here with less difficulty than in New York or Boston.

Cleveland May Have Three-cent Fare.

The Circuit Court of Ohio rendered a decision on August 4th, which granted to the Cleveland City Council the right to issue service franchises for street-car lines at a three-cent fare rate. The routes for such lines have already been advertised by the city clerk. Bids will be opened August 25th for the low-fare lines. It is said that the street-car men's union will do all in its power to oppose the successful operation of three-cent fare lines as it fears wages will decrease in proportion to the decrease in fare. This decision of the court ends for the time being a struggle that has been carried on for some years by Mayor Tom L. Johnson to establish in Cleveland a three-cent street-car fare. The two companies now operating street-car lines in the city will meet the lower fare, it is said, immediately in order to keep new companies out of the field.

A contact shoe was the cause of a recent accident on the Albany and Hudson electric railway. This is a third-rail line, and while one car was stopped owing to trouble with the shoe (the newspaper account is not explicit), another came along and crashed into it. Two passengers were killed and 25 were injured.

The Cost of Power.

By M. J. Eichhorn.

Part II.

This is illustrated in a striking manner in Fig. 4, which represents the subdivision of the total cost for various load factors. At the prevailing low-load factors of 0.3 to 0.4 the fixed charges are by far the most important item of cost (being 45.8 per cent. at L = 0.4), and the consequence is that cheap and inefficient machinery may give a lower actual cost per unit than the more efficient and consequently costlier modern machinery. But with an increased load factor these conditions will be changed, and coal will become the principal item of cost. The diagram (Fig. 4) shows, for instance, that it will become 48.6 per cent. of the total at load factor 0.8, when the fixed charges have diminished to 35.5 per cent. Fig. 4 is obtained from Fig. 3 by dividing the different items for any particular load factor, by the total cost for the same load factor.

If now the total cost for any particular load factor is divided by the total output for the same load

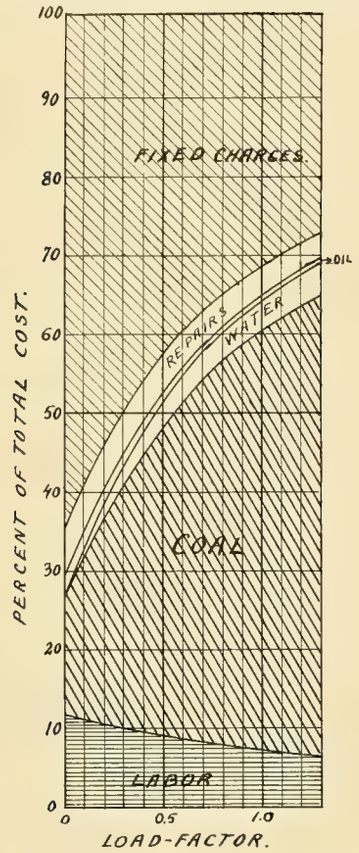


FIG. 4. COST OF POWER.

factor, and again subdivided in the same proportion as indicated in Fig. 4, the diagram, Fig. 5, is obtained, which gives a good idea of how the cost per unit changes with the load factor. The total cost at load factor = 0.4, designated by C_1, is taken as a unit. The actual value of C_1 varies, of course, for different stations; but in a first-class large plant it is about one cent per kilowatt-hour.

In order to find rapidly the probable cost for a given change in the load factor, when the actual cost is known, I have constructed the graphical table shown in Fig. 6. This is based on the following considerations: The cost per unit is, of course, equal to the total cost, divided by the number of units, and, further, the total cost is equal to the total power-house expense plus the fixed charges. Using the same notation as before, the total power-house expense was found $= 0.46\,T + \frac{0.54\,TL}{0.4}$ and the fixed charges were assumed $= 0.847\,T$. Consequently the expression for the total cost becomes $0.46T + \frac{0.54\,TL}{0.4} + 0.847T = 1.307T + \frac{0.54\,TL}{0.4} = 1.307T + 1.35\,TL$. Now, if K designates the total output in kilowatt-hours for a load factor of 0.4, evidently $\frac{KL}{0.4}$ is the output for load factor L. Further, if C and C_1 are the unit costs corresponding to the load factors of 0.4 and L, respectively, it follows evidently that $C_1 = \frac{1.847\,T}{K}$ and $C = \frac{0.4(1.307\,T + 1.35\,TL)}{KL}$.

$$C = \frac{0.4 \times 1.307\,T}{K} \times \frac{1}{L} + \frac{0.4 \times 1.35\,T}{K}.$$

By dividing this equation by the expression for C_1

$$\frac{C}{C_1} = \frac{0.4 \times 1.307}{1.847} \times \frac{1}{L} + \frac{0.4 \times 1.35}{1.847} \text{ or}$$

$$C = C_1\left[0.2831\,\frac{1}{L} + 0.2924\right] \text{ is obtained.}$$

This formula is the one solved by the abacus, Fig. 6. The dotted line across this diagram refers to the following example: If the present total cost per kilowatt-hour is 1.1 cents and the load factor = 0.4, the probable final cost would be 0.71 cent, if the load factor were increased to 0.8. This example, which is well within practical limits, shows the very considerable cost reduction that would result from an improvement in the load factor, under the assumptions made.

Fig. 7 gives in a similar manner the cost of coal per kilowatt-hour for various total costs and load factors. The formula solved is derived in the same manner as the previous one. The cost of coal was assumed to be $0.20T + \frac{0.48\,TL}{0.4}$, and the output $\frac{KL}{0.4}$; so that the cost of coal per unit, designated by C_2, becomes $\frac{0.4}{KL}\left[0.20T + \frac{0.48\,TL}{0.4}\right] = C_2 = \frac{0.4 \times 0.20\,T}{K} \times \frac{1}{L} + 0.48\,\frac{T}{K}$.

By dividing this equation as before with the expression for $C_1 = \frac{1.847\,T}{K}$.

$$\frac{C_2}{C_1} = \frac{0.4 \times 0.20}{1.847} \times \frac{1}{L} + \frac{0.48}{1.847} = 0.0433\,\frac{1}{L} + 0.26$$

$$\text{or } C_2 = C_1\left[0.0433\,\frac{1}{L} + 0.26\right] \text{ is obtained.}$$

The dotted line across the diagram refers to the following example: If the total cost of a station is 1.25 cents per kilowatt-hour at a load factor of 0.4, then the probable cost of coal alone for a load factor of 0.6 would be 0.415 cent per kilowatt-hour.

By comparing the results obtained from the diagram, Fig. 7, with those from Fig. 2, some very interesting conclusions can be drawn regarding the effect a change in engine efficiency or in the price of coal will have on the final cost, as compared with the change due to a variation of load factor. Starting, for instance, with a total cost of 0.9 cent, this corresponds to a cost for coal of 0.278 at load factor 1, as seen in Fig. 7. Now, by referring to Fig. 2, and assuming an evaporation of seven pounds of water per pound of coal and a steam consumption of 15 pounds per indicated horsepower-hour, the price of coal corresponding to these data is easily found to be $1.75 per long ton. If now this price should be increased to $2.25, everything else remaining constant, the cost per kilowatt-hour is obtained from Fig. 2 as 0.348 cent for load factor = 1, and the corresponding total cost from Fig. 7 as 1.14 cents per kilowatt-hour for a load factor = 0.4. Thus an increase in the price of coal of 28 per cent. increases the total cost per unit 26.5 per cent. Similar examples concerning the influence of a variation in the other data, can be quickly obtained from the diagrams.

By pursuing the method outlined above, it will be possible to estimate for any particular station, for which data are at hand, the effect that a given change in load factor will have on the final cost, either by using the diagrams given or by constructing new diagrams based on different coefficients.

This being done, the question arises, whether it is possible to increase the load factor, without additional investment, and whether the increased output could be profitably distributed and sold.

In regard to the so-called fixed charges, I have in the previous reasoning considered them as being

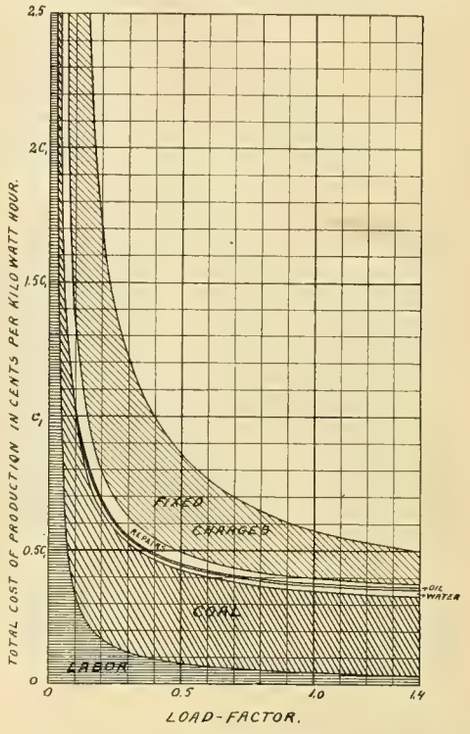


FIG. 5. COST OF POWER.

independent of the load factor. This is obviously true, so long as we consider what might be called spontaneous variations of the load factor in one and the same station. Such variations of greater magnitude are exemplified in street-railway plants where the cars are electrically heated during the winter months. In considering, however, such methods of increasing the load factor, that involve an additional outlay of capital, it will be easily apparent that the fixed charges must be increased and, consequently, that at least a part of them will be proportional to the increase in investment, which is necessary to secure the improved load factor.

In such stations, where the output is distributed and sold to individual consumers, there is a simple method of increasing the output without any additional investment, except for distribution, and that is to lower the selling price per unit.

In the days of Adam Smith, before our present factory system had made its appearance and when every member of a community was to a greater extent independent as regards industrial products,

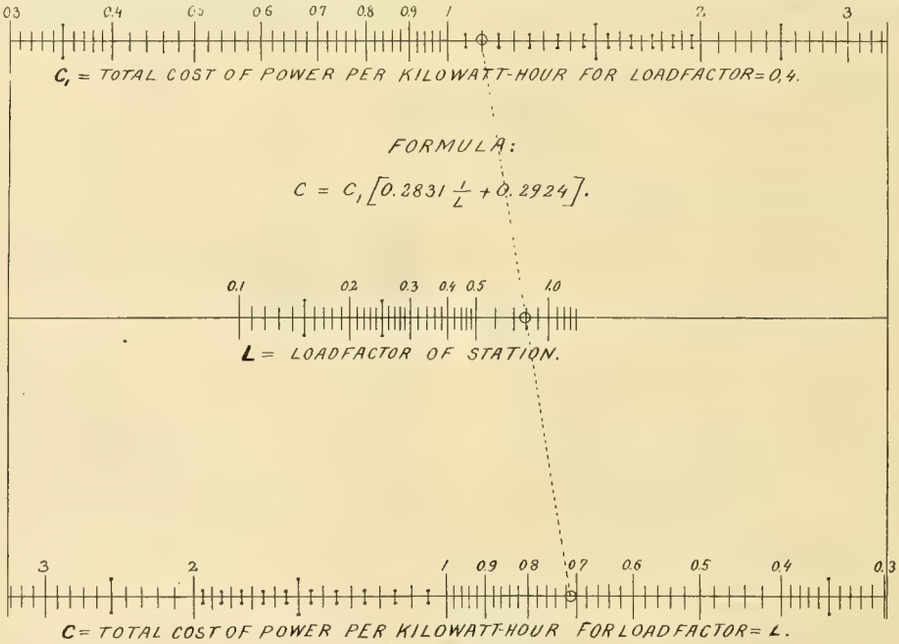


FIG. 6. COST OF POWER.

the theory of the economists was that prices were governed by supply and demand. This theory has held its sway almost undisputed for over a hundred years, and it is only within the last two decades that it has been finally overthrown by the investigations of Böhm-Bawerck and others. It is now well recognized among modern economists that we live under monopoly conditions, and that under such conditions a plentiful supply is necessary to create a demand. The prices of commodities do not depend on either, but their upper and lower limits are fixed by the marginal utility of the article to the purchaser and seller, respectively. How the price is determined between these two limits is still a matter of contention, but it seems to me most probable that McFarlane's theory is right. He states that the relative monopoly strength of the entire group of sellers and buyers, respectively, is the determining element of price. This is especially true for the case of public-service corporations, which depend largely on franchises for their continued existence. Particularly in the present case, the individual buyer may find the electric light too expensive and prefer gas light on account of its greater marginal utility, and at the same time in his capacity as a member of a franchise-granting community exert his monopoly strength toward a lowering of the rates. On the other hand, to take an extreme case, the rates offered may be so low that the individual seller, that is, the stockholder in the public-service corporation, will seek for his capital other investments offering him a greater marginal utility and at the same time exert his monopoly strength, based on previously granted franchises, toward maintaining or raising the rates.

Under these conditions actual observations have proved that if the sellers lower their price voluntarily the resulting demand will increase the output more rapidly than the price diminishes. Just how rapid this increase will be is a matter for speculation, but as a conservative preliminary estimate the 1.25th power may be taken. Putting this assumption in the shape of a mathematical formula: $D = \frac{K}{P^{1.25}}$, where D = demand or consumption of electric power in millions of kilowatt-hours per year, P = selling price of electric power in cents per kilowatt-hour, and K is a coefficient, whose value can be determined when present output and selling price are known. As this formula is rather inconvenient for numerical calculations, I have constructed the diagram shown in Fig. 8, which gives the solution for such cases as are apt to occur in practice. The value of the coefficient K is first obtained by taking on the upper line the point corresponding to the present output and connecting it by a straight line to the point on the lower line representing the present average selling price. The value of the coefficient can then be read on the middle line, and by turning the straight line around this point as a center any two corresponding values of the other variables can be read.

The dotted lines across the abacus represent the solution of the following problem: If the present station output is 45,000,000 kilowatt-hours per year and the present average selling price is nine cents per kilowatt-hour, what will be the probable output if the selling price is lowered to 6½ cents per kilowatt-hour? Answer: 68,000,000 kilowatt-hours per year. Now the first case corresponds to yearly gross receipts of $4,050,000, and the second to $4,420,000, an increase of nine per cent., effected by lowering the selling price 28 per cent. Part of this increase will no doubt be absorbed by the increased expenses of distribution, but it must be remembered that the load factor has been increased and consequently the cost of production per unit decreased. If the present load factor is assumed = 0.4 and present cost of production 1.25 cents, the new load factor will be $\frac{68}{45} \times 0.4 = 0.602$, and the resulting probable cost = 0.955 cent per kilowatt-hour, obtained from Fig. 6. The total cost of production in the first case would be $562,500 and in the second case $649,400; consequently the net gain, $283,100 per year, would be nearly all clear profit. The mathematical expression for the gross receipts is, of course, DP, and by a simple substitution the equation $DP = \frac{K}{P^{1.25}} = \frac{K}{\sqrt{P}}$ is obtained. This expression has no maximum value, showing that the gross receipts will increase indefinitely when the price of power is decreased.

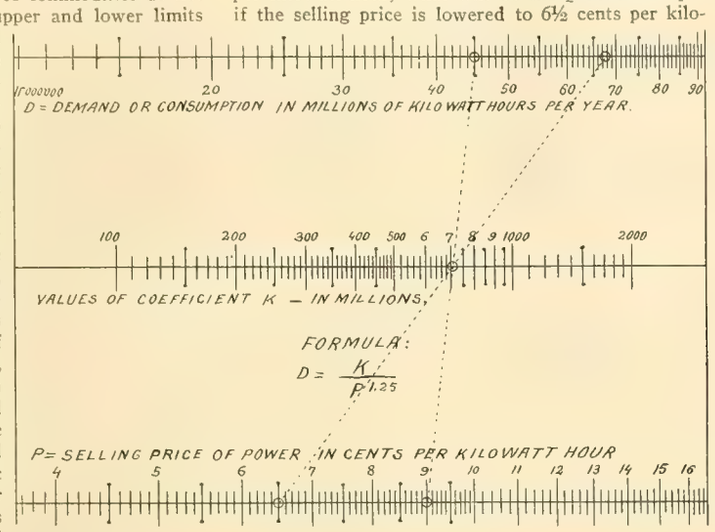


FIG 8. COST OF POWER

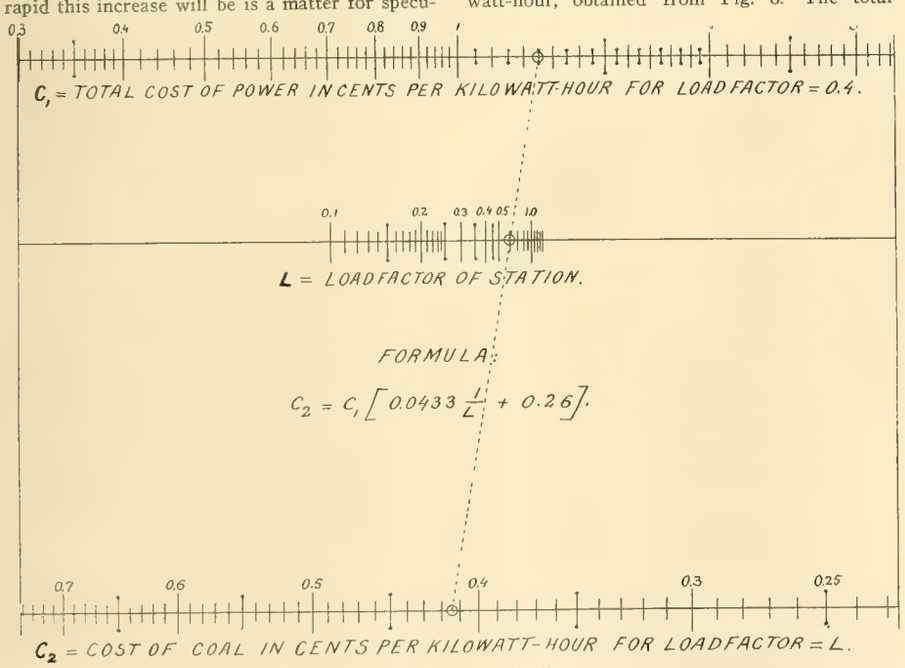


FIG 7. COST OF POWER

The system of charging for the electric power also has a certain influence on the consumption, and consequently on the load factor. I believe it would be of considerable advantage to return to the old system of a uniform price per kilowatt-hour, with a small discount for prompt payment and for quantity. The Wright maximum-demand system of charging has an apparent element of justice in considering the character of the consumer's load, but, as has been pointed out, if such a system were applied to the hardware business, it would require each buyer to pay for his share of the salesman's time, and so forth. The worst feature of this system, however, is that it creates in the mind of the consumer a sometimes well-founded suspicion that his next-door neighbor may be getting his supply of electricity for one-third of the price he himself is compelled to pay for various reasons that may be very obscure to the layman. A fact that must not be overlooked is that, in spite of our wasteful methods of converting the potential energy of coal into electrical energy, power is very cheap, and any attempt to husband it, as if it were a thing precious beyond measure, is bound to fail ultimately.

There are a great many other and better methods that may be devised to increase the load factor of individual consumers, such, for instance, as a meter that registers twice as fast during certain portions of the day and indicates clearly on the outside the rate that is being charged. Or a small storage battery may be located near a certain group of consumers, and connected with an automatic time switch to take current during the time of light load and deliver it during the time of heavy load.

I expect later to take up more in detail the methods of improving the load factor and the question of the amount of capital that may be economically expended to secure a certain improvement in the load factor.

[The end.]

Pupin Awarded Priority in Multiplex Telegraphy.

An interference case involving claims to priority of invention of an improved system of multiplex telegraphy has been finally decided in the Court of Appeals of the District of Columbia. The invention lies in the arrangement of the receiving stations in the application of electrical resonance in the art of selective or multiplex signaling, and is embodied in the issue defined in two counts as follows:

1. The method of distributing the electrical energy of periodic currents which consists in developing a number of effective currents of different frequencies independently upon a single line and conveying the several energies of these currents each selectively to a separate electrical translating device.
2. A system of distribution of electrical energy comprising a main line, means for independently developing effective electromotive forces of different frequencies thereon, branch lines connected with the main line each having its self-induction and capacity so related as to be permeable to alternating currents of a given frequency, and an electrical receiving device in each branch line.

There were three independent claimants in the case when the interference was declared—Pupin, Stone and Hutin & Leblanc. The order of their applications, as filed in the Patent Office, is the following: Pupin, February 23d; Stone, April 4, and Hutin & Leblanc, May 9, 1894.

The case was carried through all the different steps of the Patent Office and finally, on appeal from the examiners-in-chief, the assistant commissioner of patents decided that Pupin "was the first to conceive the invention, the first to constructively reduce it to practice, and the only one to actually reduce it to practice," and, therefore, affirmed their decision. Hutin & Leblanc remained in the case until this decision, but Stone carried it to the United States court.

Judge Shepard of the District Court of Appeals, in handing down the present decision, reviews the evidence briefly and concurs in the conclusions set forth in the decisions appealed from, awarding priority to Pupin.

Magnetic Experiments on Metals.

H. Nagaoka and K. Honda of Tokyo have completed a long investigation of the connection between the magnetization and the mechanical deformation of the ferro-magnetic metals. In reversible nickel steel, such as is used for scales on account of its small expansion, mechanical elongation in the direction of magnetization produces an increase of magnetism. On the other hand, the same substance stretches on being magnetized, especially when it is annealed instead of being hard-drawn. Iron, steel, nickel and nickel-steel increase in volume by magnetization, but cobalt shows contraction. The greatest volume change was observed in a nickel-steel containing 29 per cent. of nickel, in which it is, in a strong field, 40 times that of iron. As regards the Wiedemann effect, the twist produced by the combined action of circular and longitudinal magnetization in iron, nickel and nickel-steel increases with the longitudinal field strength, and reaches a maximum, whence it decreases gradually as the field is further increased. The sense of twist in iron and nickel-steel is opposite to that in nickel. The transient current produced by twisting a longitudinally magnetized wire and the longitudinal magnetization caused by twising a circularly magnetized wire are reciprocally related to the twist produced by longitudinal and circular magnetizations.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Proposed Drainage-canal Waterpower Developments near Joliet, Ill. Illustrated....85, 86, 87
Great Northern Underground Railroad in London....86
The Effect of Daylight upon the Propagation of Electromagnetic Impulses over Long Distances. By G. Marconi. (Royal Society)....87
Chicago Aldermen Complete Investigation of Eastern Traction Systems....87
Cleveland May Have Three-cent Fare....87
The Cost of Power. By M. J. Eichhorn. Illustrated. Part II....88, 89
Pupin Awarded Priority in Multiplex Telegraphy....89
Magnetic Experiments on Metals....89
Editorial....90
A Year's Electrical Exports....91
Elihu Thomson on the Metric System....91
Castelli (Solari?) Receiver for Space Telephony. Illustrated....91
Nernst Lamps Used for Decorative Street Lighting....91
Length of the Heating Season. By H. C. Eddy. (Communication.)....91
Chicago Elevated-railroad Improvements....91
Lord Kelvin's Opinion....91
Development of the Telephone Field. Illustrated....92, 93
Improvements in Long-distance Telephony. Illustrated..92
Competition Advantageous....92
Indiana Telephone Items....93
Telephone News from the Northwest....93
Ohio Telephone Notes....93
Southern Telephone Developments....93
Death of E. P. McConnell....93
President Fish Talks....93
Public Telephone Rate in Chicago Reduced....93
General Telephone News....93
The Seamy Side of Wireless Telegraphy. By A. Frederick Collins....94, 95
Recent Central-station Changes....95
Railroad Car Lighting. By L. T. Canfield. (Master Car Builders' Association.)....95
Fort Wayne Men in Conference....95
Mr. Yerkes Successful in London....95
Proposed African Power Plant....95
Energy Loss in Commercial Insulating Materials When Subjected to High-potential Stress. By Charles Edward Skinner. Illustrated. Part I. (American Institute of Electrical Engineers.)....96

DEPARTMENTS.

Correspondence....97, 98
New York Notes....97
New England News....97
Canadian Intelligence....97
Southern Developments....97
From the Buckeye State....97, 98
Information from Indiana....98
Northwestern Notations....98
Personal....98
Electric Lighting....98
Electric Railways....98, 99
Automobiles....99
Publications....99
Telegraph....99
Miscellaneous....99
Trade News....99
Business....99
Illustrated Electrical Patent Record....99, 100

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

THE coming naval maneuvers will be of particular interest to those who follow electrical advancement owing to the extensive use of searchlights and space telegraphy which is promised. The new system of wireless communication, in particular, will be given a careful test under circumstances approximating war conditions as nearly as possible. There will be telegraphing between ship and shore and between different vessels, and many valuable lessons should be learned.

AN interesting resume of the space-telegraphy situation is given in Mr. A. Frederick Collins' article in this issue. The author entitles his contribution "The Seamy Side of Wireless Telegraphy," and shows that there are two sides to the shield. The paper was prepared before the dashing Silvanus Thompson had cast his gauntlet into the arena as the knight-errant champion of Sir Oliver Lodge as the inventor of space telegraphy. Professor Thompson was not particularly convincing, but he did work up quite a bit of a shindy; so that the seamy side of the new art is even seamier than when Mr. Collins wrote. The great value of Marconi's work is clear enough to the impartial observer; but some of the trials and tribulations visited upon him and the lesser inventors are clearly set forth in Mr. Collins' article.

QUARANTINE restrictions of a rough-and-ready sort must sometimes be reckoned with in electric-railway operation. Thus a recent attempt to operate cars on the Greenfield interurban line between Knightstown and Charlottesville, Ind., was met by riotous proceedings on the part of residents of Charlottesville. The cause of the trouble was a quarantine against Knightstown on account of smallpox. The second car run into Charlottesville was met by an angry mob. The rails had been greased and the car was stoned; the motorman and conductor were arrested, and a director of the road was wounded by a stray shot. Passengers were struck and wounded by the flying missiles. The car was sent back and no further efforts will be made to operate the cars as far as Charlottesville against the shot-gun quarantine. However, the company will test the matter in the courts. It seems to be unjust that such a quarantine should be enforced against the electric lines and not against the steam roads.

MULTIPLICATION of interurban electric railways has resulted in greatly increasing the number of grade railroad crossings in the country, with consequent increase in the danger of accident. In several states accidents due to this comparatively new state of affairs have occurred, and the situation has aroused serious attention. In Indiana there were two such accidents last week. A train on the Vandalia steam road struck a Terre Haute interurban car at a crossing, injuring three persons fatally and six others seriously. At Yorktown a Big Four switch engine (steam) struck a Union Traction car (electric) at a crossing, killing the motorman and injuring a number of passengers. These accidents have caused a renewal of the controversy between the interurban and steam railroad companies regarding the use of interlocking switches at crossings. Three interlocking-switch laws have been passed by the Indiana Legislature, but none of them has met the situation. The first provided for interlocking switches for steam-road crossings, the second was made to include electric roads and the third stipulates that if an electric line crosses a steam road it must bear the cost of the construction and operation of an interlocking switch. The question whether interurban railway companies should put in interlocking switches has been at issue in the courts of several states and a case is now pending in the court of last resort in Indiana to settle the question. The lower court held the law unconstitutional. In Indiana, at least, it is probable that the next Legislature will enact a law that shall cover the situation adequately.

By their pilgrimage to New York and Boston the Chicago aldermen constituting the local transportation committee of the City Council appear to have plucked the fruits of observation to an extent sufficient to repay them for their journey. Chicago is, in truth, in a backward state, so far as its street-railway facilities are concerned, and the aldermen have returned more than ever convinced of the fact. The members of the committee are reported to be in favor of a downtown subway, which does, indeed, offer a promising solution of the problem. They were also impressed, apparently, with the advantages afforded by the operation of all the lines in the city as parts of one system. Another lesson learned was that a more systematic differentiation of long-haul and short-haul traffic is desirable—as, for instance, in broad terms, elevated or tunnel roads for long-haul or "express" business and surface lines for short-haul or "local" business. Altogether, the trip seems to have been a profitable one, and, with the able assistance of Mr. B. J. Arnold, the city's consulting engineer, the committee should be able to recommend a carefully thought-out system of permanent value.

OFTEN criticized, but apparently never improved, the telegraph service of the British Postoffice is again held up to public derision. An official circular admits that a considerable percentage of the 3,000 operators employed in the central office at London are inexperienced and inefficient, and directs operators at outside offices to adapt their rate of sending to the capacity of the operators in the central office. This state of affairs is without excuse. Austen Chamberlain, financial secretary to the Treasury, endeavored to explain the matter in the House of Commons on the theory that there must always be many recruits employed, but experienced telegraphers deny this, and point out that only three months' preparation is exacted before actual service is begun. The inefficiency, it is claimed, is due wholly to new economies undertaken in the department, since plenty of efficient employes are available. It is extraordinary, too, that in the entire telegraphic service no typewriters are used, except for a few in the foreign departments. Public ownership appears to be a failure in such a conspicuous example as the government telegraphs of Great Britain.

EVEN more up-to-date than the telephone newspaper of Budapest is the proposed space-telegraph news service of lively Paris. It is proposed to establish a central station, from which wireless telegraphy will be used to transmit the news to subscribers in different parts of town. The Société Française de Telegraphie Sans Fil has been organized with this end in view, and the experimental stations which have been installed in different parts of the city appear to work satisfactorily. The company is to send to the subscribers all the important news of the day, such as the sessions of Parliament, stock quotations, results of the races, etc., and the news will thus be received in the shortest possible time, the subscribers being kept posted as to all events without having to leave their houses. The preliminary steps have already been taken, and the company is only waiting for an authorization from the Minister of Posts and Telegraphs in order to commence work. As an example of what it intends to do, the method of transmitting the news of the races may be mentioned. In each race course will be erected a transmission mast. An automobile, provided with a complete set of instruments for a sending station, will go to the spot on the day of the races and connect with the mast. The news will be sent to the main station in town, which will transmit it to the subscribers. The Popp-Branly system of apparatus is to be used; but how the interference problem is to be met and whether news can be received at the central station at the same time that the outgoing bulletins are being transmitted are not stated.

A Year's Electrical Exports.

So far as the classification of the Treasury Department gives information, the total electrical exports of the United States for the fiscal year ended June 30, 1902, amounted in value to $9,011,505. This amount is made up as follows:

Electrical machinery	$5,379,746
Electrical appliances, including telegraph and telephone instruments	3,631,759
Total	$9,011,505

Compared with the showing for the year before (ended June 30, 1901), the exports of electrical machinery show a falling off of about 7½ per cent., the figures being: 1901, $5,812,715; 1902, $5,379,746. The comparison cannot be carried out accurately in the case of electrical appliances, for the reason that in the fiscal year 1901 they were not separately classified, being embraced in "instruments and apparatus for scientific purposes." However, there was undoubtedly a much greater decline under this heading than in the case of electrical machinery, as, lumping all "instruments and apparatus for scientific purposes" together, the decline was over 26 per cent.

Great Britain and the British colonies continue to be by far our best customers for electrical machinery. Other countries show curious fluctuations, as shown by the following table:

EXPORTS OF ELECTRICAL MACHINERY.

Exported to—	For the Year Ended June 30.		
	1900.	1901.	1902.
United Kingdom	$1,568,653	$2,760,733	$2,573,495
France	266,470	179,360	39,255
Germany	107,531	142,168	43,000
Other Europe	179,234	200,297	173,402
British North America	800,423	807,419	1,147,632
Central American States and British Honduras	5,852	3,994	18,850
Mexico	445,208	374,970	196,762
Santo Domingo	6,184	.....	617
Cuba	95,093	46,706	30,959
Porto Rico	5,788	.....	.....
Other West Indies and Bermuda	56,701	26,349	2,822
Argentina	215,505	129,640	61,705
Brazil	87,058	233,047	43,448
Colombia	5,152	8,537	2,368
Other South America	19,627	51,004	20,076
Chinese Empire	6,345	381	2,894
British East Indies	29,050	317,081	208,039
Hongkong	.....	11,873	9,274
Japan	102,943	242,464	129,777
British Australasia	187,459	169,539	563,272
Hawaii	5,230	.....	.....
Philippine Islands	91,213	45,770	27,788
Other Asia and Oceania	5,034	26,190	13,342
Africa	49,238	34,843	70,744
Other countries	.....	350	225
Total	$4,340,992	$5,812,715	$5,379,746

Elihu Thomson on the Metric System.

In a letter addressed to the secretary of the Franklin Institute of Philadelphia, a few months since, Elihu Thomson said:

"I am glad to note that a special committee of the Franklin Institute has taken up the question of the adoption of the metric system for our standards, and has reported upon the matter favorably.

"In my opinion we need the system, and I hope it will become international. We need it because it is a rational system connecting measures of length with those of area, volume, etc. It appears to me that our people have been long enough under the incubus of 'long' and 'short' tons, 'long' and 'short' hundredweights, 'dry' quarts, 'liquid' quarts, and the like; units without any rational relation, or often with curious fractional relationship to one another.

"I doubt whether there are many persons who could state the various measures and their values as learned in childhood. If such measures as our measures of length in feet and inches were the only things concerned, I should not advocate a change, but the question is far broader than that of a set of linear units, and the metric system is the only existing rational system which can be substituted for the irrational measures we now have.

"I realize that, in changing to the metric system, many of our industries will be subjected to some confusion and perhaps considerable expense. I do not think the change can be forced or accomplished by any sudden, revolutionary process. It seems to me that ample time should be allowed for the transition; in fact, a period of not less than two or three years.

"While I have never regarded the measures of length of the metric system as the most ideal for practical purposes, still no better system exists, and it is decidedly too late to devise any new systems. I hope the national government will soon enact such laws as will insure the ultimate adoption of the metric system as our standard.

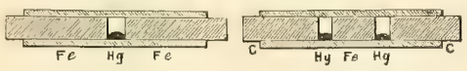
"I may add, in conclusion, that I have been in consultation with most of the heads of departments and engineers of the General Electric Company, and find that on the whole they are favorable to the adoption of the metric system, especially on new work, with the idea that it would eventually entirely displace existing measures. When it is borne in mind that in the business of machine manufacturing, the cost of gages and other tools made in standard dimensions is a large item, and that the change means the production of other gages, etc., in the new system, it is indeed surprising that so little opposition to the proposed change has arisen.

"It is beginning to be generally believed, I think, that the ultimate advantage will be greater than the temporary disadvantage, and that the longer we go on without making the change, the more difficult and costly will the carrying out of any such substitution become."

Castelli (Solari?) Receiver for Space Telephony.

From l'Elettricista of Rome (Professor Banti) and the Electrical Review of London (H. W. Sullivan) the following facts in relation to the Castelli mercury-tube receiver for wireless telephonic communication are taken. In the journals mentioned the instrument is attributed to Castelli without question, but, as shown by the Western Electrician last week, Lieutenant Solari (both Castelli and Solari are connected with the Italian navy) roundly asserts that he is the inventor. The tube is designed to replace the coherer. Two forms are shown in Figs. 1 and 2 and the manner of connection in Fig. 3.

The best size of mercury globules is from 1.5 to three millimeters in diameter, and that of the



FIGS. 1 AND 2. CASTELLI RECEIVER FOR SPACE TELEPHONY.

glass tube generally used three millimeters in internal diameter, and from five to eight millimeters in external diameter. It will be noted that the Castelli tube is in effect a new form of microphone joined up in place of a coherer in circuit with a battery and telephone, the received waves causing corresponding variations in the battery current flowing through the telephone circuit, thus producing signals. In addition to its simplicity, this receiver is self-restoring, and thus requires no tapper or other mechanical device to decohere it after each signal. This greatly increases the signaling speed. Again, a vacuum may be dispensed with, so that it is not necessary to exhaust the tube. Then, again, it is said that in case of need the operator himself can clean and efficiently recharge the tubes—a great advantage in practice. The particulars as yet published scarcely allow of an opinion being formed as to the life of the new receiver or as to its behavior in practical working from day to day in all weathers, and especially in magnetic storms.

It is natural to suppose that, owing to its extreme sensibility, the working of the Castelli tube would be even more interfered with by atmospheric disturbances than that of the ordinary, and, presumably, less sensitive granular coherer. This, however, remains to be seen.

A disadvantage of the Castelli tube is that at present its signals can be received only on a telephone,

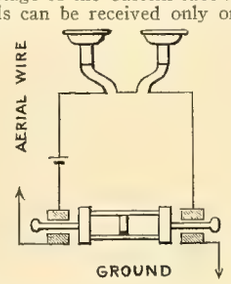


FIG. 3. CASTELLI RECEIVER FOR SPACE TELEPHONY.

inasmuch as, in contradistinction to the granular coherer, this microphonic receiver is incapable of closing a local circuit in which is placed a Morse inker or recording instrument.

According to Professor Banti, the maximum distance at which wireless telegraphic communication has been established in the Italian navy is 70 kilometers, while with the Castelli tube telephonic messages have been exchanged at ranges up to 200 kilometers, and the speed and certainty of signaling were also much improved.

Nernst Lamps Used for Decorative Street Lighting.

The London Electrical Review of recent issue says: "When the report of the king's health continued to be so favorable, the Canadian government decided not to disappoint the public, but to illuminate the large Triumphal Arch. Therefore, on June 30th the London public was delighted to see for the first time a very brilliant illumination, executed chiefly with Nernst lamps. All the graceful and prominent lines of the arch were covered with these lamps, each giving a very brilliant and dazzling white light of 160 to 180 candlepower, the total number of lamps exceeding 350. We understand that notwithstanding this immense mass of light of about 60,000 candles, the current consumed was exceedingly low, as each lamp did not consume more than one ampere on a 200-volt circuit. Thus the average power required per candle was about 1.5 watts. The arch was further illuminated with 24 arc lamps, each of about 1,000 candlepower, eight of which were provided with red-colored globes, and also 750 small incandescent lamps of about five candlepower, which were fitted on the lettering. All the different colors and shades of the various kinds of lamps gave an exceedingly pretty and effective result."

COMMUNICATION.

Length of the Heating Season.

To the Editor of the Western Electrician:

In reading the first part of an article entitled "Cost of Power," by Mr. M. J. Eichhorn, the following statement in the third paragraph is noted: "The explanation nearest at hand is that these small stations utilize the exhaust steam for heating purposes, and so are enabled to survive, but when, on closer examination, it is found that perhaps a majority do not utilize their exhaust steam, and, further, that the heating season at best is only three or four months in the year, this explanation becomes untenable."

The writer desires to take exception to the statement made by the author of the article with respect to the length of the heating season. This does not even hold true in latitudes as far south as Atlanta, Ga., and it is not apparent what authority the author has for making any such statement. In calling your attention to this matter, it is not with any idea of discussing the subject from the standpoint of the heating business, but with a view to determining, if possible, the reason for making any such statement which, on its face, appears to be quite incorrect.

H. C. EDDY.

Chicago, August 1, 1902.

In answer to this Mr. Eichhorn writes: "In regard to Mr. H. C. Eddy's objections to my estimate of the length of the heating season, I can only say that I based it solely on my personal experience of the local climate. So far as I can remember, the months of December, January, February and March constitute the only time that can be given the name of a heating season, although, of course, an occasional cold day may occur earlier or later. As I have been brought up in a more frigid climate than that of Chicago, it is possible that my personal estimate of the cold season does not agree with the general consensus of opinion, and, if so, I beg leave to apologize for the assumption that my personal experience agreed with that of the majority."

Chicago Elevated-railroad Improvements.

Sometime ago the property owners on the streets traversed by the Union Elevated Loop in Chicago presented a petition to the Union Elevated Railroad Company, requesting that the elevated structure be painted a light color, so that their respective stores and places of business would be made lighter. In accordance with the request, the company now has a force of men at work painting the entire structure. A dark gray paint was formerly used, but the new coat is white, although it gives the appearance of a light gray after it is applied to the dark structure. The structure of the Lake Street Elevated road is also being painted the same color.

An example of generosity has been set in Chicago by the Northwestern Elevated Railroad Company, which has offered to make the city a present of a public playground in a section of the North Side that has a congested population. The playground is a plot 300 by 80 feet, running east from Town Street half way to Larrabee, bounded on the north by Lutz Place and on the south by Alaska Street. The land is partly under the tracks of the elevated railroad and partly on each side. The company also offered to lay out lawns, put in a fountain and furnish the swings. All that the city is asked to do is to supply funds for the park's maintenance.

An express service will be started on the Lake Street elevated railroad on August 11th. Express trains will run from Oak Park and Austin in the morning to the city, and in the rush hours of the evening they will run from Chicago to the suburbs. The only intermediate stops will be at Oakley Avenue and Forty-eighth Avenue. The arrangement has been completed for the service through an agreement with Receiver Owsley of the Suburban railroad, which controls the surface line which extends to Austin and Oak Park. In connection with the new service the road will be operated as a left-hand road, all trains entering Chicago on the north track. The running time of the express trains between Oak Park and Chicago will be 30 minutes, with 20 minutes from Austin.

Lord Kelvin's Opinion.

At a meeting of the Anglo-American Telegraph Company held in London last Saturday the chairman, Francis A. Bevan, said nothing had occurred, so far as he knew, to alter the opinion of the directors that, although wireless telegraphy would carry a certain class of telegrams, such as those between ships or between ships and the shore, there was no reason apparent why it would compete in the class of telegrams sent by cable companies. During a recent conversation with Lord Kelvin the latter said to Mr. Bevan: "I have given careful consideration to this subject, and I do not believe the shareholders of your company need be alarmed at the prospect of wireless telegraphy."

DEVELOPMENT OF THE TELEPHONE FIELD.

Improvements in Long-distance Telephony.

Four telephone patents were granted last week and assigned to the American Telephone and Telegraph Company. They have special reference to increasing the efficiency of long-distance telephony. Two of these patents, Nos. 705,685 and 705,686, are granted to Joseph Lyons and relate to a method of and apparatus for reinforcing telephone currents imposed upon a line in any way or manner. The reinforcing of the faint telephone currents is accomplished by reducing the apparent resistance of the line to these currents continuously, and practically to any desired extent. The telephone currents are primarily caused to produce an alternating field or fields of force varying in frequency and intensity with the frequency and the variations of intensity of the telephone currents, and within such field or fields there are rotated electric circuits that are closed upon themselves with a speed that exceeds a certain critical speed. By the rotation of such circuits within the initial magnetic field or fields the electromagnetic reactance of the telephone circuit is reduced, whereby the initial field or fields and the exciting currents are reinforced.

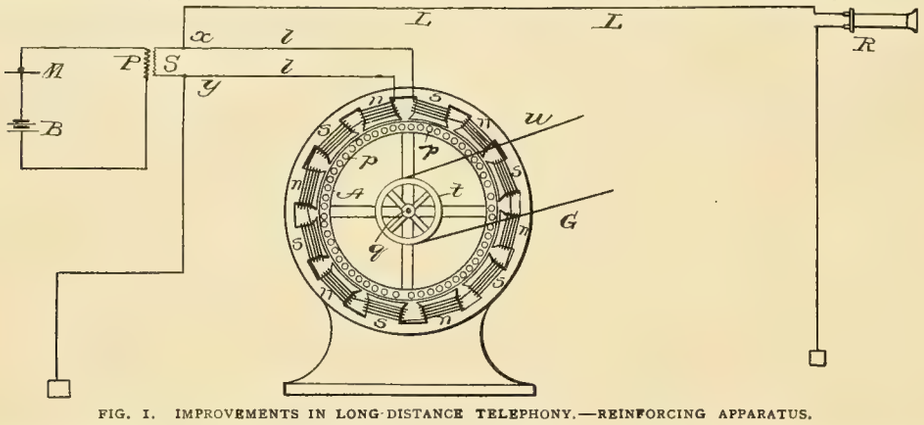


FIG. 1. IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.—REINFORCING APPARATUS.

Machines for reinforcing faint alternating currents of one definite frequency by causing them to produce an alternating magnetic field or fields and rotating within the latter circuits closed upon themselves with a speed exceeding a certain critical speed have heretofore been suggested for use as constant-potential alternating-current generators, and such machines are set forth in a patent granted to Hutin & Leblanc, July 5, 1898. Such machines, however, have heretofore been used only each for the reinforcement of an alternating current of one definite frequency, and the speed given to the closed circuits was calculated and determined with reference to the frequency of the single current that was led to and reinforced by the machine.

Mr. Lyons' invention is practiced by passing the faint telephone currents at any point on the line through the field coils of a machine of the Hutin & Leblanc type and rotating the armature of such machine with a speed exceeding the number of periods of the highest frequency current that occurs or is likely to occur in telephony divided by half the number of poles of the field magnet. By this process the lower-frequency currents are more reinforced than the higher-frequency currents; but this does not vitiate the reproduction of speech; but, on the contrary, improves the reproduction, since lower-frequency vibrations must be of higher amplitude than those of higher frequency in order to produce sounds of the same intensity as the latter.

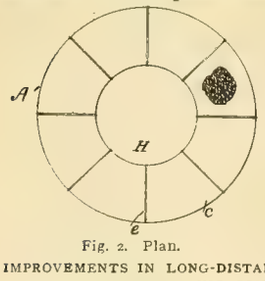


Fig. 2. Plan.

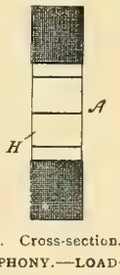


Fig. 3. Cross-section.

IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.—LOADING COIL.

In the accompanying drawings, Fig. 1 is a diagram illustrating the invention as applied to long-distance telephony with an unbroken line.

The system, as thus represented, is operated as follows: Speech uttered against the microphone (M) causes alternating electric currents to be generated in the secondary (S) of the induction coil. One branch of these currents passes through the field coils of the reinforcing machine by the conductors (11), and another branch passes to the line (L L). Both current branches are exceedingly weak, and the branch passing to the line is too weak to cause an audible reproduction of sounds in the telephone receiver (R) if the line exceeds a certain length; but if now the rotor of the reinforcing machine (G) is rotated with such speed that its number of rotations per second exceeds the number of periods of the currents due to the sound of highest pitch that is uttered against the transmitter, divided by half the number of poles of the field, then the initial and exceedingly weak alternating field excited by the telephone currents is reinforced, and these currents themselves are reinforced. This reinforcement of telephone currents may be carried practically to any desired extent, depending upon the size and speed given to the reinforcing generator and also depending upon the electromagnetic reactance of the reinforcer. This reactance should be made as small as practicable, and for this purpose the amount of iron entering into the construction of the machine should be made very small, and the iron, if employed at all, should be highly laminated, as is usual with machines of this character. The reinforcing machine may be in series in the line instead of in a branch derived therefrom.

In the ordinary system of telephony, the faintness of the telephone currents is due to the great apparent resistance of the telephone circuit, and for this reason telephony can only be successfully practiced over comparatively short lines. With this improved system, the inventor says, there is no practical limit to the length of the telephone line, since whatever that length may be, its apparent resistance is so largely reduced by the reinforcing operation that speech can be transmitted over very long lines with the same loudness as is now attained upon comparatively short lines.

The main line may be divided into sections, permitting the use of small reinforcing machines upon moderately long sections of lines, and the practice of telephony over very long distances. When a line is thus subdivided into sections, it is not necessary that each section be either metallic or grounded.

It is now well known that the efficiency of electrical circuits for the transmission of energy by varying currents, especially telephone circuits, may be increased by inserting therein at proper intervals and in series inductance coils of low resistance and high inductance. The circuits so equipped are known as "loaded lines," and inductance coils thus associated with them are sometimes termed "loading coils." To obtain the required inductance with a smaller number of turns of the electric winding than otherwise would be necessary, and thus to keep the coil small in size and of low resistance, loading coils have been provided with iron cores; but the employment of iron introduces certain core losses, since though possessing maximum permeability, iron is likewise highly conductive, and its conductivity facilitates the generation and development of parasitic or eddy currents at the expense of the working current, which is correspondingly weakened. These losses are of such serious consequence in telephonic circuits by reason of the extremely high periodicity of the telephonic current that in order to reduce them sufficiently it has been found necessary to carry out the division of the iron to the most radical extent and to have each element thereof as thin as possible.

In a patent, No. 705,935, issued to John C. Lee and Edwin H. Colpitts, is described a method or process for the production of suitable loading-coil cores of magnetic oxide or of ferroso-ferric oxide (Fe_3O_4) and a non-conducting highly permeable compact core practically continuous in the direction of magnetization produced by such method. To produce such cores, thin plates, ribbons or very small wire of magnetic metal, as iron, are assembled, lapped, or wound into a loosely built or partly open-work structure, corresponding in form and dimensions to the conformation and size of the core desired, and the structure or core form is then subjected to the roasting action of heat in an atmosphere capable of yielding oxygen to the iron until the iron is reduced or converted into magnetic oxide. The core thus made is therefore composed of artificial magnetic oxide, and while retaining the form in which it was originally built up or constructed, has become dense, continuous and compact. It possesses, moreover, in a high degree the desired qualifications of permeability and high specific electrical resistance, and in consequence of the latter has no tendency to serve as a circuit for the formation and development of eddy currents.

Another patent (No. 705,936) issued to these inventors contemplates the employment of such a magnetic or ferroso-ferric oxide core in combination with the electric conductor, helix, or winding of a loading coil. It also comprises an electric circuit for transmitting energy by varying currents loaded with ring-shaped inductance coils connected therein at proper intervals, each coil consisting of an electrical winding or windings surrounding or provided with a magnetic core constituted in the form desired of a compact mass of magnetic oxide. The cross-section of the core and its toroidal conformation determine the general character and shape of the finished inductance coil, and the electrical winding may be formed either of a continuous helix of insulated copper wire closely covering every part of the core or of two continuous helices of the wire holding like magnetic relation to the core and together covering the same.

In the drawings Figs. 2 and 3 represent, respectively, in plan and central cross-sectional view a loading-coil core prepared by winding crimped-iron wire into the conformation desired and then converting the same into ferroso-ferric oxide. Fig. 4 thus represents an electrical circuit equipped with inductance coils.

In Figs. 2 and 3 (A) is the magnetic core as a whole, which being generally formed as a torus or ring has a hole (H) through its center. The cross-section of the ring may be circular, elliptical, or in the form of a parallelogram, as preferred. In the figures, (c) represents a covering or wrapping of stiff paper or linen strips, which may be secured by a resinous or asphaltic cement or by cords or ligaments (e), which may pass through the central hole and around the substance of the core. In Fig. 2 a portion of the covering is shown as being broken or torn away to indicate the original metallic composition of the core.

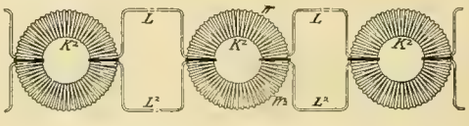


FIG. 4. IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.—LOADING COILS IN CIRCUIT.

In Fig. 4 the telephone circuit is represented as being provided with the double-conductor coils (K^2), the windings (W) of the several coils being in series in conductor (L), while the windings (W^2) are similarly connected in conductor (L^2) of the circuit.

Competition Advantageous.

Alderman Linn H. Young, chairman of the special council committee on reduction of telephone rates in Chicago, has just returned from a trip to New York, Baltimore, Philadelphia and Boston, and while in those cities made a study of their telephone systems. As a result of his observation, Alderman Young expresses the opinion that the system of measured telephone service, which is gaining ground in the East, is desirable and more equitable than the flat-rate plan to small users of telephones. He is also convinced, it is said, that competition between rival companies is advantageous to the general public, this fact having been amply demonstrated in Philadelphia and other cities. Alderman Young advocates the abolition of toll rates for near suburban towns, and says that all telephone wires should be placed in conduits underground.

The Gold Belt Line of the Rocky Mountain Bell Telephone Company is completed. The new line is 405 miles long. It extends from Boise to Blackfoot, Idaho, a distance of 256 miles, and from that place to Salt Lake City, a distance of 149 miles.

Indiana Telephone Items.

Six telephone companies were incorporated last week. The Portage Home Telephone Company, with a capital stock of $10,000, was incorporated to construct and operate telephone lines in Porter, Lake and Laporte counties. The principal exchange and home office will be at Crisman, Porter County. H. D. Schofield heads the board of directors. The Spiceland Co-operative Telephone Company will construct and operate lines in Henry, Rush, Fayette, Wayne, Hancock, Madison, Randolph and Delaware counties. The capital stock is $10,000. The home office will be at Spiceland. H. W. Jones, Sesson Hudson and others constitute the board of directors. The People's Co-operative Telephone Company of Stockwell will construct and operate telephone lines in Tippecanoe and adjoining counties. The capital stock is $6,000. W. O. Land is a director. The Indiana Telephone Company will operate a telephone system in Washington, Clark and Scott counties. The capital stock is $5,600. The principal exchange and offices will be located in Pekin, Washington County. Charles L. Graves, J. T. Graves and D. W. Bowman are the directors. The Overland Telephone Company is to construct and operate lines in Clark County. The capital stock is $1,000. The towns of Borden and Henryville will be first given service. The exchange will be in Henryville. The directors are Ernest Schleicher, D. M. Gray and others

A number of telephone men and their representatives appeared before the State Tax Board last week. Charles Martindale of Indianapolis was in attendance for the American Telephone and Telegraph Company. Others present were A. P. Linderman of the Richmond Home Telephone Company, Marvin & Coulter of Frankfort for the central-energy telephone system, and S. P. Sheerin for the New Telephone Company. The American Telephone and Telegraph Company owns the long-distance wires that are used by the Central Union, and its representative asked that its assessment be not changed. Mr. Linderman insisted that the Richmond company was assessed much higher proportionately than the telephone systems of Anderson, Lafayette, Elkhart and other cities of like size. He asked that the appraisement be reduced to $55,000. He declared that the company had never paid any dividends. The Central Energy telephone system of Frankfort is managed by Eli Marvin, as trustee. It went into the hands of a receiver nearly a year ago. Mr. Coulter argued that the plant is not desirable property, because the City Council has fixed the rates so low that it is impossible to operate it now at a profit. Mr. Coulter declared that, under the present conditions, the property is not worth a dollar. President Sheerin of the New Telephone Company made such a clear and reasonable argument to show that the appraisement of his company should not be changed, that it is believed the tax board will comply with his request. He also urged that the appraisement of the Martinsville Telephone Company and the Citizens' company of Columbus be not changed. During Mr. Sheerin's plea Governor Durbin, president of the tax board, asked Mr. Sheerin about the automatic exchanges that are now being tried. Mr. Sheerin said he did not think that the automatic arrangement could be used to advantage in large exchanges, but where there were less than 300 telephones, he believed it would be possible to do away with the telephone girls that are now required to operate the exchanges. F.

Telephone News from the Northwest.

The Ludington Telephone Company of Ludington, Wis., has been incorporated with $3,000 capital stock.

The Oshkosh-Fond du Lac electric-railway line and the Oshkosh-Omro lines will be equipped with a complete telephone system, enabling communication with headquarters from any switch.

The construction of an electric interurban line between Omro, Wis., and Algoma has made it necessary to move the line of the Little Wolf River Telephone Company, for fear that induction would be so strong as to make the telephone line useless.

The Wisconsin Telephone Company has started surveys in Eau Claire, Wis., for the reconstruction work to be done in that city.

The Mesaba Telephone Company of Hibbing, Minn., has amended its articles of incorporation, increasing its capital from $10,000 to $35,000, and its limit of indebtedness to $100,000.

The Citizens' Telephone Company of Park Rapids, Minn., has been formed with $10,000 capital stock, and proposes a local exchange.

Professor A. L. Dorsey, formerly president of a college at Grand Forks, N. D., has recently perfected an invention which, he says, will transmit articulate sounds for a distance of several miles without the aid of wires. He has gone to Washington to file his patent and to Pittsburg for a visit.

A. B. Ferdinand, who has been refused a franchise for a local exchange for Oshkosh, Wis., announces that he will construct an exchange anyway, under the state law, and will soon submit plans to the council.

The Hawkeye Telephone Company of Perry, Iowa, will remove its headquarters to Des Moines. The Town Council of Perry has passed a resolution requiring the company to reduce its rates from $18 and $24 to $12 and $16.50 for residence and business connections, respectively. The council threatens a forfeiture of franchise if the demand is not complied with.

The Cedar Rapids and Marion Telephone Company has just let contracts for the erection of a modern telephone building in Cedar Rapids, Iowa. It will cost over $25,000

The Linden and Adel Telephone Company has been incorporated with a capital stock of $6,000 and will build a line from Linden to Adel, Iowa.

The Northwood (Iowa) Telephone Company recently declared a dividend of five per cent. and authorized an increase of capital stock to $10,000. R.

Ohio Telephone Notes.

The Retail Grocers' Association of Youngstown has passed a resolution to use only the Youngstown Telephone Company's service in its business. About 60 per cent. of the grocerymen of the city are members of the association. A committee of physicians and liverymen also took action with the grocerymen in this matter. There has been a warm fight between the Independent company and the Bell people for some time.

The North Lewisburg Telephone Company, North Lewisburg, Champaign County, has been incorporated with a capital of $6,000 by W. H. Willis, L. E. Willis, Z. E. Willis, N. T. Willis and L. L. Fisher.

The Home Telephone Company of Toledo will begin service on all the established lines in a day or two The switchboard, of 6,000 capacity, is now all complete and everything has been tested up and found in perfect condition.

The People's Telephone Company of Akron has declared a dividend of one per cent., and it is expected that this will be the quarterly dividend from this time on. The company now has 3,200 telephones in use, and there is an average of about 30,000 calls a day.

The W. P. Harrison Telephone Construction Company of Cincinnati has awarded the contract for a certain portion of the material and instruments for the new plant of the Texarkana (Ark.) Telephone Company to a company in Chicago. The Harrison company is putting in the plant at Texarkana. O. M. C.

Southern Telephone Developments.

The street committee of Augusta, Ga., has recommended the adoption of an ordinance giving both the present telephone companies the right to place their wires underground. The companies must also agree not to increase the cost of telephones.

It has been decided in Baltimore, Md., that the United Electric Light and Power Company shall be allowed no further time in which to place its wires in the municipal subways. The time limit is set at November 1st.

The Columbus (N. C.) Telephone Company has closed a contract with the Bell company to bring its line to Wilmington, N. C., where it will connect with the Bell service. The line will be completed in 30 days.

At Hopkinsville, Ky., J. E. Mott of Huntington, Ind., has purchased for $3 the telephone franchise ordered sold some time ago by the city. The Cumberland company claims to have a priority of franchise, and refused to bid on the above franchise. L.

Death of E. P. McConnell.

Edward Pike McConnell, junior member of the law firm of McConnell & McConnell of Chicago and well known to Independent telephone men, died at his home on Lake Avenue on August 1st at the early age of 35 years. He was born on a farm near Springfield, Ill., and was educated in the public schools and Lombard University at Galesburg, Ill., from which institution he graduated in 1889. After graduation he came to Chicago and began the study of law in the Chicago College of Law, graduating with the class of 1891. He then practiced his profession until he became interested in electricity. He was one of the promoters of the United Telegraph, Telephone and Electric Company of Hyde Park, Chicago. This is an Independent company operating in that portion of the city south of Thirty-ninth Street and east of State Street—the old town of Hyde Park. It has a very liberal franchise, dating back to the time of the township government. But it is hampered by inability to give connections with the downtown business district, and for several years has been endeavoring, so far without success, to secure from the city authorities a franchise permitting it to extend its operations throughout the city. Mr. McConnell had full charge of the construction of this plant and was manager of the company for five or six years, giving his entire time to it. At one time he was also secretary of the Illinois Telephone Association. For the last year or two, however, the deceased had given most of his attention to the practice of law. Mr. McConnell, who leaves a wife and daughter, was a pleasant, unassuming gentleman of good ability who was highly esteemed by all who knew him.

President Fish Talks.

In an interview with a Salt Lake correspondent of the Western Electrician, President F. P. Fish of the American Telephone and Telegraph Company, who was in Salt Lake City on a pleasure trip, with members of his family, said:

"I do not think the cost of telephone service will be materially reduced, but the improvements will come in the perfection of apparatus and the extension of the service. The aim of the company now is to get the telephone in the home of every citizen. There is no profit in the cheaper telephones—that is, directly—but such telephones make the service more valuable to the consumer. Unlike any other business in the world, the more telephones that are put in, the greater the cost of operation. When there are but 100 telephones, a single subscriber can receive but 99 calls. Increase the number to 1,000, and the possible number of connections with that one instrument is 999, which plainly increases the central-exchange work in nearly the same ratio. We establish rates on the same principle as the government in carrying letters. There is a loss on the man who writes only one letter a year.

"The Bell company owns some stock in local companies, such as the Rocky Mountain Bell Telephone here, and also supplies instruments and material. The local exchange is admirably managed, and we have the greatest confidence in the work of Mr. Wallace. Opposition companies are learning what we knew years ago—that the cost of maintenance is so great that an allowance of from 70 to 80 per cent. of the gross receipts must be made for the one item."

Besides President Fish, the other members of the party were E. F. Fish, Miss Fish, Miss Livermore, Lester R. Livermore and Gladys H. Livermore. The pany had been to Yellowstone Park and afterward spent some time at Glenwood Springs and other Colorado resorts.

Public Telephone Rate in Chicago Reduced.

On July 31st the Chicago Telephone Company put into operation what really amounts to a five-cent public-telephone rate. The Druggists' Association of Chicago requested the telephone company to make the public toll rate in the city five cents instead of 10, as had been the rule. This the company did; but at the same time each druggist accepting the reduced rate guaranteed to the company six calls each day from his nickel-in-the-slot telephone. By another new rule any person calling a physician from a drug store must now pay the same as for any other call. Formerly, calls to physicians were gratuitous. The number of calls is expected to more than double under the new regime, and if this prove true, the company will in all probability put in direct lines for the five-cent public telephones, instead of party lines, which are now in use, and make other contemplated improvements. It is said that fully 900 druggists accepted the new service on the first day of its installation, although the plan submitted by the company was not exactly what the druggists wanted. The company had had the five-cent toll rate in view for some time, and would probably have brought the change about itself, although not so quickly, had not the druggists taken the matter up.

GENERAL TELEPHONE NEWS.

The Boone County Telephone Company expects to build a line to Rockford, Ill., to connect with the Independent exchange now being constructed there.

F. S. Myers, who has been the representative of the Northwestern Telephone Exchange Company at Fountain, Minn., has been made district manager for the company at Little Falls, Minn.

Will J. Burket, treasurer of the Home Telephone Company of Findlay, Ohio, died at the Mercy Hospital, Chicago, a few days ago as the result of an operation for gall stones. He was a son of Supreme Judge Burket, and 32 years of age.

The construction of the Rockford Home Telephone Company is progressing at a rapid rate, under the superintendency of L. J. Wetsel and M. F. Flatnus. Both the underground cable and the aerial cable are installed. The switchboard will be of the multiple type, equipped for central-energy operation. Jones & Winter, Chicago, are the contractors. The company starts out with a long list of subscribers.

The strike and boycott on the Iowa Telephone Company at Des Moines continues. The strikers' advisory committee has had men sworn in as special police officers, who have been engaged in removing telephones which were ordered out, where the company had failed to respond to the order within the time stipulated. The men were made policemen in order that they might protect themselves if assaulted by employes of the Iowa company, which is said to have been threatened. No attempt was made to interfere with their work, however. The city of Des Moines has ordered out all instruments of the Iowa company used by the city. The strikers contemplate proceeding against the company to compel it to vacate the streets on the ground that it has no franchise in Des Moines and has no legal right there.

The Seamy Side of Wireless Telegraphy.

By A. Frederick Collins.

The first wireless-telegraph message sent in England was in June, 1896. The test took place between a transmitting apparatus in a room in the General Postoffice in London and a receiver on a roof, 300 feet distant; Marconi had just applied for his original patent and the test was made for the postal telegraph authorities, of which Sir William Preece was the head.

The latest and greatest test of the same system was made on February 26, 1902, when the steamer Philadelphia, nearing the coast of the United States, received on a tape in the Morse code messages at a distance of 2,099 miles from Poldhu, Cornwall. This is a far cry, literally and figuratively; yet only six years elapsed between the first and the last experiment.

It is interesting to note how the great gap laying between the limits of 300 feet and 2,000 miles has been filled in with tests ever tending toward the increase of effective distance. Following the first test in London in 1896, trials were made to operate over a distance of two miles across Salisbury Plain; these proving successful, a distance of 3.3 miles was made across the Bristol Channel, and then the distance was extended to eight miles, between Lovernock and Brean Down.

From this time until 1898 experiments, extraordinary and strenuous, were constantly made, and these will be described later. Little was heard of the new wireless telegraphy until that year, when the announcement was made that bulletins of the Prince of Wales' health were transmitted daily from his royal highness' yacht Osborne to her majesty at Osborn by means of the new system; ever since wireless telegraphy has kept well before the public eye by a series of sensational achievements.

For instance, in the same year, great use of the system invented by Marconi was made at the regatta during Cowes week, and after that when the Prince of Wales wished to cruise about, the royal yacht was kept in telegraphic communication with Osborn continuously. Then followed the establishing of communication between the East Goodwin lightship and South Foreland lighthouse, just 12 miles away. This may be called the first period of wireless telegraphy.

Great was the surprise and the interest, too, when, in March, 1899, the long-distance test was made from South Foreland across the English Channel to the coast of France. While all this reached our ears here, it was not until the international yacht races were sailed in this country in the same year that the public was permitted to gaze with eager eyes upon the intricacies of the electro-mechanical apparatus, "that, yet unfound, most would have thought impossible." Without a fault, a flaw, the Morse writer at the Highlands translated into an intelligible code the messages received in untangible electric waves from a vessel in motion, following the racing yachts as they sped their triangular course. The actual distance covered was 35 miles, and not long after 50 miles was covered.

Negotiations were now in progress between the Marconi interests and the Lloyds, to carry into practical effect the transmitting of messages on an extensive scale between the Lloyds' stations and outward and inward-bound vessels passing in their vicinity. This compact has very recently been consummated, the Lloyds agreeing to send and receive no messages to and from any other vessel not equipped with the Marconi apparatus for a period of 14 years.

Every little while a new record would be established for a long-distance test, until, finally, in 1900, 200 miles was covered by messages borne on the wings of electric waves propagated through the infinite ether. Distance was evidently conquered, at least for commercial purposes, and the scientist, the layman, aye, the world, were on the qui vive for a new sensation, when, like a mathematically predicted comet, due to return at a given time, wireless telegraphy fulfilled the law of causality, and its promoters proclaimed a marvel second only to wireless telegraphy itself, i. e., syntonization, or a system where any number of instruments placed in the same zone or sphere of action, and any one or a number of instruments may be made to respond, while all others are eliminated; thus the transmitter and receiver are tuned in accordance with the laws of electrical resonance.

Again, the yacht races were to be sailed for the America's cup, and again were the results to be flashed ashore by wireless telegraphy. The interest evinced this time was great, especially so to those who were responsible for the speed and accuracy of the messages. But wireless telegraphy came, and finally conquered. It was merely a commercial matter.

A mighty sensation was sprung in December, 1901, when signals were sent flying through space, guided only by the transcendental ether, from Poldhu, Cornwall, to St. Johns, Newfoundland, over 2,000 miles, though so seemingly impossible was this result that even the most optimistic worshiper at the shrine of science halted with temerity in speaking of it as a fact. The great test needed verification for the complete removal of doubt, for there are those who needs must see the tape before they would believe. The climax was reached when the steamer Philadelphia brought messages recorded in ink and signed by the captain of the vessel.

These are the splendid achievements of William Marconi; this the glorious career of wireless telegraphy, but it is the obverse, the bright side of the art, the side that is generally known. If we gaze on the reverse side, we shall find written there all the irony of fate, a bitterness of men and things that must occasionally cause the inventor to stop and question if, after all, it is worth the while, or, resolved into a familiar quotation, "To be or not to be?"

To one who has worked and schemed for days and nights on an invention there is little need to recite what Marconi passed through in perfecting his instruments to a point sufficient to exhibit them in England; to one who has never had that bittersweet experience explanations galore would not make him feel the inventor's part, and he will be the happier in his ignorance.

To begin all over again, let us turn back to the tests across the Bristol Channel in May, 1897. The distance was 3.3 miles. On the 11th and 12th of May the experiments were discouraging to the point of madness. No signals came! Mr. Preece had, on the preceding day, tested his own electromagnetic system of wireless telegraphy with success, and thus "the fate of the new system trembled in the balance." On the following day, May 13th, the inventor, by some inspiration, bethought him to lengthen the vertical wire terminating in the air, and this he did, extending it some 20 feet. Here was a new use for a bit of wire. Instantly the signals came clear and strong, where there had been none previously. At this memorable experience there was present, besides the inventor, and several other gentlemen, Dr. A. Slaby of Charlottenburg, Germany, who, as it will be evident presently, has figured prominently in "wireless" matters. After returning to Germany in 1897, Dr. Slaby commenced a series of experiments in multiple tuning or syntonic wireless telegraphy, for a great hue and cry had now been made that wireless telegraphy was not of a selective character.

When Marconi's patent was granted in July, 1897, and the successful issue of his system had become known, scientists and inventors in every country bent their energies to the problem, and it was of weekly occurrence that glowing accounts were published announcing a "new receiver 2,000 times more sensitive than the coherer," or a transmitter "requiring but one-tenth the initial electromotive force" to operate it; but few of these wonders materialized, and the next attack was on the validity of Marconi's claims.

Since Hertz was the discoverer of the electric waves and the mode of producing them, and Branly invented the coherer, the absolutely vital parts of wireless telegraphy, the German and French savants asked on what grounds the Italian based his sweeping claims of invention; the answer was not forthcoming, and while his Teutonic and Gallic contemporaries were wrangling over the question of rights and priority Marconi proceeded to New York to report the yacht races.

Here he was met with a formidable proposition. An individual made it known early in the course of preparation that if he was not given a position on one of the ships, he would operate a transmitter of his own, and block all attempts of Marconi to get through the wireless messages. To save further and evident trouble, he was engaged, though he was not permitted for the entire period during which the races were sailed to manipulate a single piece of apparatus.

During the races a new claimant appeared for the honor of having invented wireless telegraphy, in the person of Professor Dolbear of Tufts College, Mass., who had obtained a patent for wireless-signaling apparatus in 1886. The patent was subsequently disposed of to Mr. Larned of Boston, who began suit before Judge Coxe against the Marconi company for infringement. It was shown during the trial that the systems were entirely dissimilar, and that the Dolbear patent was based on fallacious ideas of the fundamental principles of electricity and inoperative when constructed according to the specifications. The suit ended in a decision upholding the Marconi patents. Later the Dolbear patent was sold to a concern in Philadelphia engaged in wireless telegraphy.

While Marconi was thus engaged, Dr. Slaby made public the details of a tuned wireless system, which created quite a furore in scientific circles, inasmuch as the inventor had demonstrated that he could receive two messages simultaneously over the same vertical wire without conflict. This he did in the presence of the German emperor, on December 22, 1900.

Marconi had likewise evolved a system of syntonic wireless telegraphy and read a paper on it before the Society of Arts in May, 1901, explaining its functions. Shortly after this, Guarini, the inventor of the repeating wireless telegraph, cited a case wherein the Marconi syntonic system had failed utterly in its action during some tests near Nice, when a dispatch transmitted from Biot to Calve was intercepted at Ville Franche in its entirety and with perfect distinctness. On the other hand, Marconi stated that he installed the apparatus described by Slaby at Minton, Isle of Wight, and at Poole, but, though he followed the specifications with exactness, he could obtain nothing.

When the yacht races were again sailed in this country, Marconi was on the scene to transmit messages for the New York Herald and the Associated Press. But he found that there was also another system in the zone, clamoring for honor and recognition. This was the De Forest-Smythe system, the inventors hailing from Chicago. Whether Marconi had not anticipated a rival in the field, he was at any rate unprepared to use his syntonic system, and as the ether is free to all who choose to make use of it, he did gracefully the only thing that could be done, namely, arrange to divide—not the ether—but the time, so that each company should transmit messages, alternating each five minutes during a race. This was a solution of tuned wireless telegraphy analogous to the conditions which make it more convenient to climb through a window than to go through the door.

With the details of this clever arrangement concluded, what was the chagrin of both parties to the ether compact with the time limit, when they saw steaming up the bay a tugboat towing an old schooner carrying the apparatus of a third concern, coming from Philadelphia.

Messages, complimentary and otherwise, began to emanate from the wireless vessels, and during the first day of the races the ether was lively with various wave lengths emitted by the triple systems, and chaos resulted. Then another compromise was effected, by which the third system was permitted to run a wire from its shore station to that of the Associated Press office, which was in communication with the Marconi ship Mindora, and the Philadelphia company was to receive the Marconi dispatches immediately they were sent in, and for this consideration it was to refrain from sending out any further impulses.

The history of the cableless signals across the Atlantic from Poldhu to St. Johns is still fresh in the minds of my readers, but even in this gigantic feat the glory of the inventor must have been dimmed somewhat by (a) the opposing attitude of the Anglo-American Telegraph Company, which threatened prosecution if the experiments were continued; (b) the ready testimony of the so-called experts, who, at the word success, insisted Marconi had been deceived in his calculations, and (c) the scoffers sneering at the veracity of his statements.

A few weeks after the transatlantic cableless test, a new record of long-distance wireless telegraphy was established by Marconi; this was a record of signals on a tape at a distance of 2,099 miles, during a trip of the steamer Philadelphia; to this test there seems to have been little adverse comment.

The agreements having been entered into between Marconi and the Lloyds for a period of 14 years, as previously stated, the first step toward a monopoly of the ether by the company was taken, and the power behind the throne was exhibited so strenuously, that the government of at least one country felt called upon to intervene. The Hamburg-American liner Deutschland is equipped with the Slaby-Arco system of wireless telegraphy. When Prince Henry sailed on the Deutschland, homeward bound from the United States, the operators endeavored to communicate the adieus and farewell wireless handshakes of the German emperor's brother to the Nantucket lightship, having on board an installation of the Marconi system, for final distribution throughout the States; the Nantucket lightship, however, refused to accept the messages, and now the German government has called for an international congress

to regulate these matters, making it imperative for vessels and stations equipped with whatever system to receive and transmit messages between other points of installation, and so break this "monopoly" of the ether. Just how this can be done, time only will tell. En passant, it is difficult to see how it is possible to make one company accept the messages of another without merging all the interest, unless the very patent claims themselves are attacked and annulled.

At the present time the grand total capitalization of all the "wireless" companies in the United States is at least $100,000,000, and there are not more than one or two installations in operation for commercial purposes, nor can a single set of instruments be purchased from any of the companies now in operation. This condition of affairs seems to arise from the fact that Marconi holds the basic patents in the art; the other companies, apparently, fearing litigation, do not go beyond the experimental stage. As long as they preserve this attitude Marconi has no grounds on which to base a suit, since it is beyond the power of any court to stop experimental work. Therefore, for the time peace reigns. Oppositely, in Germany, two companies are now engaged in a fierce legal battle over wireless-telegraph systems. There are three German systems in use, namely, the Slaby-Arco, the Braun and the Schaffer. The Braun system is controlled by the Siemens & Halske Electric Company and the Slaby-Arco by the General Electric Company of Berlin. Suit was brought against the latter company by the former, claiming infringement of patent rights. The Slaby-Arco people countercharge the Braun interest with having simply copied the Marconi system. The whole truth of the matter is that all the companies, both here and abroad, use the spark gap in transmission and the coherer in receiving, and this fact makes them all amenable to the Marconi patents. In influential German circles it is urged that the Braun and Slaby-Arco systems be consolidated and that the fight now on be transferred to the Marconi company, which will quite probably get worsted, since the emperor is deeply interested in the Slaby-Arco system.

This is the status of wireless telegraphy—the seamy side of it to-day. A crisis is impending in which litigation will as surely follow as the night the day. Then the science of law will be called in to referee technical points in physics that have caused Lord Kelvin, J. K. Thomson and a host of other workers, days and nights of worry, for the principles involved in wireless telegraphy are a man's work.

It has been said that a patent is of little value until sustained by the courts, and never was this more true than of those appertaining to wireless telegraphy.

Recent Central-station Changes.

Some recent central-station consolidations of importance are due to the formation of the United Gas and Electric Company. This company is made up principally of Chicago men, and is headed by Samuel Insull, president of the Chicago Edison Company. One of its consolidations was effected in Southern Indiana, in the towns of New Albany and Jeffersonville. The two towns are located on the Ohio River, across from Louisville, Ky., and are only four miles apart, which fact facilitates the workings of the company.

In New Albany the company obtained control of the water, gas, electric-light and street-railway plants, and expects to build a central steam or hot-water heating plant. These plants will be operated under different incorporations, all subservient to the one incorporation known as the United Gas and Electric Company of New Albany. In Jeffersonville the gas and electric-light plants are owned by the concern, and will be operated by it.

Another purchase made by Mr. Insull is the Evanston (Ill.) Electric Illuminating Company. This company lights the city of Evanston. It has been owned and operated by Westinghouse interests for a number of years, and was purchased from them.

The United Gas and Electric Company is capitalized at $1,000,000, and has an authorized five per cent. gold-bond issue of $750,000. The officers of the company are as follows: President, Samuel Insull, president Chicago Edison Company, Chicago; vice-president, W. B. Hummer, president La Salle National Bank, La Salle, Ill.; secretary and treasurer, R. W. Waite, formerly of Chicago Edison Company; general manager, J. W. Dunbar, secretary Western Gas Association.

Union electrical workers struck in Chicago last week on all buildings where non-union wiremen were employed. The object of the strike was to force the contractors to employ only union men, but so far it has not been accomplished. The Chicago Edison Company is a large employer of construction men, and it employs men irrespective of their union affiliations and says that it will always do so. The Chicago rate of wages is 50 cents an hour, with an eight-hour day.

Railroad Car Lighting.[1]

By L. T. Canfield.

The electric-light system in my opinion is the most important of all. The makers of electric-lighting systems for railroad cars should be encouraged by giving them an opportunity to develop their devices. I do not think there is any system far enough advanced to warrant its general adoption, but great strides have been made in the past three years, and if followed up carefully I am satisfied that the cost of maintenance will be greatly lessened. The principal objections to lighting with electricity are its cost of installation and the cost of maintenance.

The storage battery, while maintaining a steady light, is objectionable in its present form on account of its excessive weight; its limited reserve capacity; the necessary large proportion of time the car is kept out of service for recharging or the amount of labor required to change the batteries, and the limiting of the movement of cars so equipped to special runs.

The second, or steam-driven motor system, is objectionable on account of the expense of operating, and the excessive vibrations felt throughout the train when the engine is running the dynamo; the vibrations of the voltage at the lamps by the variations of the steam supply to the engine from the boiler of the locomotive; the danger of fire on account of the high voltage; also the limiting of movement of cars so equipped to special runs, which destroys the mobility of the railroad company's car equipment as a whole.

The third, or axle-lighting system, in my mind, is the best system in use to-day on account of allowing of the free movement of cars. This system may be divided into two classes, one of which uses the so-called automatic regulator for maintaining the output of the dynamo constant by varying the strength of the field coils, thus keeping the voltage of the machine the same as that required by the lamp; but this regulator is such a delicate machine that the rough usage to which it is subjected puts it out of order very frequently. Besides, as far as I can learn, there has not as yet been made a perfect automatic regulating device for governing the flow or intensity of an electric current, and while they may be called automatic, and probably are automatic for a short time, they cannot be relied on. The other design depends upon the slipping of the belt on the pulley for maintaining the voltage of the dynamo constant, and, as you all know, the varying changes of the atmospheric conditions will affect the belt, and at the best this is a very crude and unsatisfactory way of attaining the desired effect, it requiring constant attention, as it is not automatic.

In operating the axle-lighting system, it is necessary to handle it with a great deal of care. The batteries must be charged immediately after they are set up, as the plates will rapidly deteriorate if they are left standing in the uncharged diluted sulphuric acid which is used. Again, you must not charge or discharge same too fast for fear of buckling the plates, and when a new battery is placed in service, it is necessary to charge and discharge it several times. If the battery is overcharged, charged or discharged too fast, it has the effect of sulphating the plates, which increases the internal resistance of the battery and also uses up these plates, and destroys the battery much sooner than in ordinary use.

I will point out a few of the faults showing what we have to contend with in trying to keep the lights burning when required. The dynamo does not become operative until the train has reached a certain speed, about 12 miles per hour, called the critical speed. In suburban service, for instance, if from any cause the batteries are run down, that is, nearly all of the stored electricity in them is used, you will not get the benefit of the dynamo in recharging them or helping to supply the light until the critical speed is reached, and in many cases about or before the time this speed is attained it is necessary to slow down the train for the next stop. Therefore, you are not generating any electricity, but your lights are burning all the time and using it continually from the storage battery, consequently you are going deeper and deeper into trouble, on account of the lights growing dimmer and sometimes going out when the train is standing still, or is running below the critical speed.

At this time of the year we naturally have very little trouble, but in the winter time, when the days are short, and it is necessary to use the light for a longer period of time, it is different. On through service you will not, of course, have this particular trouble to contend with, but in the operating of this kind of light the belts occasionally jump off of the pulleys or break, the battery becomes defective, the regulators get out of order, the fuse burns out, there is a short-circuit, a wire is broken, the armature burns out, the armature shaft breaks, the dynamo runs hot, the commutator is out of order, or something in the system gives out or goes wrong, and the lights become dim or go out altogether, then we are in trouble.

At the present stage of electric lighting it is absolutely necessary to have an auxiliary light at hand to fall back on. I am sure many of us who have had experience with this light would be perfectly satisfied to do away with it on account of the trouble it has caused—but this is an age of progress, and there is no doubt but that there will continually be improvements made in electric car lighting. When it is so perfected that it will not require an expense greatly in excess of that necessary to maintain the gas lamp of to-day I am sure it will come into general use. One point I wish to call your attention to is the fact that the dynamo should be hung to the bottom of the car, where it would receive the benefits of both elliptic and equalizer springs to relieve it of all the shocks possible. Another thing, a long belt is desirable in preference to a short one, on account of allowing the dynamo to adjust itself to the lateral motion of the axle; but it is absolutely necessary to have the perfect belt cover, so as to increase the life of the belt.

I will conclude by reading a statement comparing the cost to our company of each kind of light for one month:

Kind of Light.	No. of Lights.	Average Mileage.	Cost Per Car.	Cost Per Flame.	Kind of Service.
Oil	6	12,710	$ 2.40	$ .40	Through
Electric lights (storage-battery).	17	2,092	8.81	.52	Suburban
Electric lights (steam-driven motor)	36	12,710	37.31	1.04	Through
Electric lights (axle system)	25	1,560	7.57	.30	Suburban
Pintsch gas	20	12 710	5.73	.29	Through
Pintsch gas	16	2,092	2 45	.15	Suburban

1. Abstract of paper read before the Master Car Builders' Association at Saratoga, N. Y., June, 1902. Mr. Canfield is master car builder for the Delaware, Lackawanna and Western rail road Company.

Fort Wayne Men in Conference.

The district managers and agents of the Fort Wayne Electric Works held a convention at the home office (Fort Wayne, Ind.) last week, which was very interesting because of its business features and also because of the social enjoyment of the occasion. Representatives from all the large cities in which the company has sales offices were present. Mr. F. S. Hunting, general sales manager, made the evenings of the week especially interesting in a social way. There was a trolley and theater party to Robinson Park on Wednesday evening, and on Friday evening the week was fittingly ended by a banquet tendered by the Fort Wayne Electric Works to the district managers and sales agents at the Wayne Club, at which were present Lieutenant-governor Gilbert, H. C. Paul, president of the Fort Wayne Electric Works, Hon. R. S. Taylor and several local directors. Judge Taylor gave a very interesting early history of the business and the early struggles of the founders of the Fort Wayne Electric Works, and related how he and R. T. McDonald, when working together to gather evidence to defend an infringement suit brought against the infant concern for manufacturing an arc lamp, discovered Mr. J. J. Wood, then a young man. The representatives present were J. Allan Smith, Boston, Mass.; E. B. Goldsberry and C. A. Woolsey, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; T. W. Dixon, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; W. S. Goll, W. C. Knight and Frank McMaster, Chicago; A. L. Searles, Grand Rapids, Mich.; J. C. Lott, New York; T. L. Sturgeon and Fred L. Reynolds of Fort Wayne.

Mr. Yerkes Successful in London.

London advices are to the effect that Parliament has granted to Mr. Yerkes all needed legislative right-of-way for the completion of his entire underground electric-railway system, and has laid Mr. Morgan's bill for authorizing the paralleling of the Yerkes' lines "on the table" until the next session of Parliament. This, for the present, puts the Morgan syndicate out of the field of action. Mr. Yerkes made a statement that of the $25,000,000 capital stock issued for the new system, only $10,000,000 was held in America. His company has promised to employ British workmen in all lines of work where it is possible, and to use British machinery and supplies, excepting rails, which are to be obtained in Germany. The fare, it is said, will be four cents on all the company's underground lines.

Proposed African Power Plant.

English daily papers are discussing a possible scheme of installing an electric-power plant in Africa, on the Zambezi River. Victoria Falls, which are on the Cape-to-Cairo railroad, now nearing completion, are to be "harnessed" and electricity developed for power and light purposes. The possible power that could be developed by Victoria Falls is enormous, for the river is over a mile wide and has a descent of 400 feet. Professor George Forbes and Sir Charles Metcalf are said to be the chief promoters of the scheme. The marketing of the power constitutes a puzzling problem. Rhodesia is said to be a possible market for the power, but the transmission lines would have to be somewhat longer than has been considered feasible.

The Montgomery Traction Company of Montgomery, Ala., has filed incorporation papers placing its capital at $1,000,000. The incorporators are B. L. Holt, W. H. Ragland, W. F. Vandiver and E. A. Graham.

Energy Loss in Commercial Insulating Materials When Subjected to High-potential Stress.[1]

By Charles Edward Skinner.

Part I.

Those who have had occasion to test the dielectric strength of insulating materials by means of alternating electromotive force are familiar with the fact that heat is always developed in these materials during such test. This is especially noticeable when the test is long continued at a point approximating the breaking-down strength of the material. When the amount of material involved is large, ordinary indicating instruments will show at once that there is an actual loss of energy. The fact that energy loss exists under such conditions has been known for more than a decade, being first shown by the experiments of Siemens, and later investigated by others. Published investigations on this subject relate most entirely to the energy loss in the insulating material or dielectric of condensers. The law of variation of loss, due to variations of voltage, was first announced by Mr. C. P. Steinmetz early in 1892. At that time Mr. Steinmetz gave this loss the name of "dielectric hysteresis" because of its apparent similarity to the phenomenon known as hysteresis in iron and steel. Since that time other writers, notably Arno, Hess and Borel, have made experiments from which they conclude that this energy loss is not in the nature of a dielectric hysteresis, and various theories have been advanced concerning its nature and cause.

It is not the object of this paper to discuss the theories of the origin or cause, but rather the effects of this loss, and in the absence of a name which can be accepted as descriptive and final, it will be spoken of as "energy loss" or "loss."

It is the intention to describe some of the methods employed and to give some of the characteristic results obtained from tests made on various materials used in commercial manufacture, and also on the insulation of finished apparatus. These tests have been made from time to time during the last five or six years, and have covered a great variety of materials. The major part of the tests, however, have been made on materials of a fibrous nature, such as paper and cloth, both in the treated and untreated state, and the discussion will be largely confined to this class. By treated material is meant a paper or cloth coated with some sort of insulating varnish. The samples used were taken from stock, and standard manufacturing methods were followed as far as possible in preparing them for the tests.

The action of ordinary commercial insulating material under high-potential stress is usually so erratic, owing to surrounding influences, such as temperature, moisture, ventilation, etc., that a considerable number of observations are usually necessary in order to reach any satisfactory conclusions. For this reason the specific tests which are given in this paper are intended to show characteristic and not quantitative results, and are, therefore, not to be taken for other materials, or even for other samples of the same material. Individual tests are of little value except as they fit in a series, or, unless the conditions surrounding them are known to the minutest detail.

For these tests alternating current at the standard frequencies of 25, 60 and 133 cycles was used, the electromotive force varying from a few thousand volts to upward of 100,000 volts. The majority of the tests referred to were made on material subjected to a potential stress much in excess of that ordinarily used in actual practice, this being done both on account of the fact that the various phenomena are much more marked at the higher stresses and also because a much smaller amount of material could be used for each individual test. The results, while being true for potential stresses, are of little commercial importance in ordinary low-potential apparatus. They become, however, of the greatest importance in very high potential working, and especially so with condensers for use on high-potential circuits. The results also have a direct bearing on the question of long-continued tests of the dielectric strength of finished apparatus at very high voltages. The various phenomena noted are so interdependent that it is difficult to describe one without referring to others, and at times it will be necessary to anticipate results which are to be described later.

Variation of Temperature Due to Variation of Stress.

When an alternating high-potential stress is applied to insulating material, the temperature of the whole mass rises, but, owing to the fact that all insulating materials are poor conductors of heat, the temperature of the inner portions rises above that of the outer portions, which have a better opportunity of dissipating their heat. A considerable number of tests have been made to determine the rise of temperatures in the interior of a mass of insulating material under different conditions of stress. Usually these tests did not include the measurement of the amount of energy loss, as the results sought were the ventilation required under working conditions and the dielectric strength at various temperatures. The tests were usually made by placing the material between metal plates, which were connected to the terminals of a high-potential transformer. The plates employed for this purpose should always have well-rounded edges to prevent undue stress, which occurs at sharp corners. The size of the plates varied in different tests, but the most satisfactory results were obtained with plates approximately nine inches in diameter, whose edges were rounded to a radius of about 1½ inches.

Various methods of measuring the temperature were tried, but the most satisfactory temperature readings were obtained by placing at the point where the temperature was to be measured a copper-lead thermo-junction, connected to a sensitive galvanometer. The outer ends of the couple were kept at 0° C. by being placed in ice water. By properly insulating the galvanometer, it was found entirely feasible to take readings with a potential stress of 30,000 volts or more across a one-fourth-inch layer of material, with this junction at the center. In some tests a number of junctions were placed at different points in the material, in order to map out the temperature of the various parts.

In a number of tests the material was arranged as above and then placed in a box in which was located an electric heater, a fan motor being used to circulate the air over the heater and through the box, so that any desired initial temperature could be secured and with care the surrounding temperature regulated throughout the test. In some instances insulation resistance was measured at intervals, the high-potential wires being temporarily disconnected for this purpose. Usually, the insulation resistance was so high as to be very difficult of exact measurement with the apparatus at hand.

The test samples used were built up to a thickness of one-eighth inch to one-fourth inch or more, and tests were made at different voltages up to the ultimate dielectric strength of the material. For most

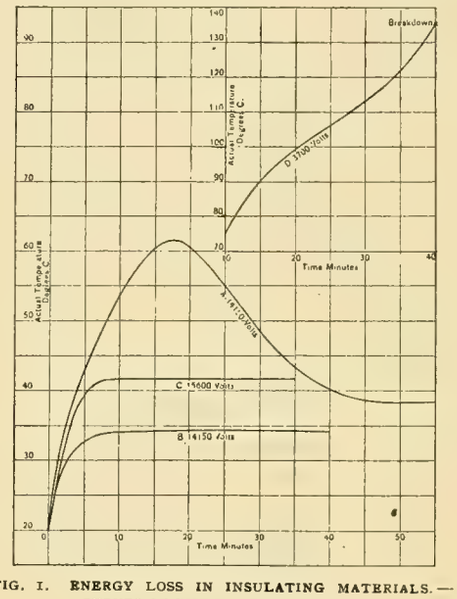


FIG. 1. ENERGY LOSS IN INSULATING MATERIALS. — CURVES OF RISE IN TEMPERATURE.

of the tests, current was obtained from a dynamo giving very approximately a sine wave of electromotive force. The results of this series of tests may be given as follows:

(1) With moderate stress the temperature of the material rises rapidly at first, then more slowly, then becomes constant. The actual rise in the temperature for a given voltage depends on the facility with which the material can dissipate its heat, and on the temperature of the surrounding medium.

(2) As the stress is increased a point is finally reached where the heat is developed at a greater rate than it can be carried away, and temperature then rises, until the material chars and breakdown results.

(3) When material is not thoroughly dried, the temperature rises much more rapidly than in well dried stock. The increased temperature cannot be accounted for by the increased C^2R loss due to lower insulation resistance. The heat generated tends to dry out the material and the temperature may fall as the drying proceeds.

(4) With a considerable area of material under test, the temperature of small portions frequently rises above that of the surrounding material to such an extent that, on examination, these portions are found much discolored, while the surrounding portions remain unchanged. This effect is especially noticeable with treated material not perfectly cured. The final breakdown in such cases is invariably found in one of the heated areas

(5) The final breakdown in fibrous materials usually results from the burning of the material, and not from mechanical rupture. When the electromotive force applied is far above the dielectric strength of the material, the breakdown may be due to a mechanical rupture. If, however, the electromotive force is sufficiently low, so that an appreciable time elapses before breakdown occurs, the breakdown is probably due to burning caused by the heat generated in the material. There may be some attendant chemical action, but this is thought to be a result and not a cause of the excessive heat. The lower the electromotive force applied, the longer the time required to produce breakdown under a given set of conditions.

(6) It follows from (5) that if the temperature is kept low either by providing good ventilation or by artificial cooling, the stress required to cause breakdown in a time test will be much greater than if the material is not so cooled.

(7) The actual temperature measured in most fibrous materials before breakdown occurred was usually at 175° C. or more. In no case did a breakdown occur directly at the point where temperature measurements were being made, and the temperature at the breaking-down point was probably higher than measured, especially as the rise in temperature seems to be very rapid at the point of breakdown just before this occurs.

(8) With a given stress, the initial and surrounding temperature has much to do with the rise. This is due to the fact that the loss in the material increases rapidly with temperature. For example, if the material and surrounding air are at 20° C. and the stress applied is 20,000 volts, the rise in temperature will not be nearly so great as if the initial and surrounding temperature is at 80° C. Tests have shown that breakdown frequently results under the latter conditions from a stress that would not injure the material under the former.

Fig. 1 gives some of the characteristic curves of rise in temperature in insulating material when subjected to high-potential stress. Curves (A), (B) and (C) were taken on a sample of untreated material which was quite porous and capable of absorbing moisture from the air. In this test the material was well ventilated, so that any moisture could be quickly dissipated. The temperatures given are those actually measured, but probably do not represent the highest point reached in the material. Curve (A) shows the effect of moisture. The temperature rose very rapidly, reaching a maximum, then fell, and at last became stationary. Curve (B) shows the effect on the same material after very thorough drying. Curve (C) shows the increased temperature due to a slight increase in the stress.

Curve (D), at the upper right-hand corner of the figure, shows the rise in temperature in treated material when poorly ventilated, and the test continued until breakdown resulted. Breakdown in this particular test occurred at a point about four inches from the thermo-junction, when the measured temperature reached 135° C. It is probable that the temperature measured was considerably lower than that reached at the point of breakdown. The temperature of the surrounding air in this test was kept at 80° C. This curve shows the tendency of the temperature to become constant, but at a point slightly over 100° C. the loss becomes so great that the heat cannot be dissipated as fast as generated, hence the change in direction of the curve and final breakdown. In numerous tests the material was found to be badly charred on the interior, without breakdown having resulted. The curves shown are characteristic, and are of the same form as many others that have been taken.

Variation of Loss Due to Variation of Temperature.

The measurement of the energy loss due to high-potential stress in a reasonably small sample of insulating material, presents a rather unusual problem. The voltage is high, the current small, and the power factor very low. In many of the tests referred to in this paper, it was necessary to measure with some degree of accuracy losses of less than 100 watts at an electromotive force of 20,000 to 40,000 volts, at various frequencies, with a power factor less than 0.1. The commercial instruments on the market are totally unsuited for this work.

Many of the measurements to determine the points under discussion were made by means of a calorimeter. The material for these tests was usually built up in the form of a small condenser, with ventilating spaces between the plates, so that the temperature could be kept as nearly uniform as possible throughout the mass of the material. In the determinations of the variation of loss due to variation of temperature by the calorimeter method, the whole body of oil and insulation was brought up to some constant temperature, then the high-potential stress applied. The rate of heating or cooling, as the case might be, due to the loss in the insulation being greater or less than required to hold the calorimeter at this constant temperature, was then noted and the actual loss derived by the use of the calibration curves of the calorimeter. These tests required great care, were very tedious, and many corrections were required in deducing the results.

After a considerable amount of work had been done by the calorimeter method, a static wattmeter was constructed and the work continued with this instrument. With this wattmeter, which was admirably suited to this work, a complete curve could be taken in the time required to determine a single point by the calorimeter method. It was a source of considerable satisfaction to find that the calorimeter and wattmeter methods checked each other with a very fair degree of accuracy, especially considering the nature of the materials on which the measurements were made.

[To be continued.]

1. A paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers at Great Barrington, Mass., on June 20, 1902.

CORRESPONDENCE.

New York Notes.

New York, August 4.—The discussion over the Pennsylvania railroad tunnel has now come down to a point where an agreement and subsequent contract may be expected without delay. The chief points which caused trouble in the first contract which was rejected, were in relation to union labor in the tunnel, perpetuity of ownership, and to some extent the amount of compensation. The company now agrees to grant the city such use of the tunnel as it may need for fire and police telegraph wires; also that the franchise shall cover the sanitary control of the tunnel by the City Board of Health, and further, that the tunnel shall always be in the control of a company operating under the laws of the state of New York. There are still some points to be settled before a franchise can be granted by the city, and for the purpose of furthering arbitration the Board of Alderman has appointed a committee of five to confer with the Rapid Transit Commission and the railroad officials, and then to report to the Board. The Aldermen have gone on their vacation and the next session will occur on the 4th of September. As the matter now stands a franchise will probably be granted the railroad company in the early fall, since the points of variance are trivial and in all probability will be settled before the next meeting of the Board of Aldermen.

The New York Central and Hudson River Railroad Company has submitted a plan to the city to substitute electricity for steam on all of its trains entering the city through the Park Avenue tunnel. Certain concessions are to be granted the company by the city with reference to changes to be made in the Grand Central Depot and land grants on the North Side. The proposed plans will require considerable expenditure in the tunnel and in terminal stations. A third-rail system is to be used, and where the trains come to the surface the conducting rail will be protected so that all danger can be avoided. The cars are to be run on the multiple-unit system. The proposed electric system will, if installed, take the trains to a distance of 30 miles or so from New York before steam locomotives are attached.

It is reported in Wall Street that the New York Central has attempted to buy the Manhattan Elevated Railway system on a guarantee of 6 per cent. dividends on the stock. George J. Gould of the Manhattan company is said to have asked 7 per cent. dividends for the property. The New York Central is supposed to have a joint operation of the Manhattan system in view with its proposed electric scheme. Manhattan Elevated stock took a sharp upward movement on the reported issue.

The 300-foot pole of the Marconi station in the Brooklyn navy yard was struck by lightning a few days ago. Fifteen feet of the pole was broken off from the top.

The Times of August 1st contained the following note: "An involuntary petition in bankruptcy was filed yesterday against the Charles G. Hose Electric Company, electric repairs, of 480 Pearl Street, by Alfred F. Moore of Philadelphia, $1,006; the General Electric Company, of Schenectady, N. Y., $270, and the Shedd Electric and Manufacturing Company of this city, $45. The Charles G. Hose Electric Company commenced business in December, 1901, with a capital of $1,000."

New England News.

Boston, August 2.—Colton & Wright are about to reopen their wire mill at Palmer, Mass., and will employ 200 people. The mill has been closed several months.

The Oakland Woolen Company is building a ten-set mill at Oakland, Maine, in which all the looms are to be run by electric power.

Thirty stockholders of the Boston Elevated Railway Company, representing 69,058 shares of stock, attended the special meeting of the company and unanimously voted to authorize an issue of new stock amounting to $5,000,000. President Bancroft stated that of this amount, $3,000,000 to $4,000,000 would be needed to complete work already under way, and the balance would be used for any other expense the company might have to meet. The company's present capital is $10,000,000. The company was originally permitted to spend $3,100,000 for stations, track, etc., but it has expended $3,980,744 and will require $364,723 more. It was authorized to spend $600,000 for rolling stock and equipment, but has expended $1,194,005, and $891,602 more will be required. For construction and equipment of power station, $1,100,000 was authorized, $1,133,085 spent, and $454,087 will be needed. The ruling price of the company's stock is 163 to 165, but the company wants the state railroad commissioners to fix the price for the new stock at 125, as the increased stock is not likely to result in increased earnings.

The Edison Electric Illuminating Company has sold the Ferdinand Street power station of the Boston Electric Light Company. The property includes 11,635 square feet of land and brick buildings.

The Maplewood and Danvers Street Railway Company has been organzed in Malden, Mass. It proposes to build an electric railway from Malden to Boxford, Mass., via Saugus, Lynnfield, Danvers and Middleton. The capital is $190,000, and the directors are George H. Chase and George F. Marshall of Malden, and others. The company expects to begin construction in the fall.

A syndicate of New York capitalists has secured options on a number of gas plants in New England cities and proposes to enter into competition with electric-lighting companies.

Only one firm bid for constructing the projected power-transmission subway for the Charlestown navy yard, and this called for an outlay of about $55,000, or $21,000 more than was estimated. Owing to this discrepancy, it is probable that the subway will not be built, but that the government will devise some other means of caring for the pipes and wires transmitting pneumatic and electric power to the shops and ships. The bid was on 1,500 feet of subway.

A special dispatch from Hartford, Conn., says that Mr. Clement, president of the Panhard-Levassor Automobile Company of Paris and of the Clement Motor Company of Leblois, France, recently visited that city, when an American company was formed with Mr. Clement as president and William G. Allen of Hartford as manager. The company is to take the plant formerly occupied by the Acme Machine Screw Company and will manufacture the Clement electric motor for bicycles. B.

Canadian Intelligence.

Toronto, August 1.—Thomas L. Chiles of Akron, Ohio, representing a number of Cleveland capitalists, is arranging for the building of an electric railway between this city and Hamilton.

The construction of the new car shops for the British Columbia Electric Railway Company in New Westminster is being pushed as rapidly as possible. The cars will be 32 feet long. The cost of the buildings will be about $15,000. Mr. Buntzen of Vancouver is general manager of the company, and T. Driscoll, for the last 14 years with the Minneapolis Car Works, has been engaged to take charge of the new car works.

The Sandwich, Windsor and Amherstburg railway will be extended to Amherstburg, Ont., on the Detroit River, at once.

The Paris and Brantford electric railway has been graded as far as the Molloy farm, half way between Paris and Brantford. It will be another link in the chain of radial electric railways springing up all over the province of Ontario and proving powerful rivals to the steam roads.

Plans for the extension of the Toronto Suburban line are being prepared. This road will run from Toronto Junction for 12 miles to Lambton Mills, and F. Turner of Toronto Junction is its president. It is the company's intention to build on to Cooksville, some eight miles farther on, as soon as the plans are ready.

The council of the township of Hallowell has granted a franchise for the construction of a street electric railway to run from the town of Picton, Ont., to Wellington and the Sandbanks. M. R. Alliston of Picton is one of the principal promoters. H.

Southern Developments.

Charlotte, N. C., August 2.—The city of Raleigh, N. C., has contracted with the Raleigh Electric Railway Company for 155 arc lights at $55.75 annually, the lights to be located by December 1st.

The Augusta (Ga.) Railway and Electric Company has signed a contract for lighting the city of Augusta for five years at the rate of $68 a light. The mayor declares that it is the policy of the administration to pave the way for municipal ownership of lighting facilities.

The Beattie Electric Company of Cincinnati is erecting a $11,000 electric-lighting plant in Nicholasville, Ky.

The Washington, Baltimore and Annapolis Electric Railway Company reports that it is expected that cars will be in operation within one year. The line is now being graded between Washington and Baltimore. The company's power plant may be located at Hyattsville. This company has also been negotiating for the purchase of the Annapolis, Washington and Baltimore railroad, and, if successful, will use the tracks of this company from Odenton to Annapolis.

A mass meeting of negroes at New Orleans, La., was held for the purpose of opposing the Jim Crow street-car law, and the meeting determined to organize a stock company to operate vehicles throughout the city for the exclusive use of the colored people.

The city of Raleigh, N. C., has granted an extension of 25 years to the Raleigh Electric Railway Company. Great improvements are contemplated.

The Cumberland Manufacturing Company has purchased a tract along Cumberland River in Tennessee at Lock No. 2, and proposes to develop the valuable waterpower there and supply power to Nashville, Tenn. L.

From the Buckeye State.

Cleveland, Ohio, August 2.—In returning their valuations for taxes this year the two city systems of Cleveland have almost doubled their figures over any former valuations. The Cleveland Electric Railway Company returned a total valuation of $1,693,000, while last year it was $868,000. The Cleveland City Railway Company placed its valuation this year at $900,300, the figures last year being $485,950.

The Cleveland and Sharon Traction Company will be incorporated to build the proposed electric line from Middlefield to Sharon, Pa., with a branch to Cortland and Warren, Ohio. The line will be 41 miles in length and will pass through a number of thriving towns. It will have traffic connection with the Cleveland and Eastern, with which it will connect at Middlefield, and its cars will come into the city of Cleveland over these lines. Arrangements have also been made to have the cars run over other lines into Pittsburg, making a through line between the two cities. Willis B. Hale of Cleveland is interested in the proposed line.

The Columbus, Delaware and Marion Electric Railway Company has agreed to build a branch, six miles in length, from Prospect to Richwood, all the rights-of-way to be deeded to the road without expense.

A six-hour schedule has been arranged for the Lake Shore electric road between Cleveland and Toledo. Within a short time cars will run through. Passengers now have to change at Norwalk.

Negotiations for the purchase of the electric-light plant at Wyoming by the Cincinnati Gas and Electric Company have been concluded, and it is said the price paid is $45,000. The story is now going that the big company will make an effort to secure every plant in Hamilton County, and it can do this by invading the territory of the smaller companies, if they do not care to sell when first approached. On the other hand, owners of large blocks in the city are arranging to operate their own electric plants.

There has been a great advance in interurban railroad stocks within the last few days. Quite a number of smaller stockholders have disposed of their holdings at good profits.

The Cincinnati and Northeastern Traction Company of Dayton has been incorporated with a capital stock of $15,000 by Dennis Dwyer, Albert Emanuel, Charles T. McCrea and B. M. Hopkins. The purpose as set out, is to build an electric line from Cincinnati to Dayton.

In an interview in the Cincinnati Enquirer a few days ago John Kilgour takes rather a gloomy view of the interurban trolley business, as based upon the business of the Cincinnati city lines which run to sparsely populated points. He says that even with the shifting population along the lines, some of them yet would be bankrupt if they were operated under individual corporations, but that the heavy business of some of the lines makes up for the losses on the others, and thus a fair profit is derived from the entire system. "A trolley line which carries less than five fares per mile per car operated will lose money," he says. "I mean where the transfers reduce the rates to 3⅓ cents per mile, as is the case in this city." Further along he says, "the interurban line which cannot get five fares per mile at the rate of 3⅓ cents per mile will never be a profitable property. A car earning less than 16⅔ cents per mile will not be profitable, and one car on a line of any length would not be profitable at double that figure. There must be business enough to require the use of not less than one car for every five miles of track, or, in other words, there must be 15 rides or fares for every five miles at the rate of one cent per mile."

The Elyria Plumbing, Heating and Electric Company, Elyria, has been incorporated with a capital stock of $10,000. E. F. Wurst, C. F. Wurst and others are interested.

The Canton-New Philadelphia Railroad Company, Canton, with a capital stock of $600,000, has been incorporated to build an electric line from Navarre to New Philadelphia. At Navarre it will connect with another road which reaches Canton. The stock is divided into $300,000 six per cent. non-cumulative preferred stock and $300,000 common stock.

Guy M. Gest of Cincinnati has been awarded the conduit work of the Brooklyn Edison Electric Company.

The Ritter Electric Company of Cincinnati has increased its capital stock from $15,000 to $50,000.

Because the light fund is exhausted, Director Immell of Columbus has notified the lighting company that he cannot pay for lights any longer in the business section of the city. In consequence, the lights were turned off and the town has been in darkness in that section.

Receiver B. W. Johnson of the Sandusky, Milan and Norwalk Electric Railway Company has sent out notices of a 12 per cent. assessment to the stockholders, to pay the judgment secured against it by John G. Doman. This will cover the amount, $10,000, and the costs. The road had passed into the hands of a new company, and the judgment falls upon the old stockholders.

The Village Council of Celina has appointed a committee to look into the advisability of erecting an electric-light plant in the center of the town to cost about $10,000.

The Marion Electric Light and Power Company, Marion, has decided to enlarge the plant and put in a lot of new machinery, including a large generator.

The Village Council of Hubbard has instructed the corporation clerk to advertise for bids for the light plant which is soon to be built and to sell the former site for a plant, which will not be used.

The Mahoning Valley Railway Company has awarded the contract for new car barns and power station at Haselton to the E. M. Scofield Company of New York. It will be a handsome steel-frame structure.

In a trial trip a few days ago, a car on the Youngstown and Sharon railroad, with several prominent electric-railway men aboard, made a speed of a mile a minute over a portion of the line, and an average

of 50 miles was made on a much longer strip of track.

Attorney John C. Rogers has brought suit in the Superior Court at Cincinnati against the Cincinnati, Georgetown and Portsmouth Railway Company to enjoin it from operating any part of its line by electricity and from operating a line through the city waterworks property. He also asks the court to enjoin the City Traction Company from allowing any of the cars of the other company from operating on its lines, in order to prevent it from reaching the interurban depot and the center of town. Mr. Rogers seems to spend much of his time fighting the electric-railway companies, which are attempting to secure the right to enter Cincinnati, but what his purpose is can hardly be told. Cincinnati has fewer electric railways entering from the outside than any other large city in the state; in fact, none of them have yet gotten downtown, and it is all because of opposition of this kind. However, this gentleman has not been very successful with his fights so far. O. M. C.

Information from Indiana.

Indianapolis, August 4.—The phenomenal advance in eastern markets of the stock of the Union Traction Company of Indiana excites much attention. That the stock should jump from 30 to 75 bid inside of one week, and 30 points of that in a single day, is regarded as highly significant. But what is behind the movement is hard to determine. Following so closely as it does the great advance in Indianapolis Street Railway stock, it has revived and increased the speculation as to whether or not the two companies, which are closely related, are preparing to merge the interurbans that center in Indianapolis. It has been whispered for several weeks that a gigantic merger is contemplated. It is also conjectured that the control of all the merged lines will pass to some steam road, probably the Pennsylvania.

The Ft. Wayne, Vanwert and Lima Traction Company has filed articles of incorporation with a capital stock of $2,000,000. The company promises to construct an electric line from Ft. Wayne to Lima, O. Charles Murdock and J. D. S. Neeley head the board of directors.

Charles L. Henry, former president of the Union Traction Company, and J. F. Wild, of Indianapolis, are said to have closed a deal for the financing and construction of an electric line from Indianapolis to Rushville, paralleling the Cincinnati, Hamilton and Dayton railroad.

The Indianapolis and Martinsville line, which began hourly service last week, charges 50 cents for the round trip to Mooresville and goes to Martinsville and return. This is just one-half the fare charged by the steam road which it parallels.

The largest contract for the year will be let within a few days. It will be to construct 100 miles of electric-railway line between Indianapolis and Logansport for the Indianapolis and Northern Traction Company. Some 12 miles of the line was constructed by the Central Traction Company. The company is preparing to give an exhibition in rapid railroad building.

President McCulloch of the Union Traction Company made an argument before the State Tax Board in which he graciously admitted that he had the greatest interurban road in the world and said that while the board might be slightly criticized for leaving the assessment of the property at $8,000 a mile, he was quite sure it would also be criticized if it should make the appraisment as high as $12,000 a mile. McCulloch argued that his road was charging passengers one cent a mile, the lowest rate of any company in the country. "Higher taxes mean higher rates, thus destroying the benefaction to the people," said he. F.

Northwestern Notations.

Minneapolis, August 2.—Tacoma, Wash., will take bids for furnishing electric current to the city. The Tacoma Cataract Company has agreed, it is said, to submit a tender of not more than 0.94 cent per kilowatt-hour, which is the price now charged by the Tacoma Railway and Power Company.

The electric-light plant at Seymour, Wis., has been sold by Frank P. Mansfield of Lake Mills, Wis., to G. N. Newall of Grand Rapids, Wis. Mr. Mansfield will go to Shell Lake, Wis., where he has been granted a franchise for a system of lighting.

The Fargo and Moorhead Street Railway Company has been incorporated at Fargo with a capital of $250,000. The company is doing all the preliminary work, preparatory to starting with the construction of a line.

Bloomington, Wis., will construct a system of electric lighting and waterworks.

The council of Plainview, Minn., has granted a franchise for a local lighting plant to T. G. Bolton, Arthur Koenig and F. J. Cornwell. They have purchased a plant at Durand, Wis., and will remove it to Plainview at once.

The voters at Montezuma, Iowa, approved a tax of 2½ per cent., to aid the projected Oskaloosa and Tama electric railway. There were 281 votes cast for the proposition and but 32 against.

The council of Jordan, Minn., will issue bonds at once for the establishment of an electric-light plant.

It is reported from Taylors Falls, Minn., that surveys are in progress in that vicinity for an electric-railway line toward the Twin Cities. It is thought that such a line would be continued on to the head of the lakes. The grade is lower through the valley than at any other point, and power is available from the river. Milwaukee and eastern capitalists are said to be interested.

A survey has been completed for an electric line to run from Rice Lake, Wis., to Downsville, Wis., a distance of 70 miles. Extensive waterpower is available along the route.

The board of water commissioners of St. Paul is making active preparation for a suit against the Twin City Rapid Transit Company, to come up in November or December. It will be based on the alleged damage to water pipes caused by electrolysis. At a recent meeting of the board the commissioner was allowed $2,000 for employing two or more electrical engineers and a chemist and other experts to assist in the collection of evidence.

The Yakima Valley Central railroad has been formed to build an electric line from North Yakima, Wash., to Sunnyside and the surrounding country. A power house will be built at Horse Shoe Bend, about 25 miles up the river. Surveys and estimates have been made for approximately 99 miles of road. The projectors estimate the cost of the road at $700,000. R.

PERSONAL.

Chief Engineer O. H. Ensign of the Edison Electric Company of Los Angeles, Cal., is in the East to purchase equipment for the new 6,000-horsepower steam plant which the company purposes installing in Los Angeles.

James F. Jackson, chairman of the Massachusetts Board of Railroad Commissioners, has returned from Europe, where he inspected the London subways and the electrical equipment of continental railroads. He will report the result of his observations to the next Legislature.

George F. McCulloch, president and general manager of the Union Traction Company of Indiana, emulating the gift of President McGowan of the Indianapolis Street Railway Company, has given $10,000 to the National Technical Institute to be located on the Arsenal grounds at Indianapolis.

H. V. Miller, for 15 years superintendent of telegraph of the Chicago and Alton Railway Company, with headquarters at Bloomington, Ill., has resigned his position to engage in active business. Mr. Miller is the inventor of the railroad signaling system which bears his name and which is just coming into prominence.

The resignation of Lord Salisbury recalls the marked interest he has ever shown in electrical subjects. For a long period he followed the development of electrical science, and when that science took a practical turn, Lord Salisbury was foremost among his peers to introduce electrical appliances into his country seat and upon his estate. His electrical studies gained for him considerable recognition in scientific circles, and in 1894 he was invited to become president of the British Association.

Perhaps the youngest street-railway conductor in the country is Charles G. Hood, who operates a car on the Fairmont and Clarksburg electric railway in West Virginia. The lad was born November 13, 1885. His father, Smith Hood, was, until six months ago, manager of the Fairmont Electric Light and Power Company, but when that company was merged with the Fairmont and Clarksburg Electric Railway Company, he became manager of the latter. The son is greatly interested in electricity. When a number of the conductors on the road went out on a strike, he secured the position of conductor at $40 a month, and it is said that he has not a superior on the line.

Stanley B. Arnold, the 13-year-old son of Bion J. Arnold of Chicago, the well-known engineer, seems to have inherited his father's talent for mechanics. He has built a miniature steam automobile complete in every detail, and is now at work on a gasoline machine. In addition, he shows marked skill and judgment as an automobile driver, as was shown in the recent 100-mile endurance test of the Chicago Automobile Club, when he won a blue ribbon for complying with all the conditions, after surmounting difficulties that might well have discouraged a full-grown man. On his return from this trip young Arnold was greeted enthusiastically at the club, where his father is a director and the boy is very popular.

ELECTRIC LIGHTING.

Columbus, Ohio, will receive bids for the construction of the municipal electric-light plant until August 18th.

It is reported that the Southern Railway intends to equip all its dining cars with electric lights and fans.

The Cincinnati Gas and Electric Company has received a permit to build an electric-light substation at Park and McMillian Avenues. The station is to cost $10,000.

A rumor is going the rounds in St. Louis, Mo., that a consolidation of all the public-lighting plants in that city is under way. The companies said to be interested are the Union Electric Company, Missouri Edison Electric Company, and the Laclede Gas Light Company, on the Missouri side of the Mississippi; and the East St. Louis (Ill.) Gas and Electric Company on the Illinois side. The North American Company is supposed to be back of the deal.

The Jeannette Light and Power Company of Jeannette, Pa., has been incorporated with a capital of $100,000.

Manchester, Mass., is said to be in the field for an electric-light plant. William A. Tucker may be addressed.

The Citizens' Electric Light Company of Battle Creek, Mich., has voted to expend $17,000 in improving its plant.

The Champaign Electric Company of Louisville, Ky., has been granted a franchise to operate a light service at Charlestown, Ky.

On August 17th St. Joseph, Mich., will vote on the project to bond the city for $32,000 to build a municipal electric-lighting plant.

The Rowe Gas, Light and Heating Company of Early, Iowa, has been incorporated with a capital of $10,000. The incorporators are E. E. Rowe, D. D. Carlton, F. K. Kerwin and others.

The city of Clintonville, Wis., is to erect a municipal electric-light plant, for which Professors Richter and Swenson of the University of Wisconsin have prepared plans. Bids will be received by Frank Gause, city clerk, until noon of August 9th. A brick power house, extending 32 by 54 feet on the ground, is to be built to contain a tubular boiler (66 inches by 16 feet), two feed pumps, one feed-water heater, a 75-horsepower engine with speed of 275 revolutions a minute, a 45-kilowatt alternator (single-phase, 2,200 volts and 60 cycles) belted to the engine, with a suitable exciter, switchboard, wiring and other accessories. Separate pole-line circuits will supply arc and incandescent lighting throughout the town. The arc-lighting transformer will be installed in the power house; others are to be placed on poles.

ELECTRIC RAILWAYS.

The Illinois Valley Traction Company, located at Ottawa, Ill, certifies to an increase in capital stock from $500,000 to $700,000.

The Rockford-Beloit-Janesville electric line—an interstate railway in Illinois and Wisconsin—is completed. It is expected that cars will be running in a few days.

Cars for railways other than steam were exported from the United States during the year ended June 30, 1902, to the value of $788,816. For the year before the figure was $1,419,930.

The Paris and Terre Haute Traction Company of Paris, Ill., has been incorporated with a capital of $5,000. The incorporators are G. W. Highes, H. H. Knipe and J. D. Hunter.

The Rockford (Ill.) Railway, Light and Power Company has completed its freight depot on South Wyman Street, and is now running regular freight trains between Rockford and Belvidere.

It is the intention of the Philadelphia Rapid Transit Company soon to engage in the building of cars, according to good authority. It is said that the company in the early fall will begin the erection of mammoth shops. A suitable site is said to have been secured in West Philadelphia.

Elevated-railway traffic in Chicago for the month of July was unusually heavy for the middle of summer. The Metropolitan Elevated showed an increase of 23 per cent. over the corresponding month last year. The long-continued rainy weather is considered partly responsible for the increase.

The Kansas City Outer Belt and Electric Company of Kansas City, Mo., has been incorporated with a capital of $1,500,000. The incorporators are A. J. Stillwell and E. E. Holmes of Kansas City, Mo., David W. Mulvane of Topeka, Kan., and Benjamin Schnierle and Burnett N. Simpson of Kansas City, Kan.

Reynolds-Corliss engines installed in the municipal street-railway plant at Glasgow, recently tested, were found to give a mechanical efficiency of 96 per cent. and to consume but 12.2 pounds of steam per hour per indicated horsepower. The combined efficiency of the engine and generator (General Electric of 2,500 kilowatts) was 92 per cent.

The Lancaster (Pa.) and York Furnace Street Railway Company, having a capital stock of $225,000, has been organized to build a trolley line 12 miles in length, starting at York Furnace, on the Susquehanna River, and extending to the vicinity of Millersville, Pa., to connect with the Lancaster and Millersville trolley road, giving communication with Lancaster, Pa.

L. S. Owsley has been appointed receiver for the Suburban Railroad Company, whose right-of-way in Chicago was recently taken away by the courts, at the request of the Chicago Title and Trust Company, which asserts that the concern is insolvent. It is said that over $400,000 in interest on the first-mortgage bonds of the company is due and unpaid and

that the mortgaged property is so situated as to make the sale of it impossible without injury to the bondholders. It is claimed that the receivership will stop the city's tearing up any more of the company's tracks.

SOCIETIES AND SCHOOLS.

The National Electrical Contractors' Association has a membership of 206 firms.

The 1902-1903 year book of the Armour Institute of Technology of Chicago has recently been distributed. It contains lists of officers and faculty, entrance requirements, descriptions of courses in mechanical, electrical, civil and chemical engineering and agriculture, general studies, list of graduates and other information. A view of the new machinery hall, given by Mrs. P. D. Armour and now under construction, serves as a frontispiece.

At the recent annual convention of the American Boiler Manufacturers' Association, held at Atlantic City, the following-named officers were elected: President, John O'Brien, St. Louis; first vice-president, Robert Monroe, Jr., Pittsburg; second vice-president, Samuel Borgen, Columbus; third vice-president, J. M. Robinson, Boston; fourth vice-president, M. F. Cole, Newman, Ga.; fifth vice-president, J. F. Casey, Chattanooga; secretary, J. D. Farasey, Cleveland; treasurer, Joseph Wrangler, St. Louis. The next convention will be held in Chattanooga in July, 1903.

AUTOMOBILES.

For the year ended June 30, 1902, the United States exported automobiles and parts of automobiles to the value of $948,528.

It is reported that a plan is on foot to build a macadam automobile road from New York to Chicago. The United States government, it is said—but this is hardly likely—has promised to pay 25 per cent. of the cost.

The Woods Motor Vehicle Company of Chicago has been incorporated with a capital of $150,000. The purpose is the manufacture of automobiles. The incorporators are T. C. Clendenning, A. B. Shafner and A. L. Schwartz.

Two boys, one 15 and the other 17 years of age, recently completed an automobile run from New York to Chicago. The actual running time was 11 days 1½ hours. It was the first trip ever made over the distance in a light automobile, the machine weighing but 800 pounds.

PUBLICATIONS.

The Æronautical World, a monthly journal devoted to "the vastly grand, universally interesting and surpassingly important subject of æronautics," has made its appearance, hailing from Glenville, Ohio. It believes that "practical aerial navigation is a possibility infinitely easier of accomplishment than is generally supposed."

Among the recent publications of the Fort Wayne Electric Works of Fort Wayne, Ind., are a bulletin describing their type-K, form-SAC, integrating switchboard wattmeters; another bulletin, descriptive of their differential type form-C enclosed, direct-current series arc lamps, and an illustrated folder, describing these lamps and also the Wood power-circuit arc lamps of the multiple series type.

The Wagner Electric Manufacturing Company of St. Louis, Mo., has issued an attractive pamphlet announcing the award to the company, by the Franklin Institute of the Edward Longstreth medal of merit upon its single-phase alternating-current motors. The pamphlet contains reproductions of the medal, the full committee's report and opinions of leading engineers which contributed materially to the result of the committee's investigation. The Wagner company has also issued bulletins descriptive of its static ground detectors and its portable instruments for direct and alternating-current measurements.

TELEGRAPH.

The Chicago Evening Post says: "The telegraph stations maintained in the Chamber of Commerce of Milwaukee by the Postal and Western Union companies probably will be removed, and the rate of five cents for a message of 10 words to Chicago abolished. Trustees of the Chamber of Commerce raised the rent of the booths used by the Western Union company from $36 to $175 a month and the Postal company is asked to pay $100 a month for a space that has been costing it $16. The matter has been taken up by telegraph officials in Chicago. Brokers are not pleased with the action of the trustees, and many are demanding that the order increasing the rent be rescinded. They will be put to additional expense and great inconvenience should the booths be removed."

MISCELLANEOUS.

All telephone, electric-light and telegraph wires in Butte, Mont., must be placed underground by December 31, 1904.

A patent (No. 705,829) was granted Thomas A. Edison on July 29th for a phonographic "Reproducer for Sound Records."

Amundsen, the Norwegian explorer, has planned an expedition for next year to carry out the researches in connection with the magnetic pole, which was discovered in 1831 by Sir John Ross, but which is now believed to have changed its position.

Pittsburg engineers are discussing the possibility of electrolytically purifying the water supply of that city. One drawback is the disposal of the residuum left in the water by the introduction and action of chemicals used in the electrolytic process.

On August 1st the boilermakers in Chicago shops went on a strike for a higher scale of wages. The strike is said to affect 2,300 men. Twenty-three firms were affected, all of which are members of the National Boilermakers' Association, against which the strike is aimed. The present scale of wages is 30 cents an hour for indoor men and 35 cents is the scale asked. Outdoor men receive 30 cents an hour, and they demand 50. No complaint was made against the length of the working day which is nine hours. Three of the firms signed the scale on the same day of the strike, and the men returned to work. Others are as yet holding firm and refuse to comply with the demands of the strikers.

TRADE NEWS.

The Northern Electric Company of Fargo, N. D., has been incorporated with a capital stock of $150,000, of which $100,000 will be used in Minnesota.

On July 25th the plant of James J. Murray & Co., makers of electrical and other glassware, of Philadelphia, was struck by lightning, but, fortunately, not greatly damaged. The firm made temporary arrangements to fill orders and is now about able to resume operations in full.

BUSINESS.

The Chapman lightning arrester for telephone and telegraph lines is a new arrester for the protection of instruments, poles and other property. It is said to be thoroughly reliable. The Electric Appliance Company, Chicago, is sending out circulars illustrating and describing it.

The Chicago Fuse Wire and Manufacturing Company states that since offering its souvenir paperweight a few weeks ago this little article has come to be in great demand. The company reports a steadily increasing demand for its fuse wire and links and telephone supplies.

The demand for the Shelby useful-light incandescent lamp has been so great that the Shelby Electric Company has been obliged to double its capacity. The new addition is now completed and the new machinery installed, and the factory is now running day and night to supply the demand for "useful light."

The Great Western Smelting and Refining Company, Chicago, refiner and dealer in metals, states that it is doing the largest business in its history. The company makes a specialty of purchasing scrap copper and other metal and has on its books many of the leading electric-light and street-railway companies. Those wishing to realize on scrap of this kind are requested to write the Great Western Company for particulars.

M. J. Isaacs, general manager of the K. McLennan Company, Chicago, manufacturer of the well-known Gale's commutator compound, states that the demand for this article is greater than ever. Among a number of recent orders was a particularly large one from Yokohama, Japan, while another large shipment was sent to Australia. The merits of this compound are well known to the thousands who have used it for the last few years.

A. L. Streeter, 173-177 South Clinton Street, Chicago, manufacturer of the Streeter spring fan motors, reports a brisk demand for his products. This fan is operated by the winding of a spring, and the manufacturer says that one winding will run the fan 1¼ hours. Mr. Streeter also states that any child can handle the fan with perfect safety.

The extensive foreign business of the Buffalo Forge Company shows the esteem in which its products—steam engines, ventilating and draft fans and the like—are held abroad. Recent orders have been received from Copenhagen, Denmark; Dutch Guiana, South America; Manzanillo, Cuba; Gustenunde, Germany; Gothenburg, Sweden; Glasgow, Scotland; Barrow-in-Furness, London and Manchester, England; Victoria, B. C., and Halifax, N. S. Fans and engines have also been recently ordered from such far-apart states as Oregon and Texas, California and Louisiana.

The Bario Vacuum Company of 156 East Twenty-third Street, New York city, is now prepared to supply all kinds of X-ray tubes or special glass work of any kind. The company is making a specialty of repair work, and its patent regulator and barium fluoroscopes are well known by all X-ray operators. Owing to the General Electric Company having discontinued the repair and manufacture of Crookes tubes, etc., there is no doubt that this company's departure will be welcomed by all X-ray operators, having regard to the fact that all their manufacturing is under the supervision and advice of some of the best X-ray experts in this country.

The Standard Pole and Tie Company of 44 Broad Street, New York, has just completed the delivery of its second large order from the Central New York Telephone and Telegraph Company of Utica, N. Y. The poles which have been supplied are the southern white cedar or juniper poles, of which the Standard company makes a specialty. The company began to introduce this pole in the northern market about two years ago, and now it reports that the orders are coming in as fast as it can handle them. The main reasons for the popularity of the juniper pole are its freedom from butt rot and its symmetry and straightness. The poles ordered by the Central New York Telephone Company were delivered faster than that company could use them in its construction work.

Among the larger contracts recently closed by the Electric Storage Battery Company of Philadelphia for Chloride accumulators in railway service are the following: Mahoning Valley Railway Company, Youngstown, Ohio, 351 kilowatts; Kansas City-Leavenworth, Wolcott, Kan., 160 kilowatts; Detroit United Railway, Detroit, Mich., 173 kilowatts; Connecticut Railway and Lighting Company, Derby, Conn., 175 kilowatts; Harrisburg Traction Company, Harrisburg, Pa., 264 kilowatts; Eastern Ohio Traction Company, Gates Mill, 259 kilowatts; Capital Traction Company, Washington, D. C., 173 kilowatts; Orange and Passaic Railroad Company, Orange, N. J., 209 kilowatts; Ottawa Electric Railway Company, Ottawa, Ont., 599 kilowatts. Other contracts recently closed embrace a battery of 8,000 amperes at 120 volts for the Edison Electric Illuminating Company of Brooklyn, and several residential and office-building plants.

Central stations supplying current for lighting or for power find it very desirable to register the total output of their generating plant and to use that record to check up the meter records of customers' uses, thereby being able to determine exactly the loss of energy in distribution. A fair instance of this demand is a recent order placed with the Stanley Instrument Company of Great Barrington, Mass., for four wattmeters for alternating current, capable of registering the output of a 50,000-horsepower plant, each meter being called upon to record the energy delivered by a 15,000-horsepower set of units. A very large proportion of the orders placed with the Stanley Instrument Company is for switchboard meters, the company having on hand, besides the above, many orders for meters of 1,000, 1,500 and 4,400-ampere capacity, to be used on a potential of 2,400 volts. The company has supplied meters capable of correctly recording the energy used on a supply line of 7,000-ampere capacity and announces its readiness to supply its magnetic suspension recording wattmeters capable of recording accurately currents of 10,000 amperes at any voltage and frequency.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 29, 1902.

705,549. Signal Device. Herbert S. Balliet, Bethlehem, Pa. Application filed April 10, 1902.

A semaphore signal-box containing an instrument of a signaling system, has within it an electric motor fan together with means for operating it arranged so that the current of air will be caused to circulate over and about the instrument.

705,558. Electric Clock. Joseph Butcher, New York, N. Y., assignor to Simeon N. Putnam, Jersey City, N. J. Application filed October 16, 1901.

The clock combines a movable armature, a weighted pawl-lever, a flexible connector which couples them together, and a contact device actuated to close the operating circuit by the straightening of the connector when the weighted arm descends.

705,561. Rheostat. William H. Chapman, Portland, Maine. Application filed December 14, 1901.

The rheostat consists of a swinging arm, a spring-pressed contact on the arm, a series of thin segment plates on which the contact is adapted to travel, insulating plates between the plates. The plates are closely clamped together at their front ends and spread apart at their rear ends, the upper half of the rear portion of every other plate and the lower half of the balance of the plates being cut away so that the rear ends of adjacent plates may be swung over each other.

705,583. Electric Signal. Arthur J. Haycox, Mansfield, Ohio. Application filed April 10, 1902.

An apparatus for signaling cars is described. A lamp located in the signal-box has one terminal permanently connected with the line conductor. Other parts are a switch-box, a switch lever pivoted therein, a conductor permanently connecting the other terminal of the lamp with the switch-lever, a contact block in the switch box to co-operate with the switch-lever, a conductor connecting the contact-block with the ground, and means for nor-

mally holding the switch-lever away from the contact-block to maintain the lamp circuit normally open

705,584. Signal Mechanism. Reinhold Herman, Crofton, Pa. Application filed October 25, 1901.

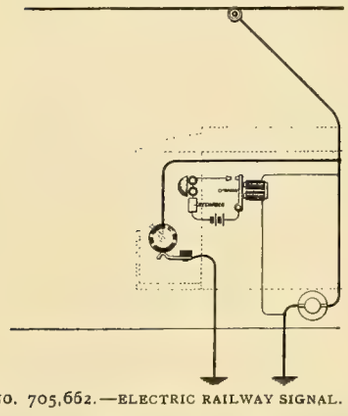
The mechanical mechanism for electrically operated signals is described.

705,597. Electric Sign. Thomas E. Murray, New York, N. Y. Application filed February 11, 1902.

A lamp-socket support is formed integrally of a thin plate in the shape of a letter or character. A glow-lamp socket having an annular projection enters the opening and a flange. Means are provided for detachably securing the flange to the plate.

705,616. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn. Application filed December 1, 1900.

In the jar of the battery described are perforated sheet metal tubes to form a receptacle for a depolarizer, an expansible wire interior of the part or parts adapted to force them outward and retain them rigidly against the jar, a zinc located interior of the depolarizer and means for the attachment of a wire to each of the elements.



NO. 705,662.—ELECTRIC RAILWAY SIGNAL.

705,630. Separator for Electric Accumulator Plates. Richard Alexander-Katz, Berlin, Germany. Application filed October 18, 1901.

A non-conducting separator for electric accumulator plates comprises two wide-meshed gratings, whereof the intersections of the one cross the open spaces of the other, the outer edges of the gratings all being in the same plane.

705,651. Reduction of Metals from Their Ores, etc., in Electrically Heated Furnaces. Ramon C. Contardo, Sèvres, France. Application filed December 1, 1897.

The process of obtaining metal direct from the ore is described. It consists in subjecting the lower end of a descending column of ore to a high temperature by a voltaic arc not in physical contact with the ore, and simultaneously causing a current of heated reducing gas to flow upwardly through the column of ore.

705,662. Electric Signal for Railway Cabs. Joseph W. Frost, Washington, D. C. Application filed January 25, 1902.

The device combines a stationary generator, the line carrying the current from the generator, a contact traveler, and a cab motor receiving its current from the line through the contact traveler, with a comparatively high-resistance receiving device included in a shunt around the motor, all at one station, and a transmitting device at another station on the line of the conductor and connected with the same. (See cut.)

705,668. Electric Heater. William S. Hadaway, Jr., New York, N. Y. Application filed September 24, 1898.

In the heater are an outer shell having an upturned edge narrowing upward, a resistance within the shell, a layer of mica under pressure on each side of the resistance, a compression plate, and a ring between the plate and the narrowed edge.

705,685. Telephony. Joseph Lyons, Charmian, Pa., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed September 2, 1899.

For this and succeeding patent see page 92.

705,686. Telephony. Joseph Lyons, Washington, D. C., assignor to the American Telephone and Telegraph Company, New York, N. Y. Original application filed September 2, 1899. Divided and this application filed April 23, 1902.

705,705. Safety Attachment for Trolley-car Vestibules. Susie E. Pressler, Toledo, Ohio. Application filed May 5, 1902.

The device combines with the window frame of a car vestibule an outwardly extending curved back bar provided with tapered attaching grooves, and tapered tongues secured upon the frames of the vestibule window adapted to co-operate with the tapered grooves in the back bar to permit attachment or detachment of the back bar.

705,727. Method of Treating Metallic Oxides in the Production of Metals and Alloys. Frederick C. Weber, Chicago, Ill. Application filed April 15, 1901.

The method of treating metallic oxids with aluminum in the production of metals and alloys and their compounds is described. It consists of placing a quantity of finely powdered oxid reducible by aluminum in the bottom of a crucible with a small coil of aluminum wire and passing an electric current through the wire of sufficient intensity to melt the aluminum wire and produce a reaction with the finely powdered oxide.

705,773. Device for Lighting Lamps by Electricity. Svend M. Meyer, Brooklyn, N. Y. Application filed January 3, 1898.

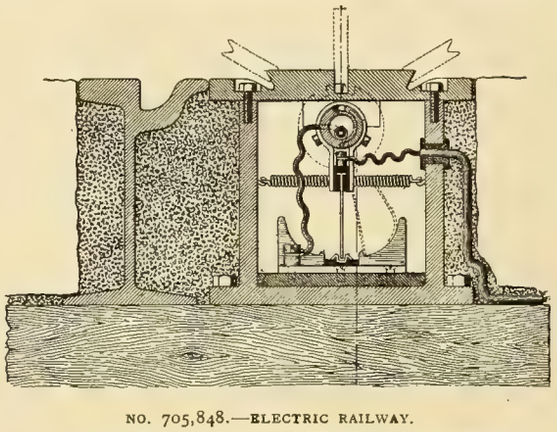
A lamp body containing a suitable source of electricity is combined with a burner removably mounted thereon, a conductor separably connecting the source of electricity with a fixed conductor in the burner, connected with lighting device adjacent to the lamp-wick, a vibrating contact-making device on the burner closing the circuit at mid-stroke only and automatically thrown to either extremity of its movement when moved by hand from the opposite extremity to close the circuit.

705,786. Automatic Switch. Herman A. Poppenhusen, Evanston, Ill. Application filed October 31, 1901.

One claim reads: The combination of a dynamo, a storage battery, a circuit connecting the dynamo with the storage battery which includes a switch, and means for actuating the switch comprising two magnetic circuits, a movable armature which is included in the magnetic circuits and is connected with and operates the switch, and coils located severally on the two magnetic circuits; one of the coils forming part of a shunt-circuit from the dynamo and the other of the coils forming part of a shunt-circuit from the storage battery. (See cut.)

705,798. Trolley. William L. von Hardenberg, Brooklyn, N. Y. Application filed June 23, 1901.

A trolley wheel formed with a deep central annular groove, and a right and left-handed helical groove substantially tangent to the annular groove is described. The helical grooves are of varying diameter, and the increase in diameter of the grooves is substantially proportional to the distance between any two points. A trolley arm is formed with a yoke. At the end of the same are beveled circular bearing portions formed on the yoke, the portions serving to guide the trolley with relation to the trolley wire. (See cut.)



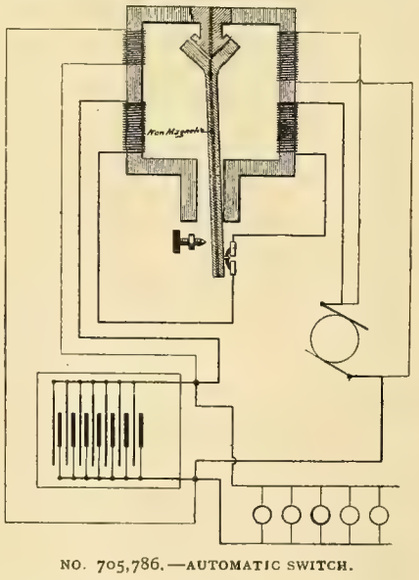
NO. 705,848.—ELECTRIC RAILWAY.

705,802. Cable-terminal Box for Electricity Supply Purposes. George Wilkinson, Harrogate, England. Application filed April 21, 1902.

The box and a supply cable which enters the box and has its inner and outer conductors spread out inside the box in different planes are combined with service cables which also enter the box, separate contact washers which bear against the conductors and service cables respectively, fuses which connect the contact washers of the inner and outer conductors with the service cables to which they pertain, and a spring which operates longitudinally of the supply cable and which holds its inner and outer conductors in contact with their respective contact washers.

705,805. Electric Annunciator. William R. Winter, Trenton, N. J. Application filed November 15, 1901.

In the annunciator are a delivery station having a commutator, a stop attached to the commutator, a ratchet wheel, a spiral spring connecting the ratchet wheel to the commutator, a hand lever for operating the ratchet wheel, a detent fastened to the ratchet wheel, the detent engaging the stop and adapted to be withdrawn by the hand lever, and an armature for locking the hand lever in its initial position.



NO. 705,786.—AUTOMATIC SWITCH.

705,811. Insulating Support for Metallic Circuits. John S. Allen, Los Angeles, Cal. Application filed November 30, 1901.

The support comprises a cross-arm affixed to a pole, two pins mounted in the cross-arm, an insulator on each pin, a core between the insulators resting thereon and supported thereby, a yoke uniting the core and insulators and affixed thereto, and a pin mounted in the core and carrying an insulator adapted for the attachment thereto of an electric wire.

705,822. Blast or Other Furnace. Ellery F. Coffin, Muirkirk, Md., assignor of one-fourth to Charles E. Coffin, Muirkirk, Md. Application filed March 27, 1901. Renewed May 31, 1902.

An improvement in the art of operating furnaces requiring a blast of air is described, which consists in drying the air by passing an electric current through it and then forcing the dried air into the furnace.

705,825. Trolley Head and Wheel. Walter A. E. Davis, Toledo, Ohio, assignor to W. H. Lidell, Brooklyn, N. Y. Application filed December 18, 1901.

The device consists of a socket piece formed with upper and lower-bearing lugs, a trolley head formed with a vertical bearing piece fitted between the lugs and pivoted thereto to swing laterally, the trolley head having inwardly and downwardly turned flanges and a trolley wheel journaled in the head.

705,848. Electric Railway. Charles J. Kintner, New York, N. Y. Application filed October 29, 1900. Renewed February 28, 1902.

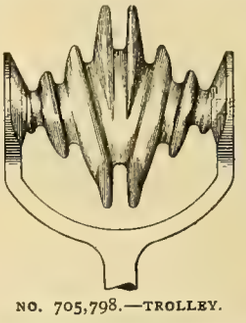
A current feeder or main extends over the route and a series of third rails or sectional conductors are provided normally disconnected therefrom. A series of rotary switches journaled with their axes of rotation substantially parallel with the track rails are provided with means for giving them gradual and continuous rotation about their axes as a car travels over or by them. Circuit connections are provided so that the third rails or sectional conductors are electrically connected to and disconnected from the current feeder or main in sequence and without damaging mechanical effects. (See cut.)

705,850. Electrical Panel Board. Hubert Krantz, Brooklyn, N. Y. Application filed March 12, 1902.

The board has a back plate and conducting bars with pairs of fuse clips, one clip of each pair being over or in front of the other, and a cover plate for the fuse clips, the cover plate having a hole for the insertion of the fuse cartridge substantially at right angles to the back plate.

705,854. Generating Apparatus for Car Lighting. Albert F. Madden, Newark, N. J., assignor to Charles A. Gould, New York, N. Y. Application filed February 24, 1902.

A rotary part of a vehicle running gear is combined with a friction wheel mounted thereon, a dynamo flexibly and independently mounted with respect to the running gear, a friction wheel on the dynamo shaft, and a transmitting wheel engaging the wheels on the running gear and dynamo shaft, the transmitting wheel being mounted to swing in an arc which intersects the peripheries of both the wheels.



NO. 705,798.—TROLLEY.

705,881. Gas-engine Ignition Regulator. Michael J. Sullivan, Springfield, Ohio. Application filed January 13, 1902.

An electric circuit-making device is described

705,882. Trolley. Thomas W. Sutton, Pittsburg, Pa. Application filed May 7, 1902.

The apparatus comprises a harp, an axle mounted in the harp and exteuded beyond the sides of the latter, a pin passing through the ends of the harp and through the axle and a trolley wheel mounted on the axle within the harp.

705,919. Electric Battery. Edwin R. Gill, New York, N. Y. Application filed November 15, 1901.

A socket and two terminal pieces attached thereto so constructed as to make contact when the socket is empty are combined with a battery cell fitting the socket and having electrodes adapted to make contact with the socket terminals respectively, and means for securing the cell in the socket.

705,955. Magnetic Core for Inductance Coils. John C. Lee, Brookline, and Edwin H. Colpitts, Boston, Mass., assignors to the American Telephone and Telegraph Company, New York, N. Y. Application filed November 30, 1901.

For this and succeeding patent see page 92.

705,936. Loaded Electric Circuit. John C. Lee, Brookline, and Edwin H. Colpitts, Boston, Mass., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed November 30, 1901.

705,991. Time-switch Mechanism. George Zaepfel, Croghan, N. Y., assignor of one-half to George W. Henderson, Croghan, N. Y. Application filed October 24, 1901.

A clock mechanism for actuating electrical switches is described. It comprises a series of spring-actuated gear wheels, a crank actuated by the wheels, a switch lever pivoted to the arm, a setting wheel in mesh with a clock-work, pins mounted on the setting wheel, a trip arm disposed in the path of the pins, a lock-lever normally holding the gear mechanism from rotation, and actuated by the trip lever and a momentum wheel, turning with the spring-actuated wheel in one direction, and designed to turn idly after the switch lever is operated.

705,996. Sparker for Explosive Engines. George A. Graves, Joplin, Mo., assignor of two-thirds to Alfred Reynolds and Thomas W. Cunningham, Joplin, Mo. Application filed October 15, 1901.

In the sparker are a fixed electrode, a shaft bearing an electrode located to be brought into engagement with the fixed electrode, and means for intermittently engaging and releasing a lever to make and break a circuit through the electrode to make a spark.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, AUGUST 16, 1902. No. 7

Electrical Equipment in Belgian Blast Furnaces.

By Frank C. Perkins.

One of the most important engineering works in that remarkable industrial center, the Basin of the Meuse, between Seraing and Liège, in Belgium, is the Ougree-Marihaye Blast Furnace Iron Works Company's plant. This great industrial establishment at present employs nearly 6,000 men, while when first established it consisted of only a few rolling mills and puddling furnaces and employed but a few men. Now it is one of the largest plants abroad and includes vast steel works and rolling mills, one of which is operated by a reversible 10,000-horsepower engine, as well as brass foundries and cement and chemical manure foundry, where the slag from the blast furnaces is made into cement and the basic slag from the steel furnaces is made into rich phosphoric manure.

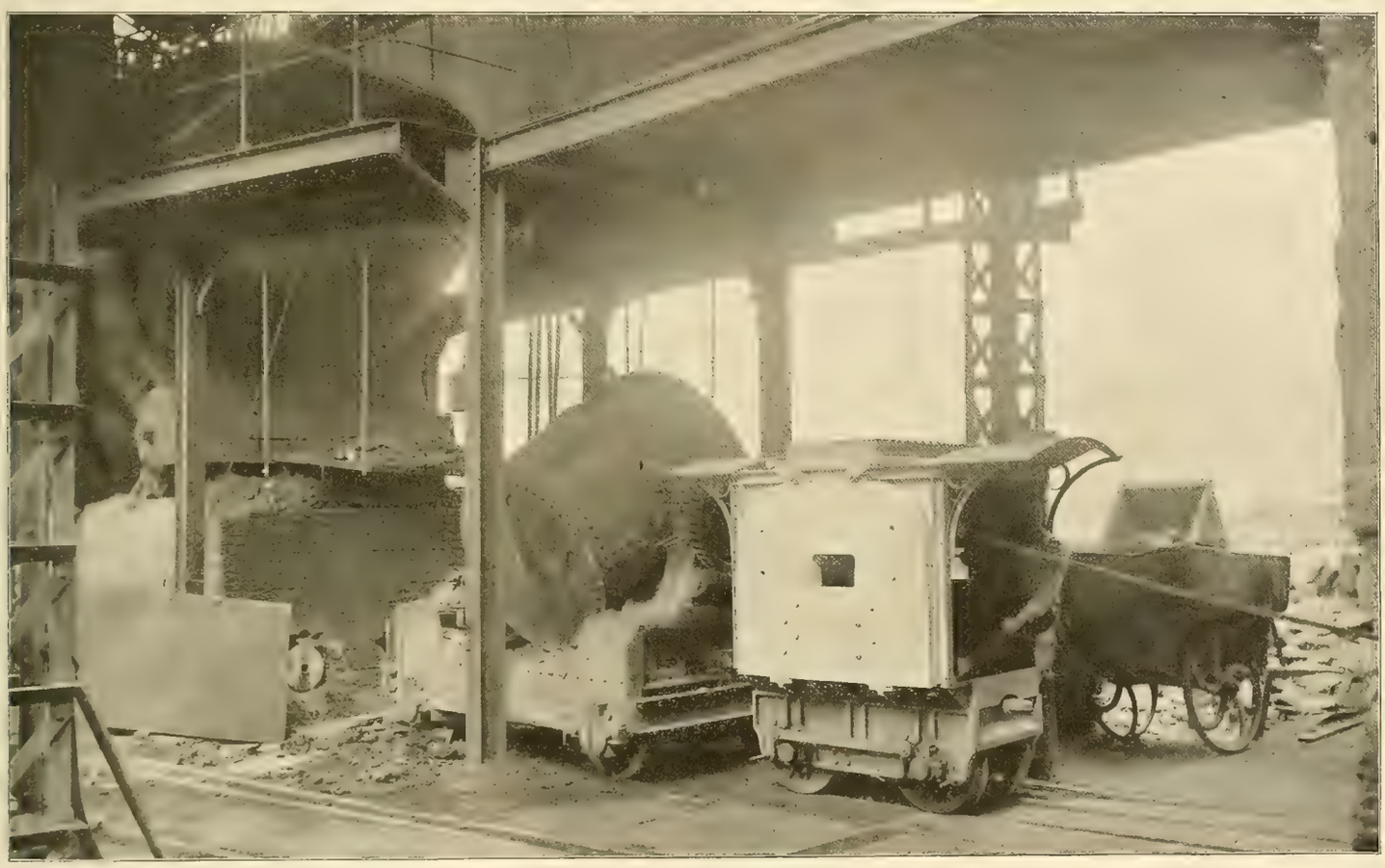


FIG. 1. ELECTRICAL EQUIPMENT IN BELGIAN BLAST FURNACES.—ELECTRIC LOCOMOTIVE FOR 20-TON STEEL LADLE.

The electrical equipment of this plant was installed by the Compagnie Internationale D'Electricite of Liège, Belgium, and it was decided, after careful consideration of the various methods of power generation, to utilize as fuel the waste gases from the blast furnaces, although the power must be generated nearly a mile from the main power-consuming centers. As the use of gas engines prohibited the use of polyphase alternating generators in parallel, or at least made the problem more difficult, and as various direct-current motors aggregating nearly 400 horsepower were already in operation, utilizing direct currents of 65, 125 and 250 volts, it was thought best to install a direct-current plant.

A central power station was erected near the blast furnaces, with three direct-connected gas-engine and generator units. Two of these consisted of 600-horsepower horizontal gas engines of the Delamarre-Debouteville type, directly coupled to multipolar dynamos constructed by the International Electrical Engineering Company. The gas engines were built by Cockerill & Co. of Seraing. The third unit installed was of 150-horsepower capacity, and can be run in parallel with the larger units, but is used mainly to supply power at times when only a few motors are running, as on holidays. The plant will ultimately utilize 3,000 horsepower, and provision was made for this amount of electrical energy in providing space for the equipment.

The generating units are of 550 volts potential and are connected in parallel to two copper bus-bars on the main switchboard, and from these bars the current is conducted to the receiving station over aluminum conductors, the receiving station being located in a central position at the works near to the principal consuming centers.

At the receiving station the switchboard is arranged for a five-wire distribution, and on account of a limited floor space, the building is constructed at a height of about 20 feet above the ground and is supported by six iron columns, the structure being entirely of steel, and thus fireproof. In order to have two circuits of 250 volts each, a balancer and neutral bar is employed. Each of the two circuits of 250 volts has a balancer, which gives two circuits of 125 volts each, and in this way the old direct-current motors of low voltage are supplied with current.

The new motors installed are of 500 volts, and the 250-volt motors are distributed evenly over the two 250-volt circuits. The balancer is said to maintain a constant pressure, even when the load variation between the two sides reaches as much as 100 horsepower. Not only the small motors, but also the incandescent lamps and arc lamps, are supplied from the four circuits of 125 volts; and the possibility of having the several voltages, 125, 250 and 500, at hand is very convenient for utilizing multi-speed motors with varying pressure.

The 600-horsepower blast-furnace gas-engine sets at the central power station operate at 90 revolutions a minute. It is said that these are the largest single-cylinder blast-furnace engines which have yet been built, while this plant is one of the first in which the waste blast-furnace gas has been made use of for supplying electric power for operating steel works. One of the 600-horsepower gas engines coupled to a 12-pole dynamo, is shown in Fig. 2 on the next page. The main bearings are cooled by a stream of cold water, as well as the piston, exhaust valve and cylinder, and all other parts liable to get hot from the gas ignition. A special regulating device is employed, which stops the engine immediately in case the supply of water is cut off from any cause whatever; all danger from overheating is thus avoided. The electric method of spark ignition is employed in the gas-ignition chamber; and in order to avoid electric contacts becoming fouled by dirt and in order to prevent deposits of dirt in the cylinder and a sticky piston, the gases are blown across a special cleansing apparatus which also cools them, thus increasing the density.

The 12-pole, direct-current, 500-volt dynamos, one of which is shown in elevation in Fig. 3, are shunt-wound, and the dynamo shaft is provided with a half coupling which fits to a similar half coupling on the gas-engine shaft. The armature of the generator is drum-wound, and the coils are shaped in formers and fitted into a core built of sheet-steel stampings, evenly insulated with paper, and arranged to insure perfect insulation and ventilation. A very high-permeability magnet steel is used for the fields, the poles being cast in one piece with the yoke, while the pole pieces are laminated and bolted on, the horns being so designed as to give sparkless commutation with fixed position of brushes at variable loads.

There are in operation at the works nearly 70 motors, varying in capacity from one-half horsepower to nearly 100 horsepower. Larger ones are to be installed as the plant is increased in size to full capacity.

There are nearly a dozen electrically operated overhead traveling cranes, at various points in the works. Three of these are operated by four electric motors each; five of the cranes have three motors each, and two are operated by single motors. The single-motor cranes are of two tons' capacity and are used for manipulating loads of sheet iron.

One of the three-motor cranes, lifting five tons, is used in the Siemens-Martin steel foundry, and two of the three-motor cranes, with a capacity of four tons each, are high speed, hoisting at 55 feet a minute, the cross-travel speed being 250 feet a minute. The motors for these cranes are wound for 250 volts. The cranes are used at the casting pits, where it is very important that the crane service should be very reliable, and have a comparatively high speed of

operation. The fifth three-motor crane is a 30-ton traveler and is constructed especially to work in a space shaped like a segment of a circle. The International Engineering Company of Liège, Belgium, has recently constructed a new electrically driven three-motor crane of five tons' capacity, which will be utilized at the blast furnaces.

The large 22-ton cranes, which are electrically driven by four motors, are of new design and have given excellent results, using two motors for separate lifting. One of these cranes is illustrated in Fig. 4. The largest rolling mills, which are driven

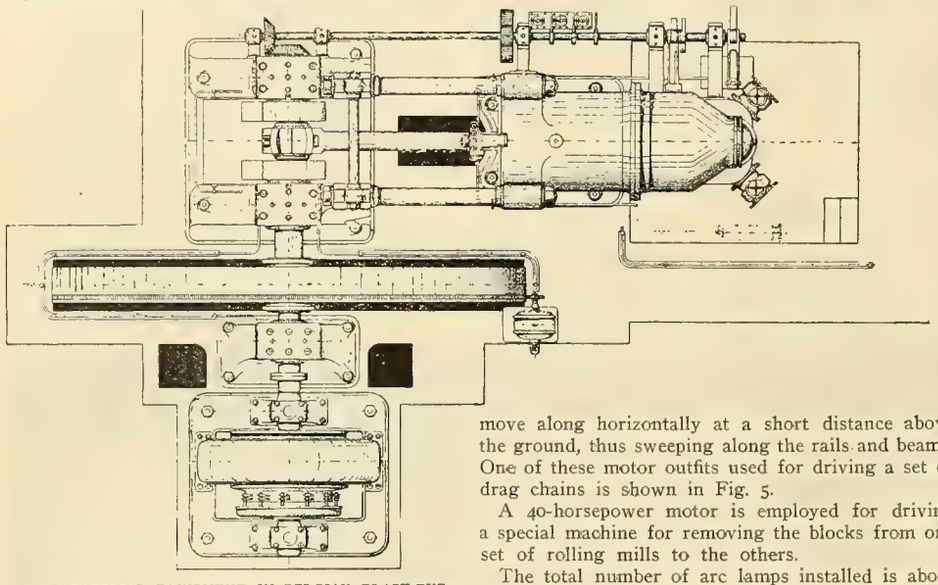


FIG. 2. ELECTRICAL EQUIPMENT IN BELGIAN BLAST FURNACES.—600-HORSEPOWER GAS ENGINE AND GENERATOR SET.

by the 10,000-horsepower engine, are supplied with two of these cranes, and by their use the manipulation of the heavy masses of steel has been greatly simplified, while the cranes also greatly facilitate the rapid mounting and dismounting of the rolling-mill rollers. When it is desired to handle more than 22 tons the two large hooks of the two cranes are coupled together, and perfect regularity of operation is insured, as the lifting speeds of the two cranes are the same. Small hooks are also provided on these cranes, which have speeds five times as great as the large hooks, and these are used for handling ingots and small loads under two tons.

At the Siemens-Martin steel foundry the main hoist or winch operated electrically has a capacity of 30 tons. There are also six electric winches or capstans for small loads, installed at various points of the works. An inclined elevator, provided for lifting mineral, coke, etc., for the blast furnaces after its delivery from the canal and railway, is driven by an electric motor and lifts 10 tons a distance of about 35 feet.

In the main rolling or cogging mill the principal rolls are driven by the power from the 10,000-horsepower engine above referred to, but electric motors are extensively used for driving a large number of secondary rolls, and all of the smaller steam engines which were formerly used have been dispensed with. There are also a large number of reversible electric motors employed for driving the live rolls for facilitating the passage of the heavy steel bars backward and forward.

Electric motors are also now being employed for driving sets of drag chains. The rails or beams after being rolled to shape and cut to the proper length by circular saws are carried along by endless-chain drags. These chains are run in sets of three and are provided at intervals with blades which move along horizontally at a short distance above the ground, thus sweeping along the rails and beams. One of these motor outfits used for driving a set of drag chains is shown in Fig. 5.

A 40-horsepower motor is employed for driving a special machine for removing the blocks from one set of rolling mills to the others.

The total number of arc lamps installed is about 240, each of which takes from eight to 10 amperes. They are connected three in series across the 125-volt circuits, and also at distant parts of the works in series of five or six lamps on the 250-volt mains. It is said that the several circuits of various pressures tend in this way to reduce the first cost of installation to a minimum. There are also used about the works more than 400 incandescent lamps of 16 candlepower each, as well as numerous electric motors for driving machine tools in various parts of the works, such as planers, lathes, drills and shearing and punching machines.

Among the many advantages given by the engineers as gained by the use of electric power at the steel plant are, the largely increased output, owing to the ease and speed of working, quick starting, stopping and reversing, which can be effected by an unskilled attendant at the controller; doing away with the large number of attendants required to look after various engines, boilers, line shafting, etc., replaced; saving in fuel from use of blast-furnace gases for driving engines and generator sets at power station; dispensing with large numbers of engines, boilers, piping, etc., of low economy. By the introduction of electricity a large number of hydraulic and compressed-air machines are replaced, and this class of machinery reduced to a minimum, while the moving of heavy masses of hot metal by electric appliances dispenses with much hand labor and the work is carried out far more expeditiously.

It is said that in the production of 100 tons of pig iron, 2,000 horsepower of energy can be obtained by using the waste gases in large engines, and that for electrical power-transmission purposes 30,000 horsepower or more could be obtained from the Liège district alone.

A technical commission under the direction of H. Hubert, engineering director of mines and professor of the University of Liège, carried out a series of tests on a powerful blast-furnace gas engine of 200 horsepower, which has been operating since 1898, at the Cockerill works, Seraing. The current generated by the dynamo driven by this engine was used for operating motors, and the test lasted several days, and established the best working conditions and admissible overload for the engine. The test showed the consumption of gas when the engine was running at full load to be 3,113 cubic millimeters per horsepower-hour, the coke used having a calorific value of 997 calories.

It was found by the test, taking into account the respective efficiencies and output of engine and generator, that a comparison of the power developed by the explosion of gas in the cylinder with the power available at the terminals of the dynamo gives an actual heat efficiency of 21 per cent. for the combination; while the best modern steam engines seldom show more than 10 per cent. of the calorific power of the fuel burnt in the boiler furnace.

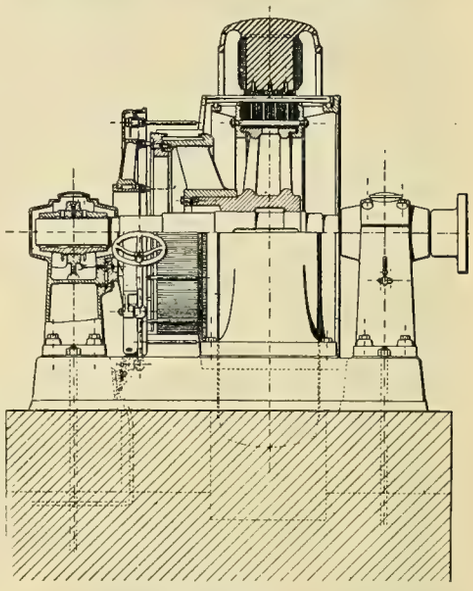


FIG. 3. ELECTRICAL EQUIPMENT IN BELGIAN BLAST FURNACES.—GAS-ENGINE-DRIVEN GENERATOR.

At the Ougree blast furnaces the electric locomotives are especially useful, as the furnaces are nearly 1,300 yards from the steel furnaces, which are in turn a considerable distance from the rolling mills. It is highly important that the metal should not be allowed to cool down when once heated until it has passed from the finishing rolls as a completed bar or rail. One of the electric locomotives used at this iron and steel works is used for hauling the 20-ton steel ladle to and from the Siemens-Martin furnace and is illustrated in Fig. 1. It is fitted with a 37-horsepower motor which has a speed of travel of 190 feet a minute.

The diagram shown in Fig. 6 illustrates a method employed for supplying the necessary current to the locomotive, instead of a slot conduit, third rail or trolley, which cannot be used on account of the close proximity to the steel furnaces and the little headroom which is available. The double insulated cable (AB) serves to convey the current from the mains (I) and (J) to the locomotive. This is done by means of a drum (C), around which the flexible cable is coiled as the locomotive travels in the direction of the arrow. There are two brushes (D) and (E) which press on gun-metal rings that are connected to the end of the cable attached to the drum. The counterweight (H) prevents the cable from dragging along the floor.

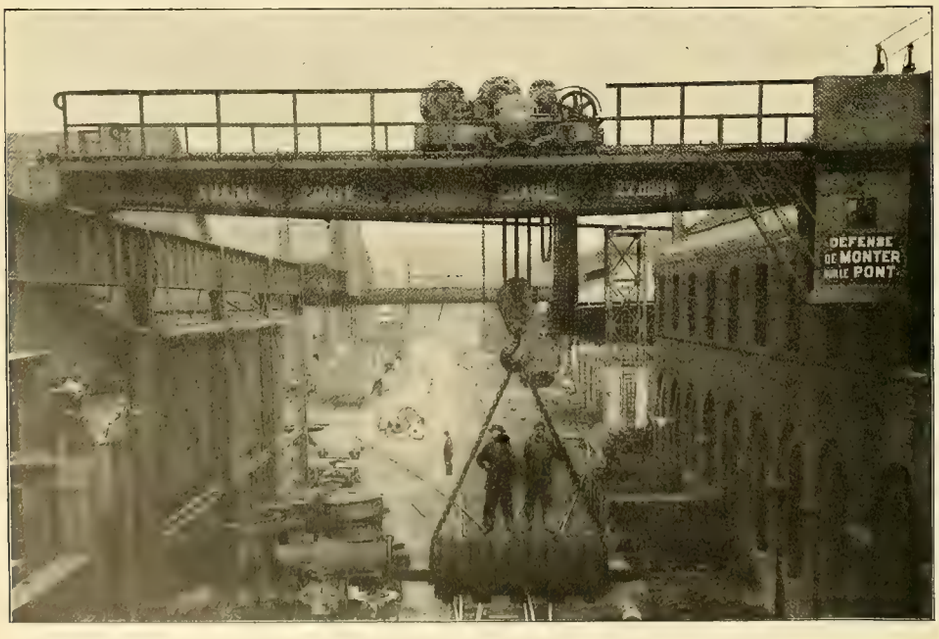


FIG. 4. ELECTRICAL EQUIPMENT IN BELGIAN BLAST FURNACES.—FOUR-MOTOR TRAVELING CRANE.

The commissioner of patents has affirmed, on appeal, the decision of the examiner of trade-marks, refusing to Stilson Hutchins of Washington, D. C., registration for the word "Telegraphone" as a trademark for apparatus for recording and reproducing sounds, signals, and the like. Registration was refused on the grounds that the word was descriptive, and therefore it was unnecessary to dicuss any further reasons for refusal.

New Electric Furnaces.

Among the United States patents issued on August 5th that are of interest to the electrical world, are three on electrical furnaces. One of these patents (Fig. 1) was granted to Edward R. Taylor, Penn Yan, N. Y. It is an improvement on an electric furnace and relates primarily to the production of bisulfide of carbon by a continuous process, although other features are interesting.

A leading object of the invention is to provide

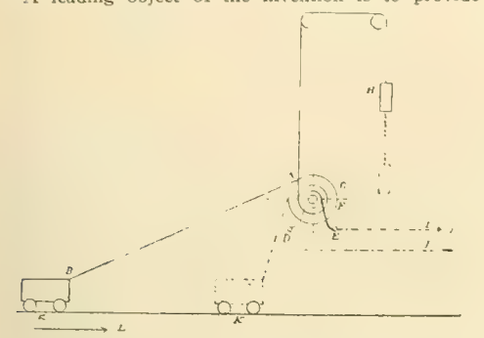


FIG. 6. BELGIAN BLAST FURNACES.—MEANS OF CONVEYING CURRENT TO ELECTRIC LOCOMOTIVE.

an electric furnace with self-renewing electrodes adapted to perpetuate themselves in the continuously working furnace and to feed themselves by gravity. Another object is to fuse within the furnace and to discharge in fused condition the residue from the carbon and sulphur in the process of making bisulphide of carbon and like difficultly fusible materials that are liable to accumulate in the bottom of the working chamber of an electric furnace.

Fig. 1 is a vertical section of the improved furnace, showing it charged and in operation. The furnace has some preferred features of construction and mode of operation. These features comprise a preferred upright or stack form, with three diameters at successive heights, as shown in Fig. 1; an iron shell (3) common to all; a chambered refractory lining (4) or firebrick or its equivalent, extending upward to a sufficient extent above the top of the body (b); stuffing boxes (5) in diametrically opposite pairs on the shell (3), through which insulated conductors, two of which (d) and (e)

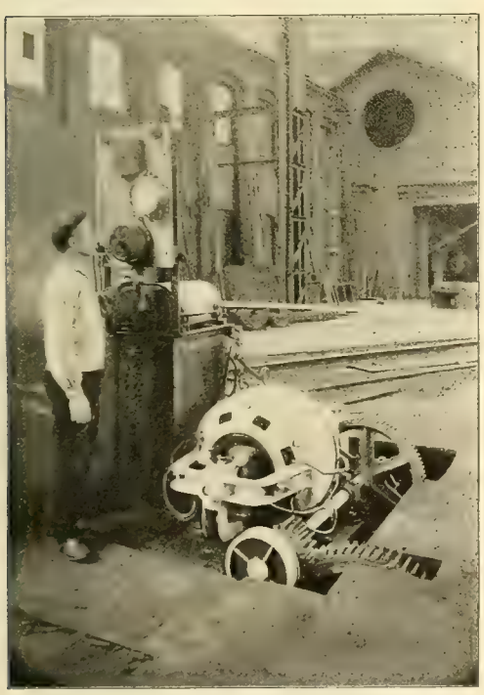


FIG. 5. ELECTRICAL EQUIPMENT IN BELGIAN BLAST FURNACES.—MOTOR OPERATING DRAG CHAINS.

extend into the furnace from a suitable generator of electricity; suitable insulation (6) between the shell (3) and lining (4) throughout; a central working chamber (7) within the base (a); a commodious feeding chamber (8), extending downwardly to the working chamber and in free communication with it; an inlet (h) to the feeding chamber through the dome (c); passages or spaces concentric with the feeding and working chambers and with each other, within the firebrick lining of the walls; hoppers provided with plugs, which respectively open and close the inlets into these spaces for the admission of fusible material for a given reaction or reduction; a cap (k) to open and close the inlet (h) into the dome (c) for the material, and an outlet (l) leading from the dome for the discharge of gaseous material. The shoulder (1) of the furnace is also provided with hoppers (m), above the several stuffing boxes (5), provided with plugs (17) for the admission of fragmentary conductive material adapted to constitute self-renewing electrodes in the working furnace, as represented at (D) and (E), and passages (n) extend downwardly from the inlets within the brickwork of the base (a).

Conduits (o), constructed of conductive material, are arranged in continuation of the passages (n) within the brickwork of the base (a), and electrically attached to the several conductors.

To prevent or resist the passage of the electric current directly from side to side of the furnace or to aid in thus confining the current to the electrodes at this point protective walls (q), Fig. 1, of non-conductive material, such as firebrick, are interposed betwen the several conduits (o) and the middle of the furnace.

Feeding themselves by gravity, the electrodes (D) (E) descend into the bottom of the working chamber from the outlets of the conduits (o) and flow toward each other, as represented in Fig. 1, being naturally thinnest where they come together, and thus affording the necessary resistance at this point to convert the electricity into heat. The heat zone of the furnace is thus located at the bottom.

(A) and (B), Fig. 1, represent, respectively, the carbon, such as charcoal or coke, and the crushed sulphur for the bisulphide-of-carbon reaction. The introduction of the carbon into the working furnace is made possibile owing to the fact that the calcium-carbide charge becomes conductive in operation, owing to the fact of its high temperature.

The furnace or crucible (a) is preferably constructed with a lining (x) of carbon on the bottom and around the sides, the whole of which can be removed with each charge as it is complete.

The last of the three patents was granted to August Voelker, Cologne, Germany. It pertains to an electrical furnace (Fig. 3), for melting glass and producing water-glass. It is characterized by inclined radiating passages in which melting is effected by the heat of electric arcs produced by electrodes arranged in them, these passages leading to a common refining receptacle, in which the material is heated by the heat resulting from electrical resistance.

The materials for forming the glass are fed by a worm conveyor (b) to four tubes (c), which lead into inclined radial passages over what may be termed the "hearth" (a). The materials are melted by the heat of arcs produced by electrodes (d), arranged in each passage, and also by arcs of electric candles (e) of the Jablochkoff kind. The passages are formed in four refractory blocks (f) and are covered by slabs (g). The molten materials flow

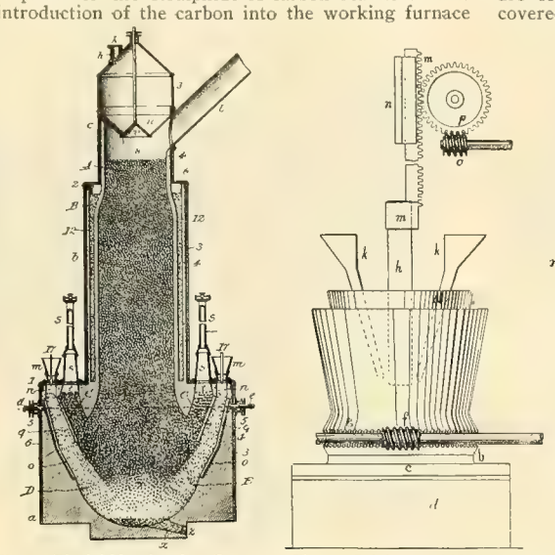


Fig. 1. Bisulphide-of-carbon Furnace.

Fig. 2. Calcium-carbide Furnace.

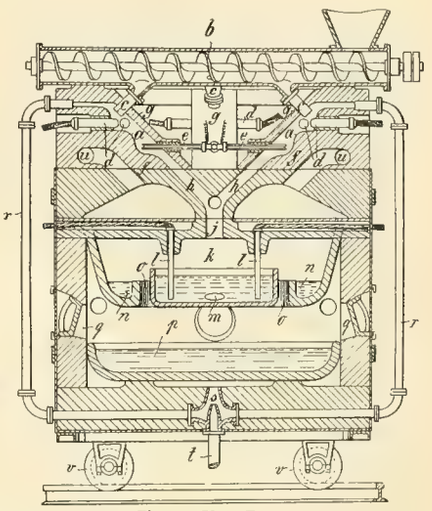


Fig. 3. Glass Furnace.

NEW ELECTRIC FURNACES.

is conveniently facilitated by a hopper and bell (u) (v) within the dome (c) above the gas outlet (l). The crushed sulphur introduced is fused by heat of the furnace that would otherwise be lost by radiation, and descends by gravity toward the heat zone, where it is vaporized simultaneously with the heating of the carbon, and the reaction is thus continuously effected.

The second patent was granted to Arthur Parker, Chorley, England, and relates more particularly to electric furnaces for producing carbides of the alkaline-earth metals, such as calcium carbide. It consists, essentially, in a special construction of the furnace or crucible with a rotary or revolving movement, so as to bring every part of the bottom in turn under the positive carbon, which is preferably made of rectangular oblong shape in cross-section.

Fig. 2 is a front elevation. The crucible (a) is mounted or supported upon a platform or structure (b), capable of rotating about its vertical axis on the fixed or stationary bed or foundation plates (c), which are firmly secured to and suitably insulated upon the supporting blocks or pillars (d). The platform (b), which supports the crucible (a), is held in position by a recessed base (e), the foundation plate (c) being made in two or more parts or sections, and secured in position around the base (e), and it is rotated by a worm (f) gearing with the toothed wheel (g), formed around or attached to the base. By this or other mechanism the crucible (a) is slowly rotated about its vertical axis. The platform (b) is formed with hollow sides (b'), forming a water jacket for the purpose of keeping the platform cool. The carbon (h) is oblong in cross-section, either rectangular or oval, so as to extend across the crucible (a) in one direction and leave sufficient room at the sides for the material to fall in from the hoppers or chutes (k). The carbon (h) is fitted to a sliding rack or frame (m), capable of moving up and down in a slide (n). When in operation, it is slowly moved upward by the worm (o) and worm-toothed wheel (p) as the material fills up the crucible.

The powdered material to be fused is fed into the crucible (a) from the hoppers or chutes (k) in a thin stream through mica or other suitable tubes arranged to direct the material so that it shall fall into or through the arc, and thus become fused before reaching the crucible itself. In addition to this, the rotation of the crucible (a) brings all the material in it successively over and over again into the range of the arc. The arc is struck between the positive carbon and whatever material may be in the crucible, and not between the positive carbon and the crucible through the material. The carbon (h) does not, therefore, come into contact with the material throughout the whole operation. This down the inclined channels (h), which meet in a central channel (j), and thence they flow into the refining pot (k), in which when fine glass is to be produced refining is effected by the heat caused by resistance between two electrodes (l), which can be led in by earthenware pipes and supplied with continuous or alternating electric currents. From (k) the fluid glass flows by openings (m) into the annular trough (n), and thence, overflowing, descends by passages (o) into the basin (p), from which it is worked by tools through the working doors (q), or the basin may be so arranged that it can be emptied by tipping. The combustible gases evolved in the passages, which cannot descend because the outlet (j) is closed by the molten material, are conducted by pipes (r) to a burner (s), where they meet with air entering by a pipe (t). The flame from this burner serves to maintain the heat of the working-out basin (p) and its contents. Such incombustible gases as are evolved pass away by channels (u). The furnace is preferably mounted on wheels (v), so that it can be readily moved from place to place, and its outer walls are enclosed in metal casing.

Large Engine for London Metropolitan Railway.

The Sulzer Company of Winterthur, Switzerland, has recently finished an engine of very large dimensions which has been ordered for the central station of the London Metropolitan railway. It has a capacity of 5,000 horsepower and is of the vertical-compound type, with a special arrangement of valve distribution. The normal power is rated at 5,000 horsepower, with a maximum of 7,000. It is to drive a dynamo of 3,500 kilowatts. The engine is designed to work either with or without condensation. Two governors are used, one of which brings the engine to a stop when the limit of speed is exceeded. Oil pumps are used to lubricate the cylinder, and the other portions have an oil-circulating system. The oil which descends is collected in a reservoir cast into the bedplate, and from there it passes to the filter and into a cooling box; the pumps then lift it to an upper tank, from which a set of small tubes feed the different points. The engine is to be supplied by nine or 10 boilers of 260 square yards heating surface each, working at 11 atmospheres. The principal data are as follows: High-pressure cylinder diameter, 51 inches; low-pressure cylinder diameter, 72 inches; stroke, 52 inches; revolutions per minute, 75; total weight with alternator, 498 tons. The parts of the engine are to be transported on 40 railroad cars.

Recent Developments in Space Telegraphy.

It is understood that Major Scriven, acting chief signal officer of the United States Army, who will be in charge of the coast signal stations during the Long Island army and navy maneuvers in September, will use the Marconi system of wireless telegraphy. He has made additional contracts for the use of that company's instruments. Stations will be established for the transmission of strategic information at Block Island, Gardiner's Island, and probably at the army headquarters at Fort Trumbull, Conn.

Colonel H. H. C. Dunwoody of the Signal Corps, Department of the East, United States Army, has informed the De Forest Wireless Telegraph Company that its bid for the installation of wireless stations connecting Fort Wadsworth and Fort Hancock, has been accepted. It is stated that these systems will probably supplant the present cable service connecting these forts. Fort Wadsworth is situated at the Narrows, on Staten Island, and Fort Hancock is on Sandy Hook, N. J., 10 miles distant. These and other forts in the vicinity, it is said, may also be connected by space-telegraphy systems with the headquarters on Governors Island.

The Marconi Wireless Telegraph Company is erecting a pole 160 feet in length on the Crescent near Babylon, N. Y., for a new station. The pole weighs nine tons and is in three sections. It is of Oregon pine and has a diameter of two feet at the base. The pole will occupy a site overlooking Sumpawams River. The station will be for the instruction of operators, and will be kept open day and night, and will operate with the one at Sagaponac. J. J. Leary, formerly in charge of the latter station, is superintendent of the one at Babylon.

The De Forest Wireless Telegraph Company has begun suit against the Marconi Wireless Telegraph Company of America for $1,000,000 damages for losses alleged to have been suffered by the former company through the publication in various newspapers of an article said to have been inspired by the Marconi company's brokers to the effect that the Marconi company is the sole owner of all patents for wireless telegraphy in the United States, and would proceed against other concerns using wireless telegraphy.

English shipping papers make the statement that a plan is on foot to establish a space-telegraphy station 110 miles west of the Lizard. A ship is to be anchored there equipped with Marconi apparatus and a powerful searchlight. With the light illuminating the sky, this vessel can be "picked up" at night from a distance of 60 miles. Being situated as proposed, right in the course of all in-coming and out-going vessels, it is expected that great commercial advantage will be derived from the distribution of orders sent from the shore by owners. Thus a ship from the south or west, on reaching this station, could be directed to proceed up either the English, Bristol, or St. George's Channel, without delay, thus avoiding pilotage and port dues, to say nothing of the waste of time. As a reporting station, to be approached in any state of weather, for transmitting important information, this floating wireless office will be of great advantage. The terms on which this station is to operate are as yet unknown, but as the enterprise is a private one and not governmental, no doubt a service rendered will be duly charged for.

A space-telegraphy system was sucessfully operated by the Navy Department on August 8th, between stations in the Washnigton Navy Yard and at the Naval Academy at Annapolis, a distance of about 25 miles. The masts used were 150 feet high and the instruments used were of French manufacture, of the Rocheford type. This experiment was preliminary to the competitive tests of wireless systems that are to be made with the object of ascertaining the best system for installation on ships of the United States Navy. Lieutenant John M. Hudgins of the Bureau of Equipment was recently sent abroad at the suggestion of Rear Admiral R. B. Bradford, chief of the bureau, to inspect and purchase sets of foreign wireless-telegraph instruments to be used in the tests. Lieutenant Hudgins returned with duplicate instruments of the Rocheford and Ducretet systems, both French, and the Braun-Siemens & Halske systems. They will be tested in the order named. A board of officers will be appointed to witness and report upon the tests, and the various systems will be tried at sea upon warships before a final conclusion is reached.

In the August 2d issue of the Western Electrician mention was made of the Postal Telegraph-cable Company having made arrangements with the Marconi concern for transmission of wireless messages from its station at Sagaponack, L. I., to vessels going out and coming in. Since the ratification of the deal, many of the big liners have been equipped with apparatus and many more are installing it. The service is somewhat expensive, and, of course, will appeal to those who like luxuries. A message of 10 words, it is said, will cost $2, with additional words at the rate of 12 cents each. A large business is expected by the Marconi station, and its anticipations will no doubt be realized.

An action has been commenced in the United States courts by the Marconi Wireless Telegraph Company of America against the De Forest Wireless Telegraph Company, asking that the latter company be enjoined from alleged infringement on the Marconi company's rights. An accounting is also asked. It is alleged that but for the defendant company the complainant would have made large profits.

Marconi Space-telegraph Station at Cape Breton.

The Cape Breton station that is to be used for the transmission of Marconi space-telegraphy messages across the Atlantic is rapidly nearing completion. The station is located at Glace Bay, Cape Breton, on a promontory of land 70 feet above mean water. The plant, as shown in Fig. 1, consists of

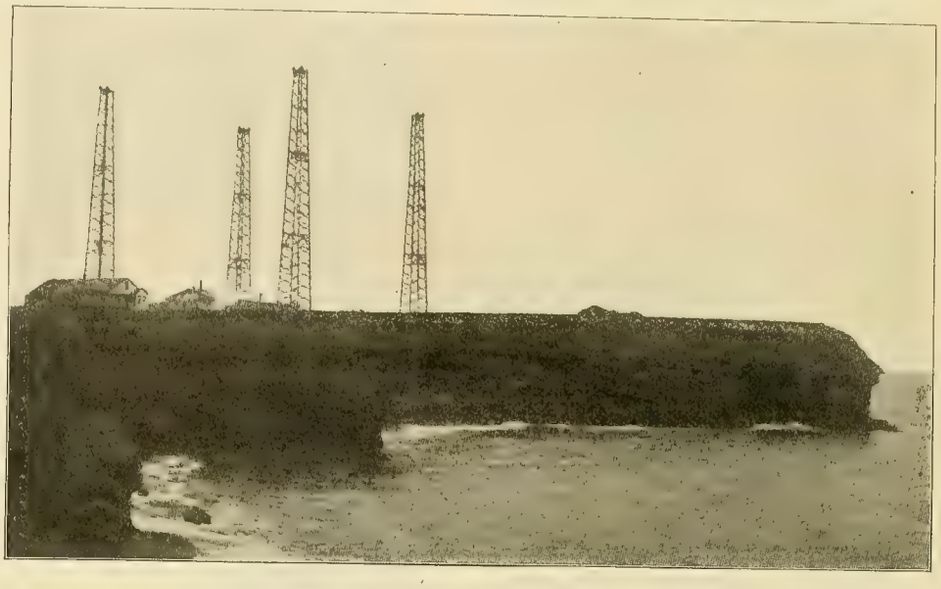


FIG. 1. MARCONI SPACE-TELEGRAPH STATION AT CAPE BRETON.

four huge towers for carrying the vertical wires, and a group of one-story buildings arranged at the base of the towers in which is contained the powerful electrical plant which has been specially constructed for the station.

The following description of the towers is given by the Scientific American: The necessary height for the vertical wires has been attained by the erection of four braced wooden towers, each 215 feet high, at the four corners of a square which measures about 200 feet on a side. Each tower consists of four legs, built up of three by 12-inch plank, the

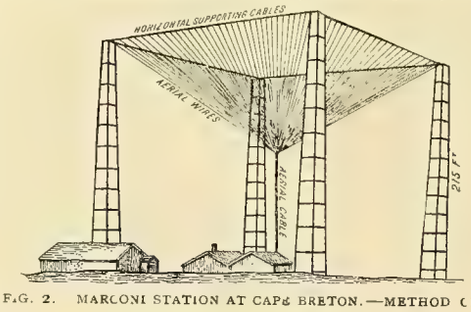


FIG. 2. MARCONI STATION AT CAPE BRETON.—METHOD OF CARRYING AERIAL WIRES.

legs being braced together on each face of the tower by three by nine-inch braces. The planking of which the legs are built is laid up so as to break joints as much as possible and secure the approximate strength of a solid 12 by 12-inch stick. The legs are spaced 30 feet from center to center at the base and nine feet from center to center at the top platforms. The foundation of each tower consists of a mass of concrete formed in a hollow square, in which are embedded the 12 by 12-inch sills and the first panels of the lateral bracing. In section this concrete mass is six feet in width by eight feet in depth, the external dimensions of the foundation being 36 by 36 feet, and the internal dimensions 24 by 24 feet.

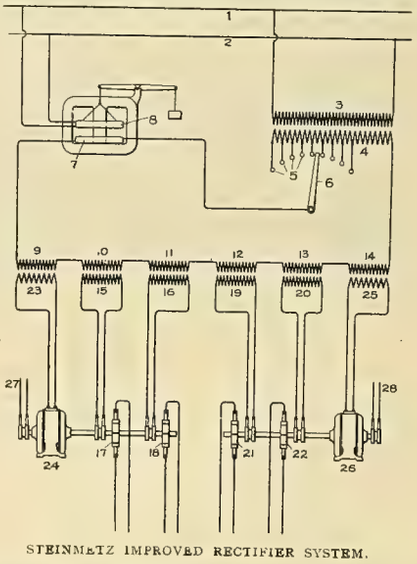
The towers are tied in such a way that the stress on each tower will be transmitted directly to its own set of cables, every one of which will be doing useful work. The wires are carried from three points on the towers (the lower and upper third and the summit), all wires having an inclination of 45 degrees. The ropes are all made of the best plow steel, the majority of them being 2½ inches, and a few three inches. The method of carrying the aerial wires upon the structure is as follows: Four three-inch cables are strung from platform to platform at the top of the towers, as shown in the diagram (Fig. 2), and from these cables depend 150 aerial wires. These are drawn together and united in the center of the tower into a single cable, which descends vertically to enter the transmitting and receiving house below. The average length of the aerial wires before they meet in the common central cable is about 140 feet.

The power of the new installation is said to be far greater than would be demanded for transmission to Europe, and it is announced that before the close of the present year messages may be sent direct from Cape Breton or Cape Cod, Mass., to Cape Town, South Africa. It is expected that Mr. Vyvyan, engineer in charge of the erection of the Marconi station at Glace Bay, after he has placed the station in operation, will leave for South Africa, where he will superintend the erection of a wireless station at Cape Town. The plan of the Marconi company is to establish, as soon as possible, a chain of long-distance wireless stations in different parts of the world. Within a year, it is expected, there will be one station in Canada, two in the United States, one in Central America or the West Indies, one in South Africa, and one on the continent of Europe, besides the present one at Poldhu, England.

Steinmetz Improved Rectifier System.

Constant-current circuits feeding arc lights or the like are frequently supplied with current through rectifiers connected to suitable sources of alternating current. In stations employing systems of this character it is usual to find a number of rectifiers each fed from a separate source of constant current—such, for example, as a constant-current transformer either of the three-phase or quarter-phase type. This arrangement involves the inconvenience of operating a considerable number of transformers, the increased expense of the apparatus, a larger floor space, decreased efficiency, etc.

Charles P. Steinmetz of Schenectady, N. Y., has devised a system of obviating these and other objections by making use of one large source of constant current to supply current for all of the rectifiers of the station, or, at least, a group of rectifiers, and to feed each individual rectifier from the secondary of a transformer, the primary winding of which is in series with the primary windings of the



STEINMETZ IMPROVED RECTIFIER SYSTEM.

companion transformers and in circuit with the source of constant current.

His invention, which is covered by a patent (No. 706,123) issued August 5th, is indicated in the accompanying drawing.

Constant-potential supply mains are indicated at (1) (2), and across these mains is connected the primary (3) of a transformer of the constant-potential type, having a secondary winding (4), from points in the length of which extend taps (5). A switch arm (6) or other appropriate contact-making device is adapted to make connection with any one

of the taps (5). The secondary (4) is connected in series with the secondary winding (7) of a constant-current transformer, the primary winding (8) of which is connected across the mains (1) (2).

The constant-current circuit, including the two secondaries (4) (7), leads to and passes through a number of transformers (9) to (14) of the constant-potential type. Some of these transformers are arranged so as to feed rectifiers, as at (17), (18), (21) and (22), while others are used for supplying current to a synchronous motor or motors, as at (24) and (26), for driving the rectifiers. The fields of the motors are to be excited by direct current obtained from any suitable source.

In the operation of the apparatus described the constant current in the main supply circuit is obtained by the conjoint regulating action of the two transformers whose secondaries (4) and (7) are in series with each other, as shown. For large variations in load, the regulating switch (6) is moved so as to bring the current within an approximation of constancy, whereupon the constant-current transformer comes into operation and by means of relative motion between its primary and secondary windings (8) (7) automatically brings the current to its normal value. The switch arm (6) may be operated by an attendant and should be moved so that the movable coil or coils of the constant-current regulating device should be brought to some intermediate position in their regulating stroke or strokes. Automatic regulation for the smaller variations from normal current will be then taken care of by the constant-current device.

The system thus described possesses many advantages, among which is that of steadier operation, since each individual lamp or even circuit is a lesser part of the system than is the case where each circuit is fed from its own source of supply. Furthermore, the synchronous motor or motors being operated by the total current of the system will be less liable to hunt, due to the greater steadiness of this current, thereby avoiding serious difficulties with the commutating action of the rectifiers.

Power Stations of the Boston Elevated Railway.

The surface and elevated-railway lines in Boston, Mass., included under the corporate management of the Boston Elevated Railway Company, are furnished motive power from eight power stations, viz., the Central, Harvard, Lincoln, Dorchester, Allston, Charlestown, East Cambridge and East Boston stations. These stations, as will be seen, are quite widely distributed, although all are operated in parallel, except the East Boston station. At the Charlestown station, the first of two large power units was recently installed. In order to accommodate this unit, an addition to the original power house was necessary, and considerable credit is due the Boston Elevated Railway Company for the general appearance (Fig. 1) of the completed design and the harmonious blending of two radically different types of architecture.

The Charlestown station is located near the Sullivan Square terminal of the Boston Elevated railway, at a point where water sufficient for condensing purposes can easily be obtained. The equipment of the old station consists of three 500-horsepower boilers of the Babcock & Wilcox type, and two horizontal cross-compound Allis engines rated at 1,000 horsepower each. These engines are direct-connected to multipolar generators of 800 kilowatts' capacity.

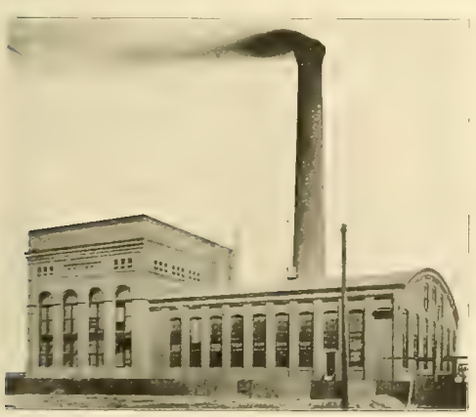


FIG. 1. CHARLESTOWN POWER STATION OF BOSTON ELEVATED RAILWAY.

In order to take care of the largely increased demands of the public service, it was found necessary to enlarge the power equipment at Charlestown, and it was determined to install an engine of sufficient size and stability to meet at all times the severe demands of high-class service under the existing conditions. A Westinghouse vertical cross-compound engine was chosen, the order being placed through the Boston office of Westinghouse, Church, Kerr & Co. This engine, shown in Fig. 2, has two cylinders, 44 and 87 inches in diameter, with a 60-inch stroke, and runs at 75 revolutions a minute. It is given a nominal rating of 4,500 horsepower, using steam at 160 pounds' initial pressure, with a vacuum of 26 inches, and has an ultimate capacity somewhat exceeding 7,000 horsepower.

The high-pressure cylinder is fitted with poppet valves for use with superheated steam, and the low-pressure cylinder with a Corliss valve gear of Westinghouse design. The cast-steel flywheel is 28 feet in diameter, with a 26-inch face, and weighs 150,000 pounds. The shaft is of hydraulically forged steel, 37 inches in diameter, with an 18-inch hole in the center. The total weight of the complete engine is, approximately, 1,125,000 pounds.

The armature of a Westinghouse direct-current generator is carried on the main shaft between the high and low-pressure cylinders. This is one of the four largest direct-current railway generators in New England. It is a 24-pole machine of 2,700 kilowatts' capacity. The commutator and armature are 12 and 15 feet in diameter, respectively, and the total weight of the generator is about 338,000 pounds.

An interesting feature of the switchboard installation, which was also designed by the Westinghouse company, is to be found in connection with the circuit-breakers, which can be thrown out from any portion of the building by means of electric buttons.

The condensing system includes two Allis condensers for the small engines built by the Allis company, and a Bulkley jet condenser for use with the new engine.

The capacity of the boiler room has been increased by adding four 500-horsepower boilers of the Babcock & Wilcox type, built by the Aultman & Taylor Company of Mansfield, Ohio. Coal is supplied to the power house direct by rail and loaded from cars into overhead hoppers, although the power house is located so that coal can be brought by either water or rail. The boilers are equipped with Green fuel economizers, arranged in the usual manner, with by-pass flues for leading the gases direct to the stack, should occasion require. The method employed for the removal of ashes is of particular interest. The overflow from the condensers and pumps is carried through trenches, which pass under the ashpits of the boilers. The ashes can be dumped at will into these trenches and are carried off with the overflow to flats or meadows, which are being filled and enclosed.

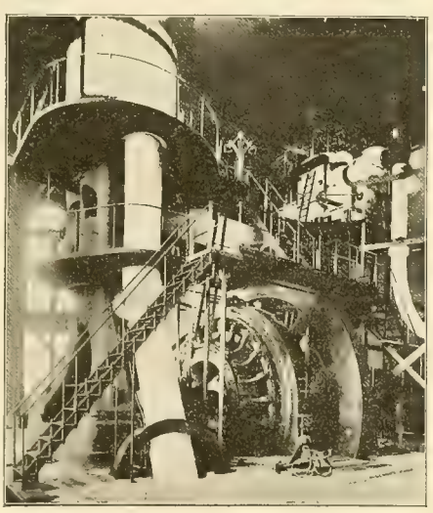


FIG. 2. POWER STATIONS OF BOSTON ELEVATED RAILWAY. —4,500-HORSEPOWER GENERATING UNIT.

The Lincoln station of the Boston Elevated railway differs in many respects from the various other power stations of the company. It is the most recent addition to Boston's numerous electrical power plants and is located on the lot known for many years as Lincoln Wharf, where there are excellent facilities for the docking of coal and other supplies. The general appearance of the building (Fig. 3) is imposing, the architectural design being notably fine. The massive chimney, extending to a height of 250 feet, and one of the first things to catch the eye, is said to be the tallest stack in the city. The building is divided into two longitudinal sections, the boiler room and all apparatus pertaining thereto being in one section and the engines, generators and condensing system in the other. The engine room is served by a large electric crane of 40 tons' capacity. The walls of this room are faced with white-enamel brick, adding much to its general appearance and illumination.

The present station contains three units, aggregating about 13,500 horsepower. While it is now complete in itself, ample ground area has been provided for the extension of the building and plant on harmonious lines to accommodate four additional units, thus permitting an ultimate equipment of about 30,000 horsepower.

The boiler installation consists of eight 468-horsepower and four 490-horsepower Babcock & Wilcox boilers. An equipment of Roney mechanical stokers of the same type as those in the large power houses in New York city, has been installed by Westinghouse, Church, Kerr & Co.

Coal will be automatically unloaded from vessels and stored in a large pocket holding 5,000 tons, with a further storage bin of 3,000 tons in the boiler house, or a total storage capacity of 8,000 tons. It is carried to the boilers by a Hunt coal and ash-conveying system, which conducts the coal into overhead conveyors, leading to the stokers, thus practically eliminating all manual labor in the handling of coal and ashes. The coal apparatus is so arranged that coal can be taken from the pocket to the storage bin in the boiler house and, in addition, tracks are located on either side, so that coal cars can be automatically loaded to carry coal to the various other stations if desirable, viz., to the Charlestown, Harvard, Allston and central stations, as well as to some 30 or more car houses situated in different parts of the city. The plant is equipped with Green fuel economizers.

FIG. 3. LINCOLN POWER STATION OF BOSTON ELEVATED RAILWAY.

Feed water is supplied to the boilers by means of two vertical compound Blake pumps. A Star vacuum feed-water heater of 8,000-horsepower capacity is placed on the base of the chimney, conveniently near the feed pumps. As the smoke flues from the boilers enter the stack at a point some 30 feet from the boiler-room floor, the space in the lower part of the stack has been found quite valuable for the location of such auxiliaries as feed-water heaters, receiver of the Holly gravity-return system and sundry piping.

The original engine installation consisted of two vertical cross-compound units of 4,500 horsepower each, built by the Providence Engineering Company. The generators and flywheels are carried on the shafts between the high-pressure and low-pressure sides. The generators are direct-current machines, rated at 2,700 kilowatts each. A third unit, which has just been completed, consists of a vertical cross-compound engine of about 4,500 horsepower, designed and built by the Westinghouse Machine Company and installed by Westinghouse, Church, Kerr & Co. It is of the same design as the one furnished for the Charlestown power station (Fig. 2), and is direct-connected to a Westinghouse direct-current generator of 2,700 kilowatts' capacity of the same make, and similar to one of the two machines mentioned above.

Ingersoll-Sergeant air compressors, each driven by a 50-horsepower Westinghouse 500-volt motor, supply compressed air for the block-signal and switching system, used by this road. Early in the conception of the scheme of running trains at high speed under the rather complex conditions existing there, the engineers of the Boston Elevated railway realized that a block system was necessary as a safeguard against accident. After careful consideration, the Westinghouse electro-pneumatic interlocking system manufactured by the Union Switch and Signal Company of Swissvale, Pa., was chosen, on account of the quality and reliability of the material furnished and the small space required for switch towers, signals and operating mechanism.

The elevated road includes some 14 miles of trackage. The switches and signals are controlled from four switch towers, and the automatic block signals are located at distances of about 800 feet apart. Each tower is supplied with indicators, showing the approach of trains. The towers at the junctions of the Atlantic circuit and main line control some 1,200 elevated trains daily. The largest tower is located at the Sullivan Square terminal, where some 500 elevated trains and 700 surface cars pass in and out daily, involving 6,000 switch and signal movements. A force of only two men on duty is required to operate the switchboard mechanism, consisting of 35 pneumatic levers. The terminals are also supplied with lamp indicators, showing the relative location of approaching trains. While the train movements at Sullivan Square are not so complicated as those at the Boston South Terminal Railway Station, the elevated-railway company has less trackroom at its disposal and handles a much larger number of trains for a given number of tracks.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electrical Equipment in Belgian Blast Furnaces. By Frank C. Perkins. Illustrated	101, 102, 103
New Electric Furnaces. Illustrated	103
Large Engine for London Metropolitan Railway	103
Recent Developments in Space Telegraphy	104
Marconi Space-telegraph Station at Cape Breton. Illustrated	104
Steinmetz Improved Rectifier System. Illustrated	104, 105
Power Stations of the Boston Elevated Railway. Illustrated.	105
Editorial	106
Transposition of Alternating-current Lines	107
The Pacific Cable Assured	107
High-speed Tests Proposed on Aurora-Chicago Electric Railway	107
Progress of the Bay Counties' Power Company	107
Sanitary District Asks Bids on Drainage-canal Dams	107
Sault Ste. Marie Waterpower Canal Finished	107
Development of the Telephone Field. Illustrated	108, 109
Composite Telephone and Telegraph System. Illustrated	108
Michigan Telephone Company's Affairs	108
American Bell Output	108
Telephone News from the Northwest	108
Ohio Telephone Notes	108
Southern Telephone Developments	108, 109
Telephone Progress in the Far West	109
Indiana Telephone Items	109
Detroit Co-operative Telephone Company's Plant	109
Des Moines Telephone Boycott Spreads	109
Independent Telephone Consolidation Proposed in Iowa	109
General Telephone News	109
Manufacturers and Dealers	109
Fessenden System of Space Telegraphy	109
Electrician Killed, But Plant Continued to Operate	109
Energy Loss in Commercial Insulating Materials When Subjected to High-potential Stress. By Charles Edward Skinner. Illustrated. Part II. (American Institute of Electrical Engineers.)	110, 111
Indianapolis Interurban Terminal Question	111
Two Wireless-telegraph Messages Read Simultaneously By L. DeForest. (Communication.)	111
American Union Electric Company	111
A Chapter of Accidents	111
United States Navy to Protect Haytian Cable	111
Prize for Wireless Transmission of Power	111
DEPARTMENTS.	
Correspondence	112, 113
New York Notes	112
New England News	112
Canadian Intelligence	112
From the Buckeye State	112, 113
Information from Indiana	113
Northwestern Notations	113
On the Pacific Slope	113
Personal	114
Electric Lighting	114
Electric Railways	114
Societies and Schools	114
Publications	114
Electrical Securities	114
Miscellaneous	114
Trade News	114, 115
Business	115
Illustrated Electrical Patent Record	115, 116

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

THE use of electrical and electrochemical action as an aid to agriculture is brought to the attention of the public from time to time by the announcement of some new method for which efficient results are claimed. During the last year several announcements of this sort have come from European experimenters. Perhaps the most systematic tests recorded were those carried out by a German investigator, Von Georg Heber, who obtained beneficial results by the following three distinct methods: Exposing wetted seeds for a long time to the action of a current of electricity; subjecting the young plants to the influence of static electricity, and traversing the soil containing the seeds by electrical currents. An account of these interesting experiments and their results was given in the Western Electrician of January 25th last.

Among the latest experiments are some credited to J. Fuchs, a wine producer of Elba, Germany. They relate particularly to the use of electricity in grape culture. He planted, some years ago, four fields with native grapevines, in the midst of a district infested with phylloxera, a small insect which does great damage to grapevines, especially in Europe, and treated two of these fields with "air electricity." The difference in the development of the grapes of the fields was apparent; those treated with electricity, it is stated, yielded better results, both in quantity and quality, and were not infected with phylloxera, while the other fields were.

Mr. Fuchs believes he has conclusively demonstrated that electricity increases the fertility of the soil. It is not sufficient to simply conduct "air electricity" to the earth, but there should be a direct metallic connection of the electric conduit with the main stem of the plant. On a field of about 2½ acres he erected five masts, the tops of which were supplied with an arrangement for accumulating atmospheric electricity. These latter devices were connected with each other by wires. Wires were laid in the soil about 1½ feet deep, forming an evenly distributed metallic net. Every accumulating apparatus was connected with this metallic net by a wire running along the mast. Short wires connected with the plants, the free ends being stuck into the stem or into the main root of the vines.

Such an arrangement is certainly ingenious, but it seems to be almost too complicated and expensive for efficient use in the general culture of plants. Its value with a permanently set field of plants, such as grapevines, however, might prove worth its installation.

AN important decision bearing on the relation between employes and officers as fellow servants of a telephone corporation has recently been handed down by the Court of Errors and Appeals of New Jersey, in the personal-injury case of Knutter against the New York and New Jersey Telephone Company. The party suing was a lineman in the employ of the company, and was injured while engaged in work with others, under the charge of a foreman. One of the other men was called the "district manager." He exercised general supervision and control of the others, including the foreman, and at the same time actively participated in the work. He had general charge of the business of the telephone company throughout a large territory, including the place where the work in question was in progress. In that territory he was intrusted with the hiring and discharge of the employes of the company, including the linemen. There was evidence tending to show that the injuries of the party suing were the direct result of negligence on the part of the district manager while he was co-operating with the party suing in the work, and at the same time was supervising and directing the work.

The court holds, reversing a judgment of the Supreme Court of the state, that the district manager was a fellow servant of the party suing, for whose negligence the common employer could not be held liable. It maintains that where there is negligence in the performance of some duty that is imposed by law upon the master for the safety of the injured servant, the master is responsible, irrespective of the rank of the negligent employe; but, where the negligence is in the performance or non-performance of some duty that is merely incidental to the general employment, the master is not responsible, although the negligent servant was superior in rank to him who was injured. For all purposes of throwing the wire over the limb upon which the party suing stood, the district manager was, to all intents and purposes, the court holds, a lineman, like the party suing. The circumstance that at other times he might have been called upon to perform duties that were "personal" to the master, in the sense that his negligence in their performance or non-performance would be chargeable to the employer, was immaterial upon this case.

It was argued that if the master in this case had been an individual, instead of a body corporate, and, being personally present, had pulled the wire negligently, causing injury to the party suing, he would be liable. The court says that this may be readily conceded. So, also, it may be granted that, if the district manager was negligent to the injury of the party suing, the former was liable. In either case the liability would be imposed upon the individual for his own negligence. This decision also has a bearing on any case in which an employe of an electric-light or railway company might be suing the company for injury inflicted through the agency of a co-worker or superior, and its conclusions are worthy of consideration.

CONSIDERABLE interest attaches to the announcement that high-speed tests are to be made over portions of the Aurora, Elgin and Chicago electric railway now nearing completion. The road extends from the western part of Chicago to Wheaton, Ill., with branches to Aurora and Elgin, and certain sections of the line offer exceptionably good opportunities for the operation of cars at very high speeds. After the road is placed in good working condition the company hopes to be able to maintain a scheduled speed of 55 miles an hour, including a stop every four miles. This, in itself, is an unusually high rate of speed to be attempted with electrically operated cars, and the outcome, should it be entirely successful, will add much to the ever-increasing prestige of the electric railway for interurban service.

However, plans are being made to carry on a series of tests over the road by which it is expected the scheduled speed will be greatly surpassed. The trials are to be in the hands of Mr. Potter, chief engineer of the General Electric Company, and it is said he is confident of attaining speeds of 100 miles an hour and over for short lengths of track. It would seem that certain features embodied in the construction of the Aurora-Chicago road are favorable to the making of such tests. The track construction is of the most thorough character and conforms closely to the best steam-road construction. Eighty-pound rails are used and the grades are very slight. The cars will receive their power through a heavy third rail.

In this connection it is interesting to consider briefly the results of the Berlin-Zossen tests in Germany last fall. Those tests were planned with the expectation that a speed of from 125 to 150 miles an hour would be attained. In this the tests were a failure, as the highest speed recorded was 99.4 miles, while the trials were only regarded as successful and satisfactory up to a speed of 81 miles an hour. Alternating polyphase current was used with overhead trolley contacts, and from a purely electrical point of view the experiments were successful. The chief difficulty lay in the fact that the track and ties were too light for such a strain, as the track began to give way and the side-swaying of the cars increased seriously at the high speeds. The rails used weighed only a little over 64 pounds to the yard and were laid on metal ties.

The conditions on the Aurora road are different and perhaps more favorable in that direct-current motors will be used, receiving their power through a third rail, and that the track construction is considerably heavier. The results of the tests together with the valuable data that will doubtless be obtained in regard to train resistance, acceleration, cost of operation, efficiency, etc., will be awaited with much interest by the engineering world. The practical operation of cars at such high speeds for passenger service, however, is another question, as few people will be found who care to travel faster than 60 miles an hour.

Transposition of Alternating-current Lines.

One of the questions brought up in the question box at the recent Cincinnati convention of the National Electric Light Association was: "What is the best practice regarding the transposition of high-potential alternating-current lines one to 15 miles in length?" The following instructive answer to the question was submitted by Dr. F. A. C. Perrine of Pittsfield, Mass.:

The transposition of any line, whether long or short, high or low potential is for the purpose of overcoming the evil effects of mutual electromagnetic induction. This mutual induction may result in interference with neighboring lines of the same class and character, or may result in interference with neighboring lines of an entirely different class, as, for example, many parallel lines running out from a station may act inductively on each other, the lines carrying high currents disturbing the potential on lines carrying low currents, and vice versa, or the lines from any station running parallel to telegraph or telephone lines may, by inducing current upon these neighboring lines, interfere with the apparatus connected with them. This mutual induction may be due to the electrostatic effect or the electromagnetic effect. So far as I am aware, no satisfactory cure has been effected of the electrostatic interference. The electromagnetic interference may be overcome by proper transpositions, and whether transpositions shall be placed in lines from one to 15 miles in length depends almost entirely upon the quality of current these lines are carrying and the proximity of other lines and the character of those other lines.

Telephone lines that run for one mile or more parallel to power lines are almost invariably seriously affected, and for these lines transportation should undoubtedly be introduced, either in the telephone lines themselves or in the adjoining power lines. The telegraph apparatus not being as sensitive as telephone apparatus, is not so readily affected, and the cases are rare where the interference is serious where the lines are parallel for distances less than four or five miles, and, indeed, the problem of properly doing away with mutual induction between power lines and grounded telegraph lines is one that has to be handled most carefully, since the ordinary method of transposition is generally unavailable to remedy the difficulty.

Power lines carrying less than 100 amperes do not ordinarily interfere with each other to a serious extent where they are run parallel for less than two or three miles, but for greater distances or greater currents they undoubtedly do interfere, and should be transposed. In one case that has been brought to my knowledge, where many lines carrying large currents were run out of the station for distribution to a city, being in parallel in some cases for not over 1,000 feet, the interference between the different power lines was so serious that pressure wires run back to the station gave no indication of the pressure at the terminals, since both the power lines themselves and the pressure wires were seriously affected by neighboring currents.

Finally, it must be called to your attention that transpositions carelessly done and without due regard to what a transposition is to effect, are of comparatively little value. I know of one line where the telephone circuit was transposed every eighth pole, and where not only was the telephone useless, but the bells burned out, although the power line was carrying only about 20 amperes. This trouble was remedied altogether by taking out these transpositions and putting in transpositions about one every 80 poles, but properly located in reference to the transpositions of the power line, which had not previously been taken into account. In order to lay out the transpositions of any line it is necessary to follow in direction and amount the field of force surrounding the line itself.

Single-phase lines are transposed simply as telephone lines by crossing them, since any two sections of equal length between which there is a cross have equal fields of force acting in opposite directions, and consequently neutralize each other. A barreling of a three-phase line rotates the field of force one-third of a revolution, and, in consequence, it is necessary to rotate the line twice before the individual equal sections neutralize each other, and in this case no two of the three equal sections between which there are transpositions neutralize, though the three are neutral when taken together in reference to any parallel line.

The four-wire two-phase line is only neutralized when there are three barrelings, and four sections of equal length and the three barrels divide the line into four sections of equal magnetic strength. These four sections neutralize each other in pairs, but no two neighboring sections neutralize. The first and third neutralize each other, and the second and fourth neutralize each other, but the first has no influence on the second or fourth, the second has no influence on the first or third, and so on. It is stated that the barreling of a line is necessary for neutralizing the effect of the earth upon that line itself, but, so far as I have been able to observe, no such effect is to be found, two and three-phase lines without any transpositions working as well as those which have been transposed or barreled, provided the three-phase wires are located at the corners of an equilateral triangle and the wires of each phase of a two-phase line at the diagonally opposite corners of a square.

In transposing any line in reference to any other line, the transpositions should be introduced in sections where the current, and consequently, the magnetic field, is constant. If this question of the constancy of the magnetic field and the effect of its direction already described be taken into account, all interference to or from neighboring lines is readily overcome. The question whether the lines carry high or low potential is, in my mind, not important in reference to transpositions, since the effect of high potential is to produce electrostatic induction, and the effect is not readily overcome by transpositions.

The Pacific Cable Assured.

President Roosevelt has agreed to conditions which seem to assure the operation of a cable across the Pacific Ocean within two years. The conditions were drawn up for the Pacific Commercial Cable Company, and are considered to be so well framed that they will pass Congress without a hitch. The company, being satisfied with the the president's stipulations, and feeling that with his indorsement its bill is assured success, is preparing to act immediately.

The United States government agrees to protect the company's terminal points from foreign invasions, and agrees to allow the company the use of the Pacific Ocean surveys held by the Navy Department. In return, the cable company agrees to the following regulations:

(1) To charge not more than 50 cents a word between San Francisco and Honolulu and to reduce that rate to 35 cents within two years after the cable is in operation; to charge not more than $1 a word to Manila or China, and to give the United States government half of these rates on all official messages. (2) To complete the line to Hawaii by January 1, 1903, and to the Philippines two years later. (3) To land the cable on American soil only, reserving, however, the right to avoid Guam if its vicinity should prove inaccessible for cable laying by reason of great depths. (4) To sell the line to the government at any time on appraisal by five arbitrators, two each selected by the government and the company and the fifth to be chosen by the other four. (5) To transmit government messages at rates fixed annually by the postmaster-general. (6) To give priority to government messages over all other business. (7) Not to receive from any foreign government exclusive privileges which would prevent the establishment and operation of a cable of an American company in the jurisdiction of such government. (8) Not to consolidate or amalgamate with any other line, or combine with one to regulate rates. (9) The United States government to have privileges equal to those tendered other governments. (10) United States citizens to be on an equal footing with those of other countries. (11) Precedence of messages as follows: Government business, company's service business, general messages. (12) To keep the line open for business daily when in working order. (13) In times of national emergency the United States to take control of the line. (14) To maintain an effective speed of transmission over the main cable route from California to Luzon of not less than 25 words per minute.

Later advices from New York quote George W. Clapperton, traffic manager of the Commercial Pacific Cable Company, as saying that some of the conditions were not entirely satisfactory to the company. The points at issue, which are considered minor, are to be embodied in a counter proposition to be submitted to the administration in a few days.

High-speed Tests Proposed on Aurora-Chicago Electric Railway.

An interesting feature in connection with the approaching completion of the electric-railway system to be operated by the Aurora, Elgin and Chicago Railway Company, is the announcement that special high-speed tests will be conducted over a portion of the road. The cars to be regularly operated on the line will be controlled by the Potter multiple-unit system, so that trains made up of several cars can be run. It is stated that the cars will be geared so that they will give a scheduled speed of 55 miles an hour, including a stop every four miles.

As the road is fitted with a heavy and substantial roadbed, it offers advantages for the making of high-speed tests, and the General Electric Company, which furnishes the car equipment, plans to make tests of this nature at an early date. The tests, which will be conducted under the supervision of W. B. Potter, will have for their object the gathering of data relative to train resistance, acceleration and other features entering into the operation of electric cars at high speeds. Mr. Potter confidently expects to be able to attain speeds of 100 miles an hour and over for short distances.

The Whitehall Railway Company of Whitehall, N. Y., has been incorporated with a capital of $500,000. Among the directors are Daniel A. Slattery and J. Osgood Nichols.

Progress of the Bay Counties Power Company.

The Bay Counties Power Company, which operates the longest power-transmission line in existence, held its annual meeting in San Francisco last month. The following-named directors were elected: E. J. de Sabla, Jr., R. R. Colgate, R. M. Hotaling, William M. Pierson, John Martin, John C. Coleman and C. A. Grow. E. J. de Sabla, Jr., was elected president and general manager, William M. Pierson vice-president, C. A. Grow secretary and treasurer, F. M. Ray, assistant general manager, and L. M. Handcock general superintendent. A dividend of 20 cents per share was declared on the 36,000 shares issued.

The annual report of the president showed the earnings for the year ended May 31, 1902, to have been $310,767.98, as compared with $173,873.54, for the year ended May 31, 1901, and the expenses for the year ended May 31, 1902, to have been $87,764.51, as compared with $71,934.91, for the year ended May 31, 1901. The report showed that much new work had been done during the year. A line 1½ miles long has been built to connect with the substation of the Pacific Portland Cement Company near Suisun, Cal., and one 12 miles long from Crockett to the Pacific Reduction Works at Bay Point, Cal. Long-term contracts have been closed with these companies, for power to be utilized continuously during the entire 24 hours of the day. A contract has also been practically consummated for furnishing power to the United States government for the navy yard at Mare Island, Cal. The greater portion of the secondary distributing systems of the company has recently been changed from 2,000 volts to 4,000 volts without installing new copper. Transformers have been installed at Dixon, Cal., and have been ordered for Suisun, Cal., for the purpose of furnishing lights and power to these two towns. A new four-mile line is soon to be put in for furnishing light and power to Vacaville, Cal., and another line seven miles long will be put in, extending to Napa Junction, to connect with the large cement works of the Standard Portland Cement Company, whose first installation of motors amounts to 1,800 horsepower.

Sanitary District Asks Bids on Drainage-canal Dams.

Judge Tuley gave his decision on August 9th in the waterpower case involving the right of the Sanitary District of Chicago to develop waterpower at Joliet. He holds that the District has no right to develop the power under its present charter, but that it has the right to construct the dam objected to by the Gaylord syndicate, if such construction is necessary to preserve its control of the power. The building of the dam by day labor, he holds, is a violation of the Sanitary District act, and he therefore issued a temporary injunction against the construction, to apply until it shall be properly awarded by contract after 60 days' advertisement. The decision is regarded with favor by both sides. The case will now go on the regular docket for hearing on the question of permanent injunction.

In accordance with Judge Tuley's decision, the board of trustees of the Sanitary District has ordered the immediate advertising for bids to provide for the development of waterpower at Lockport and at Hickory Creek, Joliet. In the vicinity of Lockport the board wants bids for the preparation of wall foundations, the building of concrete retaining walls, the excavation of a channel, and the building of sluiceways. In the neighborhood of Hickory Creek, near the southern limits of Joliet, the specifications require excavations and foundations for a dam and tailrace, a concrete-masonry dam, and appurtenances, with cofferdams and other necessary work.

Five of the trustees of the Sanitary District have gone to Niagara Falls, where they will study the development of waterpower and the power transmission to Buffalo. They will then proceed to Sault Ste. Marie, where they will be joined by Trustee Carter. The large power plant there will also be inspected.

Sault Ste. Marie Waterpower Canal Finished.

Work on the large waterpower canal of the Lake Superior Power Company at Sault Ste. Marie, Mich., has practically been completed. It is expected that water from Lake Superior will be turned into it in a few days. The canal is 2 1-3 miles long and has an average width of 224 feet. The power house is a massive building containing 320 turbines of the McCormick type, set in 80 penstocks in groups of four each. Each group of turbines is to operate a Westinghouse generator, and it is expected that a total of 40,000 horsepower will be developed. The power will be used by various manufacturing plants now being built or projected and also to light the city streets and to operate its street cars.

DEVELOPMENT OF THE TELEPHONE FIELD.

Composite Telephone and Telegraph System.

An interesting system for the composite transmission of telephone and telegraph messages over the same conductor, without interruption with one another has been invented by Martin H. Howell of Melrose, Mass. The system employs insulated conductors enclosed in a protective sheath and supported upon poles or drawn into conduits underground. The conductors may be uninsulated or bare and elevated upon poles and cross-arms. In any case, the conductors are transposed relatively to each other and all inductive effects are eliminated. In connection with the composite circuits repeating coils are also used.

The invention is said to have especial adaptation for transmitting market quotations of various sorts to adjacent towns and cities from a central source, as a number of telephone toll lines extending between the towns may be utilized and be made to serve as telegraph circuits.

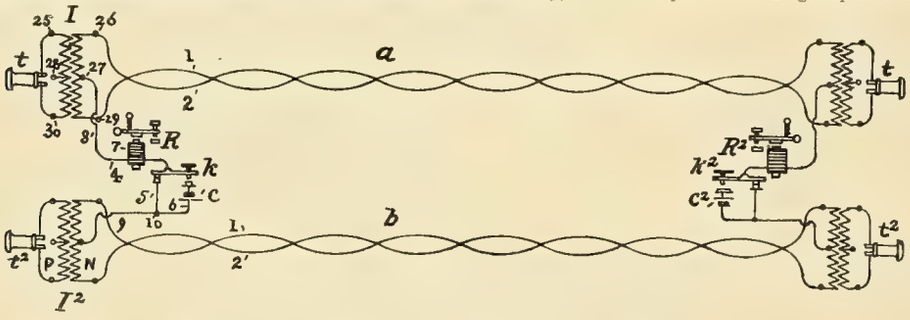


FIG. 1. COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM.

Fig. 1 of the accompanying drawings illustrates the invention, and is a diagram of two metallic telephone circuits whose conductors are employed for a metallic-circuit telegraph line. Fig. 2 is a diagram of the repeating coil employed in the invention.

Referring to Fig. 2, (31), (34), (32) and (33) are insulated conductors which are twisted together and have their right-hand ends respectively brought out to the screw posts (28), (30) and (29) and their left-hand ends to the screw posts (25), (28), (26) and (27), respectively, so that each conductor passes through the coil in two windings in series with one another, the points (27) and (28) being in the center of the respective windings, both sides of which are balanced and symmetrical. These coils are referred to in Fig. 1 by the reference letter (I), and the extensions (8) from the point (27) on the side (N) of the coils at each end of the circuit (a) connect with the electromagnet of the sounder (R) and then to the keys (k) of the telegraph apparatus (T), whose back and front contacts are connected by the wires (5) and (6) with the extensions (9) from the point (27) of the repeating coils (I^2) of the circuit (b). Batteries (c) and (c^2) are included in the wires (6) at each end of the main circuit. By this arrangement the circuit (a) serves as one side or limb, and the circuit (b) the other side or limb of the telegraph line. The telephones (t) and (t^2) are in a local circuit comprising one side or winding of the repeating coils (I) and (I^2).

In the operation of the telegraph apparatus when the key is pressed current from battery (c) passes by conductor (8) to point (27) on the (N) winding of the coil, where it splits, going through the helices in opposite directions and coming out at the points (26) and (29), and continues over the respective conductors (2) and (1) to the points (26) and (29) at the opposite end of the circuit and thence through the helices of the winding (N) of the coil in opposite directions to the point (27), where the current unites and continues by conductor (8) to the helices of relay (R^2), and in case of the metallic-circuit return shown in Fig. 1 the current passes by the rear contact of the key to the sides of the metallic circuit (b) to the opposite pole of the battery, and in grounded circuits the return is by the earth. As the current splits at the point (27) and goes in opposite directions through the helices, as described, one side neutralizes the other. Therefore no inductive effect is produced in the core, and consequently there is no disturbance in the telephones at either end, and when the telephone is used the currents generated thereby enter the (P) winding of the coil and traverse the windings thereof in series and an inductive effect is produced in the core of the coil, and similar currents are induced in the winding (N) of the coil, which traverse the helices thereof in series and are propagated over the conductors (1) and (2) of the circuit and pass through the helices of the winding (N) of the coil at the opposite end of the circuit and are inductively transferred to the winding (P), through whose helices they circulate in series and are received by the telephone in the local circuit of the winding. The impedance of the telegraph instruments prevents any leakage therethrough of the telephone currents.

The inventor states that the ordinary service toll-telephone circuits between cities may be utilized by the invention to any extent to provide a telegraph line between widely separated places in which the metallic conductors of the telephone circuits constitute one or both sides of the telegraph line at the same time the telephone circuits are being employed in their usual service.

The repeating coils used by Mr. Howell consist, essentially, of two separate windings upon a soft-iron core. The helices of one winding are in series from one terminal to the other and are inductive to alternating currents circulating through the second winding of the coil, and the helices are provided with two end terminals and also with a third central terminal. The helices of the second winding are provided with two end terminals and with a third central terminal, and the helices are inductive to alternating currents entering or circulating from an end terminal and continuing through the helices in series, but are non-inductive to currents which enter the central terminal, divide, and pass to the helices at either end of the winding. When these coils are employed the proximity of high-potential power currents has no appreciable effect upon the third or phantom circuit.

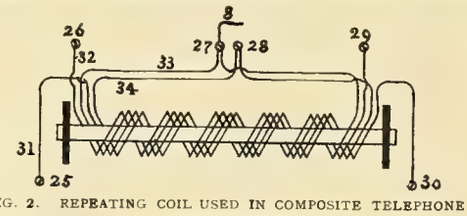


FIG. 2. REPEATING COIL USED IN COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM.

Mr. Howell's inventions are covered by two patents (Nos. 706,318 and 706,319), issued on August 5th and assigned to the New England Telephone and Telegraph Company.

Michigan Telephone Company's Affairs.

There is now little doubt, according to the Chicago Inter Ocean, that the Union Trust Company of Detroit will be appointed a friendly receiver of the Michigan Telephone Company. It is stated that amicable arrangements with the Independent companies may be possible after the reorganization, by which these companies will be allowed to come into Detroit and establish toll lines throughout Michigan, and also to buy the uncompleted People's company's plant, upon which $400,000 has already been spent. The interest, due August 1st, on the first-mortgage bonds of the Detroit Telephone Company, a subsidiary company of the Michigan Telephone Company, remains unpaid, and the bondholders are depositing their bonds with the Central Trust Company.

American Bell Output.

The American Telephone and Telegraph Company reports the output of instruments as follows:

Month ending July 20:	1902.	1901.	1900.	1899.
Gross output.	59,935	56,526	65,463	48,873
Returned	34,054	30,241	30,093	18,028
Net output...	25,881	26,285	35,370	30,845
December 21, to July 20:				
Gross output.	649,044	526,449	411,609	389,899
Returned	260,321	224,810	162,753	109,765
Net output...	388,723	301,639	248,856	280,134
Outstanding, July 20....	2,914,735	2,254,455	1,829,361	1,405,384

A local exchange is being installed for Walnut Grove, Minn.

Telephone News from the Northwest.

The Carthage (S. D.) Telephone Company is constructing 25 miles of rural telephone line west and north of Carthage.

The Citizens' Telephone Company of Mankato, Minn., is installing a new central-energy switchboard. The company contemplates installing a burglar-alarm attachment whereby the windows of a building are attached to wires, and any attempt to raise one results in an alarm to central The operators notify the police and the occupants of the building, if there are any. A somewhat similar attachment for fire-alarm purposes is also in view.

The Duluth and North Shore Telephone Company has been incorporated with $25,000 capital stock to establish a telephone system covering St. Louis, Cook and Lake Counties, Minn. The company will build first from Duluth to Grand Marais.

The Twin City Telephone Company of Minneapolis and St. Paul announces the payment of the second dividend on its preferred stock, at the rate of seven per cent. to the 700 stockholders of the company. The company has recently taken contracts for a large number of private exchanges for some of the larger firms and corporations.

A new exchange has been completed and put in operation at Hetland, S. D.

The Citizens' Telephone Company of Park Rapids, Minn., has filed articles of incorporation with a capital stock of $10,000.

The Minnesota Rural Telephone Company seeks admission to St. Cloud, Minn. The company has headquarters at Princeton, Minn., and has a traffic arrangement with the Twin City company.

The Marion and Northern Telephone Company has made a contract at Wausau, Wis., with the Wausau Telephone Company for connections, giving many country towns in the vicinity a line to Wausau.

A new telephone company has been formed at Jackson, Minn., with $20,000 capital stock for building rural lines.

The new exchange at Chisholm, Minn., starts with 40 subscribers.

The Iowa Telephone Company announces a raise in wages for the entire state of linemen and electrical workers to $2.75 a day, an increase of 25 cents.

The Union Electric Telephone Company of Davenport, Iowa, has filed mortgage bonds to raise funds for the construction of the proposed system.

The Northern Telephone Company of Fonda, Iowa, has bought the local exchange at Sioux Rapids, Iowa, in order to protect its toll-line business. The company is constructing a number of long-distance lines.

The Montgomery County Telephone Company will construct a local exchange at Red Oak, Iowa, at once, with a capacity for 600 connections.

The DeWitt (Iowa) Telephone Company will build a line to Low Moor. R.

Ohio Telephone Notes.

A company has been formed at Toledo to build a telephone plant at Shreveport, La., with toll lines in surrounding territory. The capital stock is $500,000. The following-named officers have been chosen: President, Walter B. Ritchie, Lima; vice-president, M. D. Shaw, Wapakoneta; treasurer, C. D. Crites, Lima; secretary, C. C. Handy, Wauseon.

E. N. Gerrin, representing a Philadelphia syndicate, has been negotiating for the Independent telephone plants at Bowling Green, Findlay and Fostoria, which are largely owned by the Federal Telephone Company. The deal, should it go through, will involve about $250,000.

The City and Suburban Telegraph Association of Cincinnati has filed an answer in the suit brought against it and the Union Heat, Light and Power Company by A. L. Woodworth of Newport, Ky., who claims to have been injured by the breaking of one of the telephone company's wires, which came in contact with a live wire of the light company.

The Minster Home Telephone Company of Minster has been incorporated with a capital stock of $10,000, to build a plant in that town. The incorporators are George Van Oss, M. H. Osborn, C. F. Herkenhoff, J. F. Kramer and others.

The American Federation of Labor has sent organizers into Toledo and Northwestern Ohio to organize the telephone girls. O. M. C.

Southern Telephone Developments.

In spite of the fact that the City Council is yet investigating before passing a new telephone ordinance in Augusta, Ga., the Strowger Automatic Telephone Company is going ahead under an ordinance passed last November, and is preparing to place its wires underground, stating that further delay would be expensive.

The Bell Telephone Company at Charlotte, N. C., has made a voluntary request to be allowed to place its wires underground.

The Cumberland Telephone and Telegraph Company has taken charge of the West Kentucky Tele-

phone Company at Fulton. This company also operates in Mayfield and other points.

The American Telephone Company has completed a through line from Petersburg, Va., to Savannah, Ga., by way of Maxton, N. C.

It is said the Southern Bell Telephone Company will gain control of the Richmond (Va.)-Newport News long-distance line, built by the Long-distance Telephone Company of Virginia. This would give the company control of every long-distance line running out of Richmond.

Plans for the big creosote plant to be erected at Nashville, Tenn., by the Cumberland Telephone and Telegraph Company are about completed. The buildings will cost about $40,000.

The telephone and street-railway companies of New Orleans have acceded to the demands of the striking linemen, granting an increase of 50 cents per day for labor.

The Bell Telephone Company, on account of increased business, has found it necessary to undertake the building of a new branch in St. Louis, Mo. The new building will be on North Beaumont Street and will cost about $40,000. A second branch is also being erected. L.

Telephone Progress in the Far West.

A decision has been handed down by the District Court at Great Falls, Mont., whereby the Rocky Mountain Bell Telephone Company must pay the assessed valuation of $10,000 on the telephone franchise now held in that city. The case will be appealed.

The City Council of Albuquerque, N. M., has granted an extension of 25 years to the Mutual Automatic Telephone Company of that city. The present franchise has 18 years more to run. The company will make a number of extensions and improvements.

A branch line will be built from the Casper-Lander line of the Rocky Mountain Bell Telephone Company to a point near Red Lodge, Mont., making the first north-and-south line through Wyoming.

The Lawson (Ariz.) Telephone Company has been incorporated by J. Atkins, A. F. Lawson and W. A. Crawford with a capital of $100,000.

The Rocky Mountain Bell Telephone Company's line now building from Casper to Lander, Wyo., will be extended to connect with the main line of the system at Rock Springs.

By the extension of the Sunset Telephone Company's line, Phœnix and Wickenburg, Ariz., are now connected.

The Salt Lake City exchange of the Rocky Mountain Bell Telephone Company now has connection with 475 outside towns.

J. D. Reed and J. O. Hauser have secured a telephone franchise in Covina, Cal., for $72.50, the price covering the cost incurred in granting the franchise.

Phinny T. Evans has applied to the City Council of Riverside, Cal., for a telephone franchise. If granted a franchise, it is said his company will lay an underground system, spending a total of $50,000. The terms for the first 2,000 telephones shall not exceed $39 a year for business houses and $21 for residences. The company will pay the city two per cent. of its gross earnings after the first five years. A. W. C.

Indiana Telephone Items.

The Mooreland Rural Telephone Company of Mooreland, Henry County, was incorporated during last week with a capital of $10,000. The company will construct an exchange at Mooreland and operate throughout Henry County.

Judge Carter of the Indianapolis Superior Court has rendered a decision of great interest to telephone companies having subways in cities. The action was in the nature of an injunction restraining a property owner from excavating for a cellar under the sidewalk in front of his property, on the ground that it would interfere with the telephone company's subway for wires, and thereby cripple its service. The court holds that a property holder has no right, without permission from the city to excavate beyond his property line and not then, if it will interfere with a rightful occupant of the subway.

The pathetic stories of the corporation attorneys concerning the property of telephone and telegraph companies which were related last week to the State Tax Board, have all been carefully considered, and, after much figuring, the board announced an increase of $1,720,428 in valuations upon which telephone companies doing business in the state must pay taxes, and a decrease in valuations of telegraph companies of $2,430. After several years of effort the Western Union Telegraph Company obtained a decrease of $5 a mile, the valuation being made $57 a mile on 39.346 miles of wires. The company has for several years insisted that it was assessed too high. The Postal Telegraph-cable Company was increased from $20 to $25 a mile on its 9,001.79 miles. In some instances the prayer of the telephone company to be let alone was heeded, but next to steam and electric railroads, the telephone companies show the greatest increase in valuation for taxation. F.

The White County (Ill.) Telephone Company, located at Carmi, Ill., certifies to a dissolution.

Detroit Co-operative Telephone Company's Plant.

The Co-operative Telephone Company of Detroit, Mich., is making rapid progress in installing its initial plant of a 12,000-capacity exchange, and it is estimated that the service will be opened in about 90 days, with its downtown business subscribers' exchange. The company has one of the most liberal franchises ever granted by any city. Besides all of the privileges usual in franchises, it has the right to use for its purpose all the necessary city conduits, pole lines and public buildings unoccupied upon a maintenance rental. Detroit, having its own municipal electric-light system, makes this privilege of considerable advantage. The downtown business exchange will be installed in the Golden Building, a new fireproof structure, well adapted for the purpose. The manufacture of the switchboard equipment and telephones is well under way. The exchange is being built by the International Telephone Manufacturing Company of Chicago, and will embody in the construction of its parts all of the late improvements and new features of this company's system, and when completed will be one of the most modern and efficient plants in the field.

Des Moines Telephone Boycott Spreads.

The strike of operators of the Iowa Telephone Company, Des Moines, continues. The boycott has been extended to different cities of the state. At Marshalltown, the issue has been made a painful one for merchants, and they do not take kindly to the intrusion of troubles of another city upon them. They stand to lose business whichever way they work. Many of them have signed requests to remove the Iowa telephones, but they do so under a mental protest. At Des Moines the Trades Assembly has been enjoined from further removing instruments of the Iowa company from subscribers' places of business. They will continue to work with business men to have the instruments removed, and claim to be quite successful. The City Council of Des Moines has ordered the removal of all instruments of the Iowa company from city property. In Ottumwa the strikers are working to induce subscribers to order out the Iowa instruments, and are removing them where the company is dilatory after due notice is given.

Independent Telephone Consolidation Proposed in Iowa.

Plans are said to be under discussion for the combination of all the Independent telephone companies of Northern and Central Iowa into one concern. If the plan is completed, it will mean one anti-Bell concern, covering about 40 Iowa counties. The change will be inaugurated gradually, and it is expected that it will take about 18 months to complete the consolidation. It is proposed to form an operating company, which will lease all the various companies eventually and operate them.

GENERAL TELEPHONE NEWS.

Candy boxes are made in many surprising forms. One of the latest is a telephone box, with cabinet work, transmitter, receiver, bell and cord cleverly imitated.

A telephone cable has been laid across Vineyard Sound on the Massachusetts coast. The cable is four miles long and connects Vineyard Haven, on Martha's Vineyard Island, with the mainland.

H. H. Robinson, assistant general manager of the United States Telephone Company, Cleveland, Ohio, is compiling what is to be known as the Telephone Green Book. This book will contain a complete directory of the Independent telephone companies in Ohio, Indiana and Michigan, together with useful statistics and three special papers, setting forth the history and describing the Independent conditions in those states, written, respectively, by J. B. Hoge of Cleveland, S. P. Sheerin of Indianapolis, and J. B. Ware of Detroit. Over 1,200 copies have been subscribed for, and it is the intention of the publisher, the Telephone Green Book Publishing Company of Cleveland, to get out the work each year if the demand is sufficiently great.

MANUFACTURERS AND DEALERS.

The Sterling Electric Company of Lafayette, Ind., believes it is securing its share of the common-battery telephone installations now building or in prospect. The company reports having secured in the last week contracts for complete exchange equipment and telephones at the following points: Newark, Ohio, 3,000 capacity; Davenport, Iowa, 4,000; Rock Island, Ill., 4,000; Moline, Ill., 3,000; Paris, Ky., 3,000.

The property and business interests of the Western Telephone Construction Company, Winthrop Harbor, Ill., adjudged bankrupt on August 1st, by the United States District Court, will be offered for sale before Judge Kohlsaat in the courtroom of the above-mentioned court in Chicago on August 18th. The property is offered for sale by the Equitable Trust Company, Chicago, which was appointed receiver for the bankrupt company some time ago.

Fessenden System of Space Telegraphy.

In a recent address before the Engineers' Club of Philadelphia John Gordon Gray said:

Another method of wireless telegraphy has recently attracted some attention. I refer to the system of Professor Reginald A. Fessenden, worked out under the auspices of the United States Weather Bureau. For the past two years Professor Fessenden has been at work on the North Carolina coast, patiently and systematically investigating the problems of wireless telegraphy, his work resulting in the production of a receiver entirely distinct from the coherer and possessing marked advantages over the latter. I am not at liberty to enter fully into the details of his instrument, which I may say consists in the main of a platinum wire of peculiar form and character. While positive in its action, and insusceptible to external disturbing influences, it possesses an extreme sensitiveness, messages having been sent from Cape Hatteras and received at Roanoke, a distance of 53 miles, with a one-inch coil giving 0.031-inch spark. There is an interesting ceremony at a certain period of college life called "burning the calculus," and the United States Weather Bureau assistants at Hatteras and Roanoke, who had struggled long with the painful uncertainties of the coherer, were so much relieved by the certainty of action of the new receiver that a few weeks ago they were preparing to celebrate their emancipation from it by ceremonially burning the coherer.

Owing to foreign patents which have not yet been granted, it is not possible, as I have said, to describe in detail the wireless-telegraph system of Professor Fessenden. In a general way, however, it can be stated that the sensitive part of his receiver is a continuous conductor and does not depend for its operation, like the coherer, on a vast number of loose contacts. Each time the electrical oscillation passes along the circuit in which the Fessenden receiver is placed a change occurs in the electrical condition of the circuit. This change of condition manifests itself as a click in the telephone receiver. One click is produced each time a complete oscillation passes along the wire; or, in other words, each time the secondary spark occurs at the sending station. If these interruptions are slow, the clicks are difficult to interpret. As the number of interruptions increases the individual clicks form themselves into more or less of a buzzing sound; and if the interruptions are made with a tuning fork, for instance, the telephone receiver will produce the same tone as the sending mechanism gives out. It will be seen that this arrangement lends itself, with slight modifications, to a telephonic system, details of which are not yet ready for publication.

The chief advantage in this system is the simplicity of circuits and the fact that there are none of the fine adjustments necessary that are found in the coherer system.

This system is also admirably adapted to syntonic methods, and from experiments already performed it is believed that any pair of stations can hold communications without interference from outside influences, and that there is but little probability that any outside receiver can pick up the signals sent.

The demonstration made at Roanoke a few weeks ago, before General Greely and other officers of the United States Signal Corps and the representatives of the United States Navy, was highly satisfactory, and the confidence of the officers of the Signal Corps in the Fessenden system was shown by the award to a Philadelphia firm of the contract to install that system for the Signal Corps in Alaska, between Cape Nome and St. Michael, a distance of 108 miles across Norton Sound. The submarine cable at Norton Sound, which is not now in working order, has been put out of service every winter as a result of injuries from the ice floes, which, owing to the shallowness of the sound—at various points, the depth not exceeding 13 feet—grind against the cable. Thus communication being cut off, after the middle of October, and there now being a considerable population at Cape Nome, there is urgent need of such a system as the wireless for that locality. This installation will be of special interest, as being the first practical use of the wireless system between points at so great a distance on the American continent.

In answer to a question from Carl Hering, Mr. Gray said that the Alaska installation was to be in operation not later than October 1st at a total cost of something over $14,000.

Electrician Killed, But the Plant Continued to Operate.

Eugene C. Ketcham, night electrician at the power plant of the Missoula Light and Power Company, at Bonner, Mont., was killed some time during the night recently, by coming in contact with the brushes and terminals of the generator, making the connection while oiling the engine. He reported to the Missoula office by telephone at nine o'clock. The plant continued to operate regularly and was going as usual at six o'clock in the morning, when the day man arrived to relieve Ketcham. The marker on the recording meter showed a steady power all night.

The Whitewright Telephone Company, Whitewright, Texas, has been incorporated with a capital of $10,000. The incorporators are W. C. Fain, R. May and Lille Selph.

Energy Loss in Commercial Insulating Materials When Subjected to High-potential Stress.

By Charles Edward Skinner.

Part II.

In Fig. 2 are given curves which are characteristic in form for the increase in loss due to temperature. These particular curves were taken by the wattmeter method on a sample of material which had been used for some months for other tests, and was known to be in the very best condition as regards moisture, etc. This general form of curve has been found to hold for all materials tested, although the rate of change of the loss and the amount of the loss per unit volume may be very different for different materials, and even for the same sample of material under different conditions.

This series of tests has shown:

(9) The energy loss in fibrous material increases with temperature, the rate of increase in the loss being greater than the rate of increase in the temperature.

(10) The rate of increase depends upon the kind of material and on its condition with respect to dryness, etc.

(11) The local heating found in a mass of poorly ventilated material is due to a greater initial loss

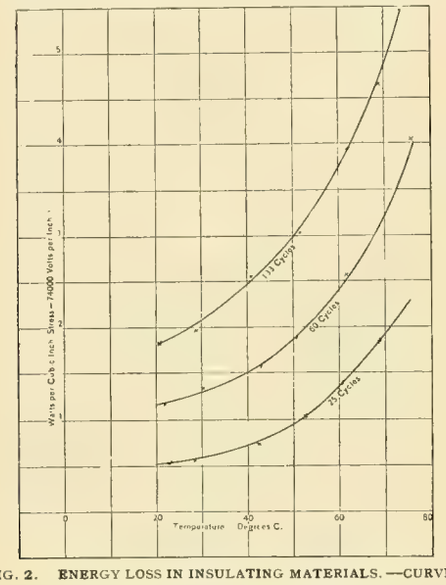


FIG. 2. ENERGY LOSS IN INSULATING MATERIALS.—CURVES OF INCREASE IN LOSS DUE TO TEMPERATURE.

in one portion, causing increased heating, this in turn causing greater loss, etc., until the temperature finally reaches a point at which charring and breakdown result.

(12) These curves show that the rate of increase of loss is greater at high than at low temperatures, therefore giving the reason for the greater rise in temperature with a given stress when the initial temperature is high than when it is low.

Other tests have shown:

(13) That the loss increases very rapidly, indeed, when temperature approaches the charring temperature of the material.

(14) Losses as great as five watts per cubic inch have been measured in material before serious injury resulted, due to charring. A considerably less loss than this will, however, char the material in time unless special means are taken to dissipate the heat generated.

(15) It follows from considerations of rise of temperature due to increased stress, and increase in loss due to increase in temperature, that a long-continued test at high stress may seriously injure the insulation of a piece of apparatus without this being made apparent by the test. This has often been spoken of as "straining the insulation" for want of a better term, the idea being that this was in some way analogous to the straining of a piece of metal beyond its elastic limit. It is probable that this "straining" is always due to charring.

Variation of Loss Due to Variation of Voltage.

As will be seen from the foregoing, there are two conditions to be considered under this head: (a) Variation of loss with voltage, the temperature remaining constant; (b) variation of loss, with voltage, the temperature varying, due to the loss itself.

(a) Variation of Loss with Voltage, the Temperature Remaining Constant.—If the loss in a dielectric is due to partial conduction, as has been stated by Hess, it is to be expected that this loss will vary as the square of the voltage applied. This fact was shown experimentally by Mr. Steinmetz in 1892, and the law announced by him at that time as follows:

"The energy consumed by the dielectric medium under alternating electrostatic strain is directly proportional to the square of the intensity of the electrostatic strain."

(16) The tests made show a fair agreement with the law above noted, the increase in loss usually being slightly greater than the square of the electromotive force.

A specific example to illustrate this case is given later in some measurements made on the armature insulation of two of the 5,000-kilowatt alternators built by the Westinghouse Electric and Manufacturing Company for the Manhattan Railway Company.

(b) Variation of Loss with Voltage, the Temperature Varying, Due to the Loss Itself.—It has already been shown that there is a rapid increase in the energy loss in a body of insulating material due to increase of temperature; also that the energy loss varies approximately as the square of the voltage when the temperature remains constant.

(17) It follows, therefore, that under the usual conditions of high-potential stress the loss will increase more rapidly than the square of the voltage, because the temperature increases at the same time.

(18) The rate of this increase will depend on the facility with which the material can get rid of its heat, and on the length of time the material is subjected to each successive stress in carrying out the test.

(19) It will also depend on the initial temperature of the material and the temperature of the surrounding medium.

It will be seen that many of the conditions named under variations of temperature due to variations of stress apply to this case.

Variation of Loss Due to Variation of Frequency.

Like all the other phenomena described in this paper, it has been found very difficult to make check measurements on the losses of a large number of samples of materials at different frequencies and deduce a mathematical law from the results. In Fig. 2 are shown three curves giving results on a single sample of material tested at 25, 60 and 133 cycles.

(20) It will be noted from these curves that the rate of variation for this particular set of tests is approximately in proportion to the frequency at the lower temperatures, but follows a different law at the higher temperatures.

(21) In some other tests, which were carefully made, the loss varied approximately as the square root of the frequency, but these results are not sufficiently well substantiated to announce as a law.

Energy Loss in the Insulation of Large Alternators.

Some measurements recently made of the energy loss in the armature insulation of the 5,000-kilowatt alternators built by the Westinghouse Electric and Manufacturing Company for the Manhattan Railway Company, should prove interesting in this connection. These tests were made to check some of the results obtained on a smaller scale, and to give some of the conditions which exist when very high potential tests are made on large high-voltage apparatus.

These alternators are wound for a terminal electromotive force of 11,000 volts, the winding being three-phase, star-connected. In the design of the insulation, special attention was given to securing great dielectric strength, low dielectric loss and permanency under all conditions of operation. Preliminary tests in the factory had shown a dielectric

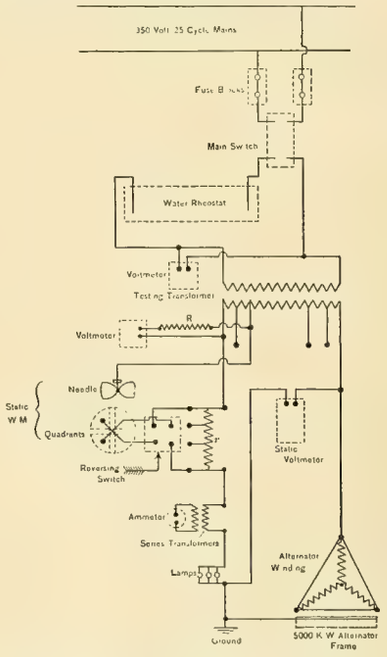


FIG. 3. ENERGY LOSS IN INSULATING MATERIALS.—DIAGRAM OF CONNECTIONS IN TESTING LARGE ALTERNATORS.

strength of 80,000 to 90,000 volts for a short applications of electromotive force, and a very small rise in temperature for a 30-minute test at 35,000 volts.

The tests to be described were made on two of these alternators after they had been installed ready for service. The accompanying diagram, Fig. 3, shows the connections of the various apparatus used. The primary current for the testing transformer was obtained from 350-volt (25-cycle) mains, and voltage regulation was by means of a large water rheostat in series with the primary of the testing transformer. The testing transformer had a capacity of 250 kilowatts at 40,000 volts, loops being brought out to give steps of 5,000 volts on the high-tension winding. Three instruments were used to measure the voltage—a direct-reading voltmeter across the primary of the transformer, a voltmeter in series with a high resistance across a part of the whole of the high-tension winding, and a static voltmeter across the high-tension winding. Current was measured by means of a specially calibrated low-reading ammeter, with a series transformer arranged to multiply the current by four. The small bank of lamps shown was used as a rough check on the ammeter readings.

The losses were measured by means of the static wattmeter referred to earlier in this paper. The quadrants were connected across a variable, previously calibrated resistance, and the needle connected to the 10,000-volt loop on the high-tension winding of the testing transformer. The deflection of the needle was read by a telescope and scale. The wattmeter was calibrated by using the voltage across one lamp in a series of four on 500 volts direct current. It may be said for this instrument that after standing over two months in the power house between tests the constant had changed less than two-thirds of one per cent.

During the tests one terminal of the testing transformer was connected to the three leads from the armature winding, and the other terminal to the

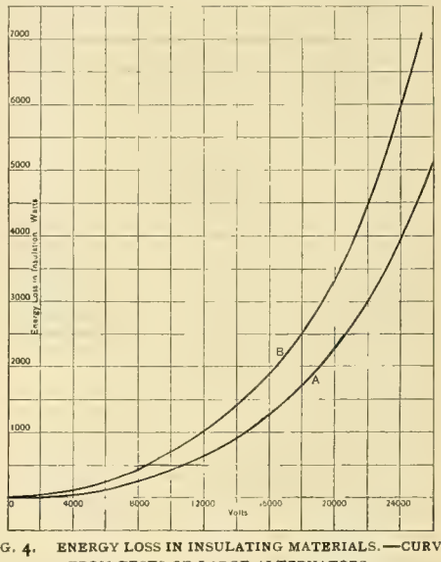


FIG. 4. ENERGY LOSS IN INSULATING MATERIALS.—CURVES FROM TESTS OF LARGE ALTERNATORS.

frame and to ground. The measuring instruments were connected in the grounded side as far as possible. The temperature of the windings was taken by means of a thermometer near the floor line of the machine. Loss measurements were made at approximately 5,000, 10,000, 15,000, 20,000 and 25,000 volts.

The accompanying curves, Fig. 4, show the results of these measurements. Curve A was taken on alternator No. 7, and B on No. 6. The temperature of the windings on No. 7 at the time of test was approximately 21° C. and on No. 6 approximately 31° C. These temperatures are only approximate, as there must necessarily be some difference in temperature in different parts of a machine of this size, where the parts of the winding are so widely separated from each other. Unfortunately, it was not found feasible to make tests on one machine at different temperatures, and even if this had been done, it would have been difficult to have made accurate measurements of the temperature, for the reasons stated above.

The amount of insulating material under stress in these tests was approximately 19,500 cubic inches, this giving a maximum measured loss of 0.35 watts per cubic inch at 25,000 volts. At a stress of 11,000 volts between the windings and the frame, the loss measured was less than one kilowatt total for the machine. The loss in the insulation during normal operation of the machine will be much less than this, as the maximum stress to ground when circuits are statically balanced will be approximately 6,400 volts at the lead end of the winding, and 0 at the neutral point. As the loss increases approximately as the square of the voltage, the total loss due to normal operation will be only one-third of the loss at a stress of 6,400 volts applied between the windings and the frame. The total loss, therefore, under normal conditions of operation and at the normal temperature at which the machine will run will be less than one-half kilowatt, which is entirely negligible, both as regards its effect on the efficiency of the machine and on the rise in temperature. On the other hand, it will be seen that the loss at a stress of 25,000 volts is a very measurable quantity, and the form of the curve shows that this will increase very rapidly as the stress is increased above this point.

From these curves we may see:

(22) The variation in loss due to variation of stress is slightly greater than the square of the stress applied. This increase in rate cannot be due to temperature, as the total loss is not sufficient to cause

appreciable heating, and measurements made during a 30-minute application of 25,000 volts did not show any variation in the loss.

(23) The increased loss at the higher temperature was somewhat greater than was to be expected from measurements made on small samples of material. This may be due to an actual difference in the loss of the two machines or to the fact that it is nearly impossible to get any accurate measurement of the average temperature of the insulation of a machine of this size.

(24) The loss at 25,000 volts is not sufficient to cause any injurious heating, even in a long-continued test.

(25) The rate of increase of loss indicates that at a point not far above 25,000 volts the loss would be sufficient to cause heating and possible damage to the insulation if the stress were applied for any considerable length of time.

It is not possible to state in general terms the safe limiting stress which can be applied in a time test to a piece of high-potential apparatus, but measurements of the loss and a knowledge of the materials used will give the designer some idea for any particular machine. Such tests are very rarely necessary, and should not be required on ordinary commercial apparatus. When a time test is required, it should be at a voltage much below the dielectric strength of the insulation under test.

In conclusion, the author wishes to state that while the work done has been considerable, there is much more to be done in this line, and it is hoped that many of the points now more or less obscure and uncertain may be cleared up in the near future. There are yet many materials to be investigated, and experimenters who have the time and patience will find this a fertile field for their labors.

Finally, I wish to acknowledge my indebtedness to my co-workers, Mr. P. H. Thomas and Mr. Miles Walker, for much data and many valuable suggestions in connection with the investigation of this subject. The former, particularly in connection with the extensive calorimeter tests carried out by him and the interpretation of their results, and the latter in connection with various temperature and wattmeter measurements. I am also indebted to Mr. H. G. Stott, superintendent of motive power of the Manhattan Railway Company, for the facilities placed at my disposal for making the measurements on the 5,000-kilowatt alternators in the above company's power house.

[The end.]

Indianapolis Interurban Terminal Question.

The finishing touches have been made on the interurban franchises, and on the grant to the Indianapolis Traction and Terminal Company, which are to be presented to the council of Indianapolis, Ind., for approval. The eight interurban companies and the Terminal company are to receive franchise privileges for a period of 31 years. The franchise provides that the interurban roads shall pay the city one cent a round trip for every car that enters the city during the life of their franchises and the Terminal company will pay four cents a car for the first 11 years, six cents a car for the next 10 years, and 25 cents for the remainder of the franchise. There is an exception in the Union Traction Company's amended grant which requires it to pay one cent for the first period of 11 years, nine cents for the second, and 16 cents for the third, the remainder being charged to the Terminal company.

The Indianapolis Traction and Terminal Company, in return for a 31 years' grant of the right to occupy certain downtown streets, agrees to construct a central passenger station and not more than two freight stations, to be used by all the interurban lines. There are to be two loops, the boundaries of the outer being a mile square and the inner loop surrounding the squares in the heart of the city. The freight and passenger stations must be completed within 12 months. The Board of Works reserves the right to "regulate" the hauling of freight and express through the city, and the minimum rate shall not be less than 80 per cent. of the present steam-road rates.

The passage of the ordinances approving these franchises is expected without delay, and, if so, ground will be broken for the buildings and construction on the loops be begun in a short time.

It is generally conceded that the Board of Works and Mayor Bookwalter have made a good bargain for the city in the settlement of the interurban and terminal question. The companies are represented by two progressive and broad-minded men, H. J. McGowan and G. F. McCulloch, who can foresee the value of such a franchise in the constant growth of Indianapolis, and the almost certain possibility of it becoming the greatest interurban center in the country. The contract carries with it an agreement upon the part of Mr. McGowan to build certain cross-town lines and to extend and improve certain other lines of the local company. This promise is verbal, but is none the less binding, and will be carried out.

The terminal company mentioned above which is to undertake the foregoing problem has filed articles of incorporation. Its capital stock is $500,000. W. K. Schoepf, president of the Cincinnati Street Railway Company and a representative of the Widener-Elkins-Morgan syndicate, has been made president, and this revives the rumor of an ultimate merger of the local and interurban companies entering Indianapolis. Other members of the board of directors are H. J. McGowan, John D. Thompson, James M. Jones and Clarence Winter.

COMMUNICATION.

Two Wireless-telegraph Messages Read Simultaneously.

To the Editor of the Western Electrician:

During the last week two operators of the De Forest Wireless Telegraph Company accomplished a feat which, while new in the annals of wireless telegraphy, is only significant of the possibilities before the "responder" or automatic receiver in combination with the telephone.

At the station at 17 State Street on the roof of the Cheeseborough Building, this city, two messages were received and read simultaneously by the two operators listening in on two separate telephone receivers, attached to one and the same responder, and without any special attuning or syntoning device in circuit. One message was from the Staten Island station, and was sent quite rapidly, 30 words a minute, with a high-frequency spark (120 a second). The other was from some foreign station, evidently Marconi installation. The speed was about 10 words a minute, sent with a low-frequency interrupter. Mr. Horton concentrated his attention upon the Staten Island message, while Mr. Barnhart was able to pick out, by their peculiar drumming sound, the signals from the other station.

The result is no more remarkable than the fact that two conversations can be carried on simultaneously over the same telephone wire, if the two voices differ considerably in pitch and timbre. But the fact that without any tuning device this can be accomplished with one and the same responder, certainly demonstrates the advantage of the telephone receiver over any sounder or tape-recording device and the greater immunity of such a system from atmospheric and foreign disturbances.

So far as has been published, two simultaneous messages constitute the record to-day for any tuned or syntonized system in the present development, and it is interesting to know that, with two styles of interrupter and sending speed sufficiently diversified, the same can be accomplished by the human ear listening in a telephone connected with an automatic responder.

Last week also the De Forest operators established a new record as to speed in wireless transmission. A commercial message (not of selected words) 48 words in length, was transmitted and successfully read at the rate of 52 words a minute. This is far and away the fastest speed yet attained by the wireless telegraph, being five times as rapid as is ordinarily attained by coherer systems.

L. DE FOREST.

New York, August 5, 1902.

American Union Electric Company.

S. Marsh Young of the American Union Electric Company announces that that company, in addition to its purchase of the Union Railway, Power and Electric Company, Morris Electric Company, the Falcon Electric Manufacturing Company, Electric Motor Specialty Company, Fountain Manufacturing Company, the Federal Manufacturing and Specialty Company and Refrigerator Machine Company, has added to its line of purchases the Metropolitan Switchboard Company.

The American Union Electric Company has purchased all the capital stock of the Metropolitan Switchboard Company from Charles L. Eidlitz, T. J. Murphy and G. A. Annable, and intends to continue to operate the factory of the company at West Twenty-ninth Street as an auxiliary to its plant at Ampere, N. J., and in the Twenty-ninth Street factory will handle all switchboard and special panel-board work under the supervision of T. J. Murphy, former president of the Metropolitan Switchboard Company. The purchase carries with it the ownership of the Murphy patents, which cover all forms of installation of panel boards, as well as built-up panel-board boxes and the divisible panel board.

There has been considerable controversy between the Metropolitan Switchboard Company and the several manufacturers of panel boards, but the new managing company announces that it will probably turn in these patents to the general benefit of the panel-board business, and will issue licenses to about a dozen of the principal panel-board manufacturers, its object being to strengthen the general situation and to enable the legitimate panel-board manufacturers to receive a fair return on their investment. The new additions to the factory of the American Union Electric Company at Ampere, N. J., covernig about 23,000 square feet of floor space, are about completed, although plans are being prepared for the still further addition of a new brick building 300 by 50 feet, for a general machine shop, as well as office building and warehouse.

It is rumored that next season will see steamboat companies selling tickets out of Chicago good for connections with an electric line between Benton Harbor and Dowagiac, Mich., and other points in the fruit belt of Michigan.

A Chapter of Accidents.

A rather long delay in the repairing of the Van Buren Stret bridge in Chicago, which was out of order over two weeks, was occasioned by a rather unusual chapter of accidents. The bridge, which spans the Chicago River, is of the rolling-lift type, and is operated by two electric motors which draw current from the 550-volt direct-current street-railway service. The motors, which had been operating the bridge for the last three years—in fact, ever since its construction—were finally burnt out, probably from overloading.

Since the bridge crosses a navigable river, it was of necessity allowed to remain open until repairs could be made. This, it was at first thought, would take but little time. But it was soon discovered that the motors were built by the Westinghouse people some three or four years ago, and that the company had since ceased to manufacture this type. There was a further delay caused by a mistake in asking the General Electric Company for repairs, instead of the Westinghouse company. Finally this blunder was straightened out, and the needed armature coils were ordered by telegraphing to Pittsburg. But the parts were not in stock, for the reason already mentioned, and had to be manufactured. This was done, and they were shipped some 10 days or so after the receipt of the order. But as yet the old motors, which were removed after the breakdown, have not been replaced. The bridge is working again, in fact, was put into operation about two weeks after the breakdown, motors having been borrowed from the Sanitary District of the city for the purpose.

United States Navy to Protect Haytian Cable.

Instructions have been issued by the United States Navy Department to Commander McCrea of the gunboat Machias to proceed with his boat to Hayti, as a result of an appeal from the Haytian Telegraph and Cable Company to protect the company's cable from being cut by the revolutionists, who are attempting to overthrow the government of the island. The orders were issued by the Navy Department because it was deemed internationally legitimate to protect the cable (between the island and New York) since the belligerents were not a recognized party by the powers. Although a state of warfare exists, yet the old government still controls the island and the revolutionists are looked upon by the outside world as being more insurrectionists and peace disturbers than as an organized body attempting to better their government and free themselves from an obnoxious yoke. This is in accordance with the Monroe doctrine, which provides that the United States shall have power to preserve peace and order so long as it does not interfere with the sovereign rights of the southern countries in doing so.

The cable is of importance to the United States government, aside from the fact that a great many American capitalists' interests are at stake, because it is partly used by the government in communicating with Porto Rico, and is often used to reach American war vessels in the West Indian waters.

Prize for Wireless Transmission of Power.

Reference has been made in the Western Electrician to the prize of $3,000 offered by the St. Louis Exposition authorities for a successful attempt to transmit power by energy proceeding through space. The offer is made in connection with the aeronautic competition at St. Louis in 1904; but this fact does not detract from its general scientific interest, for, of course, if an air-ship motor can be driven by space-transmitted power, any other motor can be so driven. If the problem is solved, the effect on the conditions of power transmission will be tremendous.

The offer is contained in Section 3 of the Rules and Regulations Governing the Aeronautic Competition of the St. Louis World's Fair, 1904. Quoting the exact language of that section, it is as follows: "One prize of $3,000 is offered for a successful attempt to drive an air-ship motor by energy transmitted through space, either in the form of electric radiation or in some other form of electric energy, to an actual amount of one-tenth (0.1) of a horsepower at the point of reception and at a distance of at least 1,000 feet. The test must be made on the exposition grounds by experts satisfactory to the jury."

A somewhat surprising state of affairs in electric wiring in the Union Stock Yards buildings of Chicago was reported to the Chicago Underwriters' Association recently by an insurance inspector who has been stationed at the stock yards for the last two months. The wiring was reported to be in such bad shape that the inspector, whose location at the yards was to have extended over a period of six months, will now remain there permanently. Extensive repairs are to be made under the supervision of the inspector, but in some instances repairs are an impossibility without demolishing the buildings.

CORRESPONDENCE.

New York Notes.

New York, August 9.—As was anticipated in my last letter, considerable progress has been made toward the drawing up of a franchise agreeable to all parties in the Pennsylvania tunnel case. It will be remembered that a committee was appointed by the Board of Aldermen to confer with the rapid-transit commissioners and railroad officials. A conference was held on the 6th instant, and discussion held as to the points of variance still existing and barring a possible franchise. The chief point of debate was over the labor question. The committee insisted on the railroad agreeing to the placing of a clause in the contract, to the affect that the "prevailing rate of wages" would be paid on all construction work. The railroad officials stated that it was an impossibility for them to sign any such an agreement, as the construction work would be sub-let and contractors would do as they pleased with the wage question. The point of the argument is, recognition and employment of union men at union wages. It looks now as though the company will not be asked to include the above clause in the contract owing to the reason stated by its representatives. Should the committee strike the clause from the contract, and present the revised paper, with its recommendation, to the Board of Aldermen at its meeting in the fall (September 4th) there will be no doubt of its passing, which will mean the immediate closing up of the deal.

J. H. Hoadley, with his partner, C. S. Drummond, arrived from England during the week. They are interested in the extra tunnel scheme between Manhattan and Brooklyn. Mr. Drummond, who is an Englishman, is president of the company organized to build the tunnel, and is also a director of the British Electrical Traction Company, which proposes to run electric omnibuses to and from the termini of the tunnel, which will begin at Ann Street and Park Row, and end at the Brooklyn Borough Hall. Mr. Hoadley is chiefly interested in the omnibus end of the proposed enterprise, and is looking to the construction of an omnibus on the English plan to suit American ideas. It is said between $5,000,000 and $6,000,000 in capital, partly English and partly American, is back of the project. The followig men are interested: Earl Gray, Lord Kintore, Sir Charles Rivers Wilson and Washington Humes.

A strike is imminent on the Manhattan elevated railway in New York unless a settlement is arranged between the company and its engine drivers. Electricity is being substituted for steam on the road, and the engine drivers are employed as motormen. The men assert that they were to be employed as motormen under the changed conditions, and were to work 10 hours a day receiving $3.50 as their wage for the same. Instead, it is said, they are compelled to work 11 and 12 hours a day and receive no compensation for the overtime. A nine-hour day is asked for and pay for overtime. Unless the company complies 500 men it is feared may go out.

It is stated that the Miller electric train signal system (fully described in the Western Electrician February 15) will be installed by the New York Central and Hudson River Railroad Company in the Park Avenue tunnel within a short time. This system will be remembered as one employing electricity as an operative force and having as a main feature the use of two incandescent lights in the engine cab, one of which burns red on danger and the other white on safety, both lights never being off at the same time, unless the circuit is broken and the system out of working order. The railroad company has been making elaborate tests with the system during the last week, and says that no fault can be found with the manner in which it has worked. In order to give the system a more perfect test and to satisfy the least incredulous, Mr. Miller is having 10 engines equipped at his own expense. Mr. Miller is a Chicago man and until recently was superintendent of telegraph for the Alton railroad.

The installation of electric power on the New York Central and Hudson River railroad, which was spoken of in my last letter, will cost the company at the outset $10,000,000. This is for the installation of 100,000 horsepower.

Directors of the Manhattan Railway Company say that the statement for the year ended June 30th shows over six per cent. earned on the stock. The last lear has been most successful to the company.

The Brooklyn Rapid Transit Company shows a decrease of $15,000 in the gross and net earnings of the company for the month of June, 1902, as compared with the same month last year.

The Staten Island Electric Railroad Company and the New York and Staten Island Electric Company were sold at auction on the 6th inst. The property of the first-named was bought in for $250,000, and the other for $10,000. The purchaser in both cases was W. L. Bull, chairman of the reorganization committee, formed to control both properties. The two concerns have been in the hands of a receiver since March 1st. They are now to be incorporated on September 1st as the Richmond Light and Railroad Company.

On the 8th instant, a blaze in the basement of the Western Union Building stopped the entire telegraph system in the city for half an hour. Sixteen dynamos operating the lines are located in the basement and these were put "out of business" by the water used in extinguishing the fire.

It is rumored here that Jacob L. Greatsinger has resigned his position as president of the Brooklyn Rapid Transit Company. No definite information can be obtained as to the veracity of the report.

The Minneola, Roslyn and Port Washington Traction Company of Roslyn, N. Y., has been incorporated to operate a road on Long Island 10 miles long. The capital stock is $150,000. Among the directors are Isaac H. Odell and Frederick H. Parker of New York city.

New England News.

Boston, Mass., August 8.—The White Mountain Paper Company has purchased a waterpower at Bonny Eagle, Maine, and the electric railway between that town and Saco, Maine.

Stone & Webster of Boston, who control the electric railways of Columbus, Ga., have secured a waterpower extending some eight miles along the Chattahoochee River. A dam 47 feet high and a power plant will be built, the latter with a maximum capacity of 20,000 horsepower, which will furnish electric power for railways, lights and mills.

The New London (Conn.) Street Railway Company has elected the following-named officers: President and secretary, Walter Learned; treasurer, W. A. Tucker of Boston; directors, W. A. Tucker, Walter Learned, Horace C. Learned, Billings P. Learned, ex-Congressman Augustus Brandegee and William Belcher.

The Maine and New Hampshire Railroad Company has filed articles of association with the Maine secretary of state. It proposes to build an electric railway between Hiram, Oxford County, Maine, and Biddeford, York County, Maine, via Baldwin, Standish, Cornish, Limington and Dayton, with a branch through Limerick, Waterboro, Newfield, Shapleigh and Acton; another from Cornish to the state line, via Parsonfield, and another from Limington to Windham, via Standish, Sebago Lake and Gorham. The latter branch will connect with Westbrook, Windham and Naples railway at Windham. The line will be 90 miles long—the longest electric railway in Maine. The company has a capital of $400,000 and the directors are George B. James of Boston, A. Crosby Kennett of Conway, N. H., E. E. Hastings and Henry Andrews of Fryeburg, Maine, and Leslie C. Cornish of Augusta, Maine.

The Uxbridge and Blackstone Street Railway Company is building eight miles of electric railway between Millville and Whitinsville, Mass., which will complete the direct electric line between Worcester, Mass., and Providence, R. I. It is expected that the line will be in operation by September 1st.

The Greenfield Company has been organized at Waterville, Maine, with a capital of $50,000, nothing paid in, and proposes to manufacture street-railway supplies and appliances. Cyrus W. Davis of Waterville, Maine, is president, and Ralph M. Gilmore of Waterville, Maine, is treasurer.

The Norfolk and Bristol Street Railway Company is planning to build an electric railway between Wrentham and Walpole, Mass. It has recently opened a line between Foxboro and Wrentham.

The Stamford Street Railway Company's electric railway to Sound Beach, Conn., and the Greenwich Tramway Company's electric railway to Mianus Bridge, Conn., have been completed and contractors are working on the line between Sound Beach and Mianus. These are the last links in the continuous electric railway between New York and New Haven, Conn.

Norwich, Conn., has completed the preliminary legal formalities incident to the establishment of municipal gas and electric plants. It proposes to purchase the plant of the Norwich Gas and Electric Company, which has voted to sell. The company has filed a schedule of its assets and has fixed its price for the plant at $797,329. The city considers this exorbitant, and, at its request, Judge Gager of the Superior Court decided to appoint a commission of three persons to determine the market value of the property. The parties at interest are to agree upon the members of the commission.

J. Dana Bickford, a New Hampshire inventor, has bonded an estate at West Medford, Mass., where he proposes to establish a home for aged inventors who are unable to support themselves. The home will have a workshop in which the inmates can develop their ideas.

The Pettingell-Andrews Company, dealer in electrical supplies, has leased the Faulkner Building at the corner of Atlantic Avenue and Pearl Street, Boston, for a long term of years. The building contains six floors and a basement, each floor having over 10,000 square feet of space. The company will use the upper floors for manufacturing.

Electricity has replaced steam as power in the two largest shoe factories in Lynn, Mass. The power will be furnished by the Lynn Gas and Electric Co. Four electric motors will be used—one of 75 horsepower in the smaller building, and three of 30 horsepower each in the larger building.

The strike on the Fair Haven and Westville railway system has been settled. A committee of New Haven business men conferred with President Parmelee of the railway company on Friday, and they reached an agreement. The company will recognize the union, and thus practically concedes all the employes' demand. The company began running cars for passengers at 8 p. m. to-day.

A broken trolley wire came in contact with the top of an express wagon in Hyde Park, Mass., Wednesday night, and the current therefrom tore the top from its fastenings, wrecked the front spring of the wagon, and threw the wagon's contents into the street. The driver was thrown into the air, but he escaped serious injury.

The New Britain (Conn.) Common Council has directed the corporation counsel to apply for an injunction against the New York, New Haven and Hartford Railroad Company, enjoining the operation of electric cars by the third-rail system.

The Methuen (Mass.) selectmen have granted a location in that town to the Lawrence and Methuen Street Railway Company, whereby the latter can connect with the Southern New Hampshire system at Haverhill, Mass., and make a direct electric-railway line between Lawrence and Haverhill, Mass.

B.

Canadian Intelligence.

Ottawa, Ont., August 9.—Some very large transformers have been put in operation at Chambly and Montreal by Ahearn & Soper of Ottawa. These transformers are 20 in number and have a total capacity of 750,000 lights. By the use of the transformers the current at Chambly is raised to a voltage of 25,000 and transmitted at that pressure to Montreal, where it is again lowered to 2,000 volts. Ahearn & Soper have also reecived the contract for the equipment of the new Levis County railway, which will operate in Levis, opposite the city of Quebec, and will connect the town of Levis with St. Romauld de Etchemin Bienville and St. Joseph.

Messrs. Hare of Toronto have patented an electric train signal, which has been thoroughly tested under all sorts of conditions. Engines are protected with this device and warned by the ringing of a bell in the cab upon the approach of any other train within a distance of half a mile in front or behind the engine, thus preventing all possibility of collisions.

The Ontario government has so modified the regulations governing the grant of additional water privileges at Niagara Falls, to the Ontario Power Company, that no further opposition is anticipated from the Canadian Power Company, the original lessee of the Falls power. Both companies will proceed now on a basis of 50,000 horsepower development each, and it is understood that the bulk of the power has already been arranged for. The Toronto-Niagara Power Company, which will bring the Canadian companies' power to the city of Toronto, expects to use about 20,000 horsepower in the city and the immediate vicinity.

The Electric Tram Company of Halifax, N. S., has been paying its conductors and motormen 15 cents per hour. On August 1st a sliding scale went innto effect, under which these men will hereafter receive 14½ cents per hour during the first year of service, 15½ cents the second, 16 cents in the third, 16½ cents in the fourth, and 17 cents in the fifth.

W.

From the Buckeye State.

Cleveland, Ohio, August 9.—Attorney-general Sheets has appealed the injunction suit against the three-cent-fare roads in Cleveland (mentioned in the Western Electrician last week) to the Supreme Court and will have a hearing there. An ordinance for the proposed routes was vetoed by Mayor Johnson, in order to test the sincerity of persons bringing suits on the complaint that the proposed lines would damage their property. Judge Caldwell, who granted the temporary injunction against the City Council, was not present when his decision was reversed.

The Cleveland Electric Illuminating Company has returned for taxation this year $818,197, instead of $489,698, which was the amount returned last year. The manager says that the company has spent about $400,000 in additions and repairs, which makes the difference in the returns.

In the case of the state against Chauncey A. Graham, charged with shooting at a Columbus, Buckeye Lake and Newark Traction Company's lineman, Police Judge Dick of Columbus held that if linemen persist in trespassing upon private property, the owner is justified in shooting them. Graham was dismissed by the court.

The net earnings of the Toledo, Bowling Green and Southern Traction Company for the month of July were $12,342.47, an increase of $4,847.81 over the same month last year. This road is rapidly becoming one of the best properties in the state and its stock is rapidly increasing in value.

G. M. Hodges of Dayton, Ohio, has purchased the property and franchises of the Merchants Traction Company of Anderson, Ind., for the Richmond and Northwestern Traction Company, and it will be used to form another link in the proposed system which is to connect Cincinnati and Chicago. The road will extend from Anderson to Newcastle and will parallel the Pennsylvania between Anderson and Richmond. It is to be completed by January 1st.

It is rumored that there have been negotiations

again for the merging of the Cincinnati, Dayton and Toledo Traction Company and the Toledo, Bowling Green and Southern Traction Company, but they have not been confirmed. Such a move would go far toward solving the problem of reaching the lake from Cincinnati by electric line.

The Cleveland and Sharon Traction Company of Cleveland has been incorporated with a capital stock of $10,000, to construct and operate a line from Cleveland to Sharon, Pa. This is the line which has been mentioned by the Western Electrician which will operate in connection with the Cleveland and Eastern. T. C. Willard, C. W. Dille, C. G. Mullen, C. W. Noble and J. C. Young are the incorporators.

Judge F. E. Dellenbaugh of Cleveland, representing several capitalists, is projecting an electric line from Cleveland to New Baltimore. It is intended that the road shall run over a private right-of-way and that the power house shall be situated at a point where the road touches the Cuyahoga River.

The Toledo, Fayette and Western Railway Company of Toledo has been incorporated to build a line from Fayette, Fulton County, to the state line in Williams County. The capital stock is placed at $10,000. Luther Allen, L. C. McMillen and others are the incorporators. The proposed line is an extension of the Toledo and Western Railway Company's lines, and will be 40 miles in length. In Indiana it is intended that it shall reach Angola. The portion between Fayette and Pioneer will probably be completed at once, the surveys having already been made.

The Cincinnati Traction Company made its tax valuation $3,000 per mile, and the City Board of Supervisors added $1,000 per mile, which was accepted. The company's total valuation in the city is $1,751,433.49, and that in the county outside of the city is placed at $311,769.48. The Cincinnati Gas and Electric Company added about $500,000 to its tax value over last year.

The Electrical Supply and Construction Company of Zanesville has been incorporated with a capital stock of $10,000 by Gilbert Snyder, J. B. Rhodes, A. T. Brennan, R. J. Moore and S. M. Winn.

The net earnings of the Cincinnati, Dayton and Toledo Traction Company for the month of July were $11,050, as compared with $11,585.47, in 1901. However, the gross receipts showed a gain of over $8,000. This company has just taken over the Miamisburg and Germantown Traction Company and the Hamilton and Lindenwald Electric Transit Company, which will likely make some difference in the net earnings for a time. Nearly $16,000 was deducted from the earnings for taxes and interest also. O. M. C.

Information from Indiana.

Indianapolis, August 11.—The State Tax Board has made a material increase in the valuation of interurban electric-railway property. Last year the value was placed at $7,746,452, this year at $9,655,492, an increase of $1,909,040. The Indianapolis, Greenwood and Franklin Railroad Company is assessed at $9,000 a mile, the same as last year, the Indianapolis and Greenfield Rapid Transit Company at $11,000 a mile, instead of $7,000, last year, and the Union Traction Company at $13,000, against $8,000 last year. Rolling stock and improvements on right-of-way were likewise increased. The Indianapolis Street Railway Company's assessment is increased $1,500 a mile, or $32,000 per mile for its 109½ miles.

The Ohio and Indiana Construction Company of Fort Wayne has been incorporated with $600,000 capital stock. The purpose is to build and equip street or electric railroads and power houses in Indiana and Ohio. Henry C. Paul heads the board of directors. The Muncie and Portland Traction Company has been incorporated with a capital of $100,000. The company will build a line from Muncie to Portland. The Union Traction Company is behind enterprise, and will operate the line when completed. The Newcastle, Muncie and Alexandria Traction Company has incorporated to construct electric lines in and between Newcastle, Mount Summit, Springport, Oakville, Cowan, Muncie, Alexandria and Normal City. The capital is $10,000. E. T. Ice and C. C. Hunt are among the incorporators.

C. M. Kirkpatrick of this city has received a contract to build an extension for the Indianapolis and Eastern Railway Company from Knightstown to Dublin, a distance of 18 miles. He is under bond to complete it by October 10th. After this contract was let the officers of the Richmond Interurban Company and the Dayton and Western Traction Company of Ohio held a conference in this city and entered into a contract whereby the former is to build east to the state line in Indiana and the latter west to the state line in Ohio. This will complete the chain of electric lines between Indianapolis, Dayton, Cincinnati, Piqua, Columbus and other Ohio cities.

Judge Gamble of Logansport holds that a street or interurban railway is an additional burden to the land of the adjacent property owners, and that such land owners must be compensated before a traction company can occupy the highway. This decision is regarded as very important, and an appeal has been taken to the Supreme Court.

Special Judge Rabb, at Logansport, dissolved the injunction of Boyd & Murdock restraining the Northern Traction Company from constructing its line on a strip of ground secured through condemnation proceedings, holding that the company has the power to exercise the right of eminent domain and to condemn property. The Northern Traction Company needed a strip of land 30 feet wide and 2,000 long in order to reach Spencer Park. Boyd & Murdock bought the strip, paying $2,400 for it. In the condemnation proceedings the appraisers valued it at $1,200, and the company paid this to the court and proceeded with the work of construction until enjoined. As soon as the injunction was dissolved 200 men were put to work and the track was laid in two hours.

The Indianapolis and Shelbyville line will establish traffic service between the two cities this week. An accident at the power house caused some delay. The distance is 27 miles, and the fare will be 40 cents.

A. A. Boyd of Terre Haute has been named as receiver for the Lake Cities Electric Railway Company of Michigan City. Mr. Boyd succeeds I. I. Spiro, removed on petition of the stockholders.

The Jasper, French Lick and Northwestern Traction Company was granted a franchise to build an electric road into Mitchell. The road will do a freight and passenger business, but its main purpose is to tap the coalfields of Dubois County.

The interest of the Goshen and Eastern Interurban road has been revived, and it is announced that the road will now be built without further delay. The road will connect Goshen with Toledo, through Lagrange, Angola and other towns. The power house is located at Angola. Waterpower will be used. The electric machinery has been ordered from the General Electric Company.

The war is over at Charlottesville. The quarantine against the Greenfield line is raised and the shotgun guards dismissed.

The Fort Wayne Electric Light and Power Company has been incorporated with a capital of $500,000. The company has applied for a new 40-year franchise, and offers to reduce the light bill for the city $15 per lamp per year, and to pay the city $120,000 for the franchise, in 40 annual instalments, all special taxes to be remitted.

The Interstate Car Company of Indianapolis has been incorporated to manufacture, repair, alter and construct all kinds of street and interurban cars, engines and machinery. John Groff heads the list of directors. F.

Northwestern Notations.

Minneapolis, Minn., August 9.—The Interurban Railway Company of Des Moines has completed work for its tracks into Altoona, 11 miles.

Surveys are in progress for an electric railway from Winona, Minn., to Rushford, about 50 miles. Several routes are being surveyed.

The council of Anoka, Minn., has served notice upon the Water Works and Electric Light Company to insulate all its wires properly. This is the result of the recent death of a boy from coming in contact with a live wire which was hanging close to the ground.

J. W. Steed is an applicant for a competing franchise for electric lighting at Anoka, Minn.

The La Crosse and Eastern railway has been granted a franchise into Viroqua, Wis. A right-of-way will be secured from La Crosse to Viroqua at once.

A new electric-lighting plant is being installed at Brookings, S. D., and will soon be completed.

The Superior Suburban Railroad Company has filed articles of incorporation from Superior, Wis., having a capitalization of $25,000. The company proposes to build an electric line to the southern boundary of the county and also other lines. The ultimate plans of the company include a network of lines covering the county.

Washington, Iowa, is taking bids for the construction of a municipal electric-light plant.

Benson, Minn., has voted for the purchase of the electric-light plant. The power station will be removed at once to the waterworks pumping station and both will be operated from the one plant. A number of changes and improvements to the light system are projected.

The electric-light plant at Rockford, Iowa, has been sold by Barkee & Harrtleib to Mr. Warfel of Illinois.

E. S. Shepard is applicant for an electric-lighting-plant franchise for Rhinelander, Wis.

J. H. Martin seeks a franchise at Green Bay, Wis., and announces his intention of constructing an electric car line from Kaukauna to Green Bay.

Employes of the street-railway company at Everett, Wash., were recently surprised by receiving a voluntary raise in wages from the company.

The Winnipeg Electric Street Railway Company will proceed to build a line to St. Boniface, having been granted a franchise in that place.

Thomas Baker, Jr., Alex Stern and E. A. Hughes of Fargo, N. D., have applied to the council of Aberdeen, S. D., for a franchise for a competing electric-light plant.

The Minneapolis General Electric Company will make extensive changes and improvements to its Fifth Street station in Minneapolis. Two additional stories will be built to the building and storage batteries will be added to increase the power of the station by 1,000 horsepower, making a total capacity of 4,000 horsepower. R.

On the Pacific Slope.

San Francisco, August 6.—It is reported in San Francisco that representatives of a Philadelphia corporation have examined the valuable water supply of the South Yuba Ditch Company, with a view to purchasing the water ditch and the electric-power systems owned by the latter company. If the sale is made, it will be principally as a water proposition, although the three valuable electric-power plants of the Central California Electric Company will be included. The properties in question afford one of the best examples in the state of an economic and profitable use of waterpower. The water is first sold to miners, is used three times to produce electric power, and is finally sold to farmers for irrigation purposes in the lower valleys. Electric power is transmitted to Sacramento and vicinity. The third plant at Alta is now being completed.

The Cloverdale Electric Light and Power Company will take steps at once to build its electric-power plant on Sulphur Creek, near Cloverdale, Cal. Contracts will soon be let for the dam, pipe line and reservoir. The initial installation will be about 400 horsepower. Electric power will be transmitted to Cloverdale, Asti and other points.

The Standard Electric Distributing Company is laying underground conduits in Mission Street and the cross streets, San Francisco. The ducts are of paper and asphalt pipe, four inches in diameter. The old underground electric-power system purchased from the Pacific Power Company is being rebuilt and extended. The Standard Electric Company's transmission lines have been completed to San Francisco, and when the distributing system is finished the city will be supplied from Electra, 145 miles distant.

The electric-light plant in the Yosemite Valley, Cal., has been completed and will be turned over to the Yosemite Valley commissioners on August 10th. The hotel, cottages and roads in the valley will be illuminated. It is a waterpower plant and was installed under the supervision of C. L. Cary of San Francisco.

The United Railroads of San Francisco will construct a new sub-station at San Bruno, where two 500-horsepower rotary transformers will be installed. These machines will be operated by the three-phase current generated at the company's new power station now in course of construction at North Beach. This is expected to be in runnnig order by next October. The rotary transformers will supply a direct current at 600 volts for the operation of the electric cars to San Mateo. This line will be completed about the end of the year.

The sale of the Del Monte and Pacific Grove railway, in Monterey County, Cal., to a company composed of Los Angeles and eastern capitalists was recently consummated. The new company, of which O. Z. Hubbell of Los Angeles, Cal., is the president and J. M. Gardiner, vice-president, paid about $52,500 for the property. It also has an option on the gas and electric-light plant at Monterey. The plans of the new owners include the converting of the present horse-car line into an electric road, and the building of electric-light and gas works. The money for these improvements, amounting to $180,000, will be partly supplied by a bond issue. The road is now 4½ miles in length, but this will be increased to five miles by the extension of the Santa Cruz and East Santa Cruz line to Capitola.

There has been a good deal of delay in commencing the new plants of the California Power Company at Los Angeles, Cal., but now that $3,000,000 of a $10,000,000 bond issue has become available, construction will be pushed rapidly. This company is a successor to the Southern California Power Company and is allied to the Redlands Electric Power Company and the Edison Electric Company of Los Angeles.

The Fullerton, the large sailing vessel recently built for the Pacific Oil and Transportation Company of San Francisco, has been equipped with an electric-lighting plant. This large oil carrier is one of the first sailing vessels on the coast to be equipped with electric lights. The plant consists of two General Electric slow-speed, direct-current generators, driven by a gasoline engine.

The Vancouver Power Company, with headquarters at Vancouver, B. C., has just let a contract for the construction of a 13,000-foot tunnel through the mountains separating Lakes Beautiful and Coquitlam. The company will at once proceed with its preparations for installing its power plant as soon as the tunnel is constructed. A.

W. W. Gurley, counsel for the Union Traction Company of Chicago, appeared before the Board of Review recently to plead on behalf of the company against the increased assessment of its personal property. The assessment in 1901 was $10,634,500, and this year it has been raised to $15,550,000 notwithstanding the fact that the company's schedule was placed this year, and correctly so, says Mr. Gurley, at $7,788,335. Mr. Gurley also entered a protest against the increased assessment of the personal property of the Consolidated Traction Company. This company's assessment was raised from $1,602,923 to $4,818,485.

PERSONAL.

H. F. Porter of Cincinnati has succeeded A. S. Thompson as superintendent of the Paducah (Ky.) Street Railway Company.

Lord Kelvin of Glasgow, Scotland, was granted a United States patent on August 5th for an electric-current measuring instrument.

W. A. Freese has been appointed superintendent of telegraph for the Chicago and Alton railroad lines, with headquarters in Bloomington, Ill.

William H. Tucker succeeds M. E. Satchwell as superintendent of the Jacksonville (Fla.) Street Railroad Company. Mr. Tucker is also manager of several other properties in Jacksonville.

George L. Lindsley, president of the Lindsley Bros. Company, Chicago, wholesale producer of cedar poles, is about to make an extensive trip through Idaho, Oregon and Washington in the interests of his company. Mr. Lindsley will be absent about a month, during which time he will go thoroughly into the cedar-pole situation in the West.

A. L. Havens, who for the last six years has been city salesman for the Western Electric Company in Chicago, has accepted the management of the sales department of the Kilbourne & Clarke Company at Seattle Wash. Mr. Havens will also act as representative of the Western Electric Company and the Warren Electric Manufacturing Company.

Professor S. W. Stratton, director of the National Bureau of Standards, Washington, D. C., is taking a trip through Europe for the purpose of studying the scientific equipment of similar foreign institutions. He will also investigate the present status of the metric system in Europe so he can give the committee of Congress the latest information in regard to its uses abroad.

A public celebration of John Fritz's eightieth birthday and of the foundation of a memorial in his name will be held in New York city on October 31st. The memorial will consist of a fund which will provide for a medal to be awarded every year "to the originators of the most useful scientific or industrial achievements, in perpetual honor of John Fritz and to the glory of engineering." The competition will be open to the world.

President Clarence Buckingham of the Northwestern Elevated Railroad Company has turned over to Chicago's special parks commission $1,500 to be used in fitting up the new playground at Larrabee Street and North Avenue, given by the company, and has promised $500 more, if necessary. Mr. Buckingham is considering a plan to create another playground under and beneath the company's tracks. The site under contemplation is between Schiller Street and North Avenue.

Richard Emory has been appointed general manager of the Columbus, London and Springfield Railway Company and the Columbus, Grove City and Southwestern Railway Company, in place of H. A. Fisher, who resigned some time ago to give his attention to the Columbus, Delaware and Marion Railroad Company. Mr. Emory has had a great deal of experience in the electric-railway business, having been general manager of the Baltimore Traction Company, and connected with several other roads of equal importance.

The official publication of the press exhibition, which was recently opened at Copenhagen, Denmark, prints a letter from Thomas A. Edison in reply to queries as to his opinions concerning motor, traction and aerial navigation. Mr. Edison's letter reads as follows: "I believe that within 30 years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horses almost entirely. In the present state of science there are no known facts by which one could predict any commercial future for aerial navigation."

As a result of an unfortunate quarrel over the settlement of an account Walter A. Scott, president of the Illinois Wire Company of Chicago, was killed on Saturday morning, August 9th, by Walter L. Stebbings, a well-known civil engineer and architect. The fatal wound was inflicted by a paper knife held in the hand of Mr. Stebbings and was evidently accidental. The affair occurred in the Monadnock Block in Mr. Scott's office. Since he has been taken into custody Mr. Stebbings has received many tokens of sympathy from fellow members of the Western Society of Engineers and other engineering friends. Mr. Scott left a widow and one son.

ELECTRIC LIGHTING.

Sturgeon, Mo., is anticipating the construction of a lighting plant.

Akron, Ohio, will advertise for bids for lighting the city on September 1st.

L. M. Able proposes to construct a lighting and power plant at St. Matthews, S. C.

The name of the Calumet Gas and Electric Company is to be changed to the Calumet Lighting Company. The company, which is said to be a personal enterprise of Samuel Insull, president of the Chicago Edison Company, has acquired the Harvey Water and Light Company, Harvey, Ill. Granger Farwell & Co. of Chicago negotiated the sale of the Harvey property, taking in payment $200,000 five per cent. five-year bonds of the United Water and Light Company, guaranteed by the Calumet Gas and Electric Company. The United Water and Light Company is a concern organized to operate the plant, while the Calumet Gas and Electric is a company that has been acquiring light plants in the towns to the south of Chicago.

ELECTRIC RAILWAYS.

Charles Henry of Anderson, Ind., has been granted a franchise to run the Rushville and Indianapolis Interurban line through Morristown, Ind.

The City Council of New Iberia, La., has granted a franchise to J. A. McIlhenny and F. F. Myles to run an electric railway through that city.

The Franklin-Southwestern Traction Company has been incorporated at Franklin, Ind., with a capital stock of $10,000. T. P. Ellsworth is interested.

The final survey for the trolley line between South McAlester and Hatleyville, I. T., has been approved by the secretary of the interior, and work will commence at once.

The earnings of the Chicago and Milwaukee Electric Railway Company for the month of July show an increase over the same month last year, in spite of the wet weather met with around Chicago. The figures in 1901 and 1902 are as follows: Gross earnings, July, 1901, $23,459; 1902, $23.590; gain, $131; operating expenses, July, 1901, $7,688; 1902, $7,586, decrease, $102; net earnings, July 1901, $15,770; 1902, $16,004, gain, $234. This is considered very satisfactory, as the July business is somewhat dependent upon excursions and picnic parties, and these the weather greatly interfered with.

It is reported that the Omaha (Neb.) Street Railway Company will shortly control all the railway lines in Omaha, Neb., and Council Bluffs, Iowa. The company is said to have obtained control of the Omaha and Council Bluffs Railway and Bridge Company, which owns all the street railways in Council Bluffs, as well as the line connecting the two cities, including the bridges over which the lines pass. Besides the above, the Lake Manawa, East Omaha and Omaha and Suburban, it is said, will soon come under the one management. Important improvements, involving the expenditure of $1,000,000, are in the future plans of the company.

SOCIETIES AND SCHOOLS.

The Augustus Lowell Electrical Engineering Building of the Massachusetts Institute of Technology at Boston is rapidly approaching completion. The contract for the new building was signed June 28th and it is to be completed by September 15th. The building is of temporary construction and covers 40,000 square feet. The chief room is an experimental power house 42 by 324 feet in size. The building has no basement, is one story high, and will contain 47 rooms. The steel used in the building all came from Germany, as it was impossible to obtain it in this country in time. The contractor directs the building operations with the aid of field glasses, telephones and a megaphone.

The local associations at Chicago of the National Association of Stationary Engineers have made arrangements with the Dearborn Drug and Chemical Works to use their offices and laboratories, situated on the first floor of the Rialto Building, 145 Van Buren Street, as headquarters for the delegates and visitors going through Chicago on their way to the convention at Boston, on Saturday and Sunday, August 30th and 31st. The offices will be open at six o'clock Sunday morning and remain open until train time. Refreshments will be served. Arrangements have been made to take care of the ladies, and they will be taken to the depot in carriages. Delegates and visitors are requested to take their grips and baggage direct to these headquarters.

PUBLICATIONS.

There has been so great a demand for the Buffalo Forge Company's improved ventilators that the catalogues describing them have been exhausted, and the company has been compelled to get out a new edition.

The American Miniature and Decorative Lamp Company of 436 Broome Street, New York, has issued an attractive "miniature" catalogue which illustrates and describes its many styles and varieties of miniature and decorative incandescent lamps. The booklet is 2½ by 3½ inches in size and is substantially bound in black leather.

The seventh annual report of the Meteorological Observatory of St. Ignatius College, Cleveland, has recently been issued. This is the institution of which Rev. F. L. Odenbach, a well-known meteorologist, is director. Part I. is devoted to a description, with illustrations, of his ceraunograph or lightning recorder. Part II. discusses the weather-map index and catalogue prepared at the observatory, and the last few pages describe an interesting observation of the Hevelian halo around the sun, probably the first glimpse of it in the twentieth century.

The New York Times has secured the triangle bounded by Broadway, Forty-second Street and Seventh Avenue, and will at once begin the erection thereon of a large, modern steel-construction building, primarily for its own use. This is a very excellent location—one of the most prominent in New York—and the Times gives a pleasing demonstration of its strength and enterprise by securing it. The New York Times is one of the very best of the daily newspapers of the country. It is one of the few that treat technical subjects with intelligence; and in every other way, also, it has merited success.

ELECTRICAL SECURITIES.

The Commonwealth Electric Company of Chicago has just sold five per cent. bonds to the amount of $500,000. The proceeds of the sale will be used in connection with work on the $6,000,000 plant which the company is building. With the additional issue of $500,000, the total outstanding amount of bonds is $3,996,000. Recent sales of the issue have been at 107¼.

According to the Record-Herald of Chicago, a man largely interested in the electrical industry says: "I think it probable that the reported deal involving the Electric Storage Battery Company, the Stanley Electric Manufacturing Company and the General Electric Company, has been halted to await developments in the new battery which Edison has invented. Although it has been talked down in some quarters, the trade, while waiting for practical results, believes it is a good thing. Thomas A. Edison knows what he is talking about when it comes to electric batteries."

MISCELLANEOUS.

The Colonial Conference of the British Empire, on August 11th at its final meeting for this year, adopted a measure providing for the establishment of the metric system of weights and measures throughout the British colonies.

The International Towing and Power Company has been incorporated at Newark, N. J. The company proposes to operate canalboats in the different waterways of the country by means of electricity. Edward T. Maguffen, Millard W. Baldwin and Henry H. Picking are the incorporators.

The strike of the journeymen electricians of Galveston, Texas, which was inaugurated one week ago, has been declared off, the men having lost the struggle. The primary cause of the refusal of the contractors to recognize the union is said to have been the admission of inefficient men into the union. The contractors will continue to recognize the scale of wages and hours as before.

During a recent electric storm a storehouse at the United States Arsenal in Frankford, Pa., was struck by lightning, and 500,000 condemned cartridges exploded. Across the street from the storehouse Charles Leming's chemical works is situated, and almost the entire discharge of bullets was received by the chemical factory. The tiled roof was torn away and nearly every pane of glass in the factory was shattered.

Notices have been sent by the Subway Commission of Baltimore, Md., to the United Electric Light and Power Company and the Chesapeake and Potomac Telephone Company, giving them six months to put all of their wires underground in the congested sections of the city. The municipal authorities announce their determination to compel the burying of all wires in the congested district within the required time except the trolley wires, which, for the time being, will be allowed to remain overhead.

TRADE NEWS.

The Plumbing, Heating and Electric Company of Elyria, Ohio, has been incorporated with a capital of $10,000.

The Highland Canal and Power Company of Duluth, Minn., invites bids on electric machinery for its plant.

The Whitney Electrical and Development Company, Chicago, is said to have been recently organized with a capital of $56,000,000.

The Climax Electric Storage Battery Company of Portland, Maine, has been incorporated with a capital of $500,000. William Bowker and John Oldfield are the incorporators.

The International Battery Company of Chicago has been incorporated with a capital of $20,000. The incorporators are Edward W. Sweig, Paul A. Neuffner and Robert J. Slater.

J. Canham of Jamestown, N. D., asks bids on the following machinery: A 1,500-light dynamo, an 80-horsepower engine, and the other necessary equipment for a lighting plant of 3,500-light capacity. A sum of $4,000 will be expended.

The Dielectric Manufacturing Company, St. Louis, Mo., has been incorporated with a capital of $3,000. Its purpose is to manufacture, buy and sell insulating materials. Fred Schwedtmann and J. J. Kessler, Jr., are among the incorporators.

A large two-story building at the plant of the

National Carbon Company, Cleveland, Ohio, collapsed recently, destroying property to the extent of $100,000. The accident occurred at a time when no one was in the building, or many lives would have been lost. The building contained heavy machinery, used in crushing and mixing.

C. H. Race, 20-24 Fairmont Avenue, Jersey City, N. J., announces that he has purchased the business of the Signaloid Chemical Works of that city, manufacturers of Signaloid, a frosting compound for incandescent lamps, and other chemical specialties. Hermon Greeder, chemist, founder and former owner of the works, is on an extended western trip in the interest of the firm.

The National Light, Heat and Power Company has been incorporated at St. Louis, Mo., with a capital stock of $1,500,000. The shareholders are all prominent St. Louis business men. The company was organized for the purpose of owning, controlling and exploiting all fundamental principles of the application of oil as fuel in burners for domestic use and under boilers for locomotives, steamships and manufactories.

The Treasury Department is inviting sealed proposals until August 29, 1902, for manufacturing and placing in position in complete working order combination gas and electric-light fixtures in United States public buildings in the following-named cities: Oskaloosa, Iowa; Hot Springs, Ark.; St. Cloud, Minn.; and Joliet, Ill. Prospective bidders will be furnished with drawings, specifications and blank forms of proposal upon application to the superintendent of the Treasury Department, Washington, D. C.

Sealed proposals will be received at the office of the supervising architect at the Treasury Department, Washington, D. C., for the installation of conduit and electric wiring systems for the United States postoffices at Oakland, Cal., Abilene, Texas, and New Brunswick, N. J. Plans and specifications may be obtained at the supervising architect's office, Washington, D. C., or at the offices of the superintendents of construction on the grounds. The bids will be received and opened as follows: Oakland, Cal., until 2 o'clock p. m., September 18th; Abilene, Texas, until 2 o'clock p. m., September 17th; New Brunswick, N. J., until 2 o'clock p. m., September 11th.

The General Electric Company has chartered a ship at New York which is to be used by the company for a large shipment going to Japan. The cargo will be composed of 1,000 tons of electrical machinery and appliances, including a complete line of lamps, fan motors, trolleys, controllers, dynamos, etc. The factories at Schenectady and Lynn will supply the cargo, the Lynn plant supplying 100 street-car motors which are to be in the shipment and Schenectady the remainder.

The Lindsley Bros. Company of Chicago, one of the largest producers of cedar poles, announces that it has secured the services of J. Alexander Navarre, who is known extensively among the producers and users of cedar poles, especially in the Central states, through his 10 years' connection with W. C. Sterling & Son. Mr. Navarre will be assistant manager of the Lindsley company, and part of his time will be spent on the road calling on his numerous friends. Mr. Navarre's headquarters will be at the main office of the company in Chicago. Although the Lindsley company is at present doing a very large pole business, it is confidently expected that with the acquisition of so well posted and energetic a man as Mr. Navarre its business will be greatly benefited. The Lindsley company has offices and extensive yards in Portland, Ore., and Spokane, Wash., and makes a specialty of the large poles produced by those states.

BUSINESS.

The Westinghouse Electric and Manufacturing Company reports the sales of Westinghouse integrating wattmeters for the month of June to have been the largest in the history of the company. The sales of Westinghouse transformers have more than doubled in the last six months, and the transformer-building capacity of the company has been largely increased to meet the demand for O. D. and type-N transformers.

Francis Beidler & Co., West Twenty-second and Loomis Streets, Chicago, have recently closed a large contract for all the poles and ties to be used in the construction of the extension of the Ottumwa Traction and Light Company's electric railway, which is being built from Ottumwa to Oskaloosa, Iowa. The firm says it has ample facilities for taking care of this business, and that this contract, though large, only cleans up a surplus of certain sizes, so that its stocks continue unbroken, and it is ready for more business.

The Replogle Governor Works of Akron, Ohio, expect to ship shortly, through the Pelton Waterwheel Company, New York, five sectroidal relay governors and three duplex relay governors to Spain. These were contracted for in the face of Swiss and German competition. One of the Replogle Works' latest differential relay governors has just been shipped to the Rochester (N. Y.) Gas and Electric Company, and one of their relay returning governors has been sent to the Montreal Cotton Company, Valleyfield, Que. Electrical relay governors will shortly be shipped to the Shattuck & Babcock division, American Writing Paper Company, DePere, and to Eben Stevens, Quinebaug, Conn. The firm considers the business outlook very good.

The A. G. Schoonmaker Company of 126 Liberty Street, New York city, reports a very satisfactory state of trade. This company is the representative of the Eager Electric Company of Watertown, N. Y., builder of direct-current apparatus, and among its recent installations of the Eager apparatus may be mentioned J. H. Lebkuecher, Newark, N. J., six 150-kilowatt generators; the Analomink Paper Company, Water Gap, Pa., one 30-kilowatt generator; the Black River Traction Company, Watertown, N. Y., three 200-horsepower railway generators and one 50-kilowatt booster set. The Schoonmaker Company carries in stock a full line of Ward Leonard automatic starting boxes, and a full line of smaller new motors in 220 volts and 500 volts. The shipment of rebuilt cars and motors is conducted from shops in Brooklyn. Recent shipments were a large vestibuled motor car for the Moline, East Moline and Watertown Railway Company, and several open cars to the East Bangor, Portland and Delaware River Street Railway Company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 5, 1902.

706,009. Belt-tightener. Norman C. Bassett, Boston, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 5, 1900.

An electric motor has an idler pulley mounted on its shaft which keeps the belt tight by means of a spring.

706,011. Art of Controlling Electrical Switches Operated by Electromagnets. Frank Bourne, Mt. Vernon, N. Y., assignor to the McElroy-Grunow Electric Railway System, Bridgeport, Conn. Application filed November 8, 1901.

The method consists in controlling the movements of the movable part of the switch by two magnetic forces which act upon magnetically independent magnetic masses carried by the part and in such manner that when the circuit is first closed they act conjointly and afterward oppose each other.

706,012. Electromagnetic Switch. Frank Bourne, Mt. Vernon, N. Y., assignor to the McElroy-Grunow Electric Railway System, Bridgeport, Conn. Application filed November 8, 1901.

The switch has a fixed and a movable terminal, a movable part carrying the movable terminal provided with two magnetizable parts, together with a magnet coil adapted to magnetize both of the parts in such manner as to act conjointly to close the switch and ultimately to oppose each other.

706,017. Dynamo-electric Machine. James Burke, Berlin, Germany. Application filed June 26, 1900.

The pole piece has a separable extension which is magnetized directly by the magnet winding of the machine.

706,019. Hoisting Mechanism. Charles W. Carman, Chicago, Ill. Application filed June 27, 1901.

See issue of next week.

706,020. Train-control System. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 7, 1901.

A number of step-by-step controllers, provided with electrically controlled actuating devices, are combined with two working conductors, switch arms automatically operated by the controllers to connect the actuating devices with each conductor alternately, one or more master controllers, a helix in circuit with each conductor, and a locking device for the master controller operated by the helices.

706,039. Electric Regulator. Augustine R. Everest, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 9, 1900.

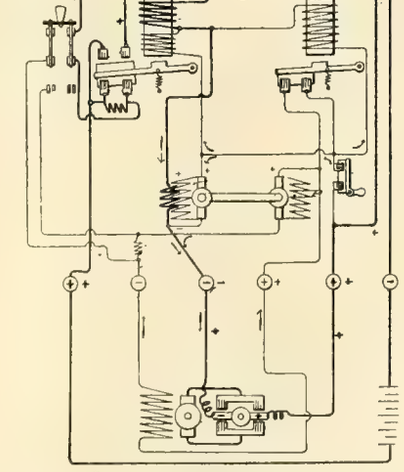
A regulating winding is connected to a row of contacts, and a circuit having one terminal connected to a movable contact co-operates with the row of contacts and the other terminal to a switch-arm adapted to make electrical connection with either of two of the contacts of the row of contacts.

706,047. Prepayment Electric Meter. George L. Gowlland, Peterborough, Canada. Application filed August 21, 1901.

Combined with the motor supported on a suitable frame and having one circuit wire extending therethrough and the other circuit wire and contacts separating the ends of the same, are a gravitating coin-slide, a lever suitably pivoted and supporting the slide at one end, the counter-vailing weight at the opposite end of the lever, the contacts connected to the lever and rotatable current indicating means interposed between the slide and the motor and operated from the latter whereby when the slide is depressed by the coin the contacts are thrown in and the measuring means set in motion.

706,053. Means and Appliances for the Manufacture of Covered Strips of Soft Metal for Electrical or Other Purposes. Isaac W. Heysinger, Philadelphia, Pa. Application filed December 4, 1901.

The means consist of one or more braiding machines provided with a cup beneath adapted to hold a supply of liquid cement, guides adapted to carry a continuous soft-metal strip down through the cement, and thence up to and through the braiding machine, feed rolls adapted to pass the strip through the machine continuously, a twin-needle sewing machine adapted to receive two of the covered soft-metal strips from the braiding machine, and suitable means for subsequently receiving the completed fabric in separate strands.



NO. 700,085.—LIGHTING AND POWER SYSTEM.

706,055. Time-limit Circuit-breaker. Henry M. Hobart, Berlin, Germany, assignor to the General Electric Company, Schenectady, N. Y. Application filed January 5, 1901.

A circuit-breaker having a tripping coil normally connected to the circuit upon which the circuit-breaker operates, is combined with electro-reactive means for causing the current in the tripping coil to vary slower than the current in the circuit.

706,082. Automatic Pole-reverser. Morris Moskowitz, Brooklyn, N. Y., assignor to James H. Young, trustee, New York, N. Y. Application filed August 27, 1901.

Combined with an electric generator and its armature, are means for automatically reversing the polarity of the generator, consisting of a friction pulley and brake operated by the armature shaft of the generator, a centrifugal governor connected thereto, and a switch controlled by the movement of the pulley.

706,083. Automatic Switch. Morris Moskowitz, Brooklyn, N. Y., assignor to James H. Young, trustee, New York, N. Y. Application filed September 28, 1901.

Combined with a series and shunt-wound electromagnet are a pivoted switch-arm actuated by the electromagnet and provided with guides for a weight and a weight fitted to the guides and sliding thereon and having integral with it two clamping jaws and a clamp screw by which it may be fixed in position.

706,084. Automatic Switch. Morris Moskowitz, Brooklyn, N. Y., assignor to James H. Young, trustee, New York, N. Y. Application filed September 28, 1901.

As a means for actuating the switch when the direction of rotation of a rotary part reverses, there is provided a rotary mechanism and connections for positively, in contradistinction to frictionally, engaging and actuating the switch in a direction corresponding to the direction of rotation, and means for retracting the engaging part when a predetermined speed of rotation is exceeded.

706,085. Electrical System for Lighting and Power. Morris Moskowitz, Brooklyn, N. Y., assignor to James H. Young, trustee, New York, N. Y. Application filed September 28, 1901.

The electrical system has a work circuit, a storage battery with connections for supplying the work circuit, a generator subject to variations in speed, and connections therefrom for supplying the work circuit and for charging the battery. A motor dynamo is connected to derive its motor current from the generator and has connections for exciting the field coils of the generator. Means are provided for regulating the strength of the field of the generator, and there are a circuit maker and breaker for the connection from the generator for supplying the work circuit and battery, and automatic means for closing the circuit maker when the desired electromotive force of the generator is attained. (See cut.)

706,092. Trolley-pole Catch. James A. Norton, Wilkesbarre, Pa., assignor of one-half to Michael C. Malloy and James F. Munday, Wilkesbarre, Pa. Application filed November 19, 1901.

A pivoted vertically swinging trolley pole is combined with means operated by the downward movement of the pole for automatically locking the pole in its depressed position when the pole is thrown downward.

706,099. Electric Furnace. Arthur Parker, Chorley, England. Application filed May 8, 1901.

See page 103.

706,106. Electric Railway. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 18, 1896.

The invention consists of a third-rail conductor the continuity of which is interrupted at stations or other predetermined points, sectional conductors at the points of interruption, traffic rails divided electrically into sections

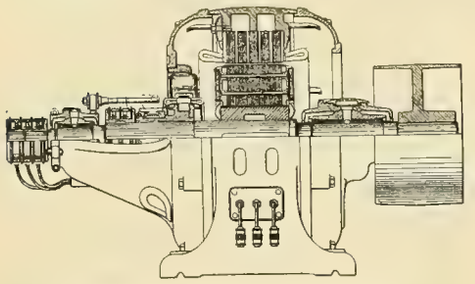
at the points of interruption, and energizing coils for circuit-closing switches permanently included in circuit between the traffic-rail sections and the negative conductor. The arrangement is such that the coils are energized by the main-line current after it has passed through the propelling motor or motors.

706,108. Dynamo-electric Machine. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 13, 1900.

An internal revolving field alternator is provided with an exciter or regulating machine therefor having its armature synchronously rotatable with the revolving-field member of the alternator. Collector rings are connected to the armature, and other collector rings are connected with the revolving-field member. (See cut.)

706,117. Clutch for Induction Motors. Alfred Schwartz, Munich, Germany, assignor to the Helios Electricitaets-Aktiengesellschaft, Cologne-Ehrenfeld, Germany. Original application filed March 18, 1901. Divided and this application filed October 28, 1901.

The clutch consists of a belt pulley mounted on a journal and provided with clutch jaws for engagement with the interior wall of the pulley to release the retaining means whereby the jaws engage the extended cylindrical wall of the pulley.



NO. 706,108.—DYNAMO-ELECTRIC MACHINE.

706,123. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. N. Y. Application filed June 30, 1900.

See page 104.

706,126. Electric Controlling Apparatus for Elevators. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed January 31, 1902.

A motor and its supply line are combined with a controlling circuit of lower potential than the line deriving its energy from the supply line, and means for varying the power of the controlling circuit for doing work without varying that of the line.

706,128. Electric Furnace. Edward R. Taylor, Penn Yan, N. Y. Application filed April 4, 1901. Renewed January 2, 1902.

See page 103.

706,143. Means for Controlling Electric Circuits. James J. Wood, Fort Wayne, Ind. Application filed June 28, 1901.

In the electric distributing system are combined a dynamo, a main circuit conductor and branch lines normally fed therefrom, an automatic circuit-breaker in the main circuit at the central power station, a line switch in each line, and means for operating the line switches from the power station. (See cut.)

706,156. Electric Railway. Charles R. Campbell, New York, N. Y. Application filed December 28, 1900.

A sectional third-rail electric railway for sending electric cars in opposite directions over the same track has a third-rail conductor, a main feed wire carrying the working current, means for diverting an auxiliary or shunt therefrom having changeable groundings through mesne contacts, multiple switches and wiring adapted to form separate pathways for grounding the auxiliary current in opposite directions, and supplementary wires carrying independent currents for actuating the switches.

706,165. System of Electrical Distribution for Carlighting Purposes. John L. Creveling, New York, N. Y. Application filed December 7, 1900.

In the system are combined a generator, a main circuit and electromagnetic means for controlling the magnetization of the generator, a work-circuit and electromagnetic means for controlling the work circuit, the last means being adapted under predetermined conditions to act magnetically upon the first means to cause them to vary the magnetization of the generator.

706,169. Antiseptic Telephone Mouthpiece. William M. English and George A. Burns, San Francisco, Cal. Application filed October 28, 1901.

The mouthpiece consists of an outer and inner shell having an intervening unfilled and unobstructed space, openings from the space through the inner shell, and means for discharging an antiseptic or sterilizing substance through the openings so that it may freely circulate throughout the space.

706,194. Insulator. Louis McCarthy, Boston, Mass. Application filed May 26, 1902.

The insulator comprises oppositely disposed recessed metallic portions, an intermediate portion of insulating material, means for securing the insulating material to the metallic portions, and a mass of molded insulating material filling the space between the proximate ends of the metallic portions.

706,211. Trolley Wheel. Rudolph H. Apelt, Boston, Mass. Application filed March 30, 1901. Renewed December 19, 1901.

The wheel has two flange plates, slidable on the hub, and an oil chamber formed by the two flange plates around the hub and within the tread-ring.

706,218. Electric Signaling System and Apparatus Used Therein. Robert G. Callum, Washington, D. C. Application filed January 9, 1902.

The system combines a normally closed metallic circuit connecting the place to be signaled from with a signal-receiving station, a ground connection in the circuit dividing the batteries thereof, one or more signaling instruments within the circuit adapted to ground the circuit automatically and transmit signals therover at both sides of such ground, and means for indicating an increase of current through the first-mentioned ground connection.

706,219. Method of Operating Electric Railways. Charles R. Campbell, New York, N. Y. Application filed May 6, 1902.

The method of operating electrically driven cars in either direction is described. It consists in leading a power current along the line, diverting a portion of the current to form a divisionary shunt controlled by switches for use in fixing the direction the cars shall take, going or coming, leading two supplementary currents along the line independent of but paralleling the power current for momentarily energizing one or the other of the double solenoids, providing a changeable route for such divisionary, and controlling by switches the grounding of the shunt independently toward the right or left.

706,226. Electric Train Connector. Charles E. Felt and Daniel A. Kimbark, Chicago, Ill. Application filed November 29, 1901.

The device consists of a female member, a male member insertible transversely therein and means for locking the members together.

706,251. Mechanical Telegraph Transmitter. Joseph W. McDonald, Larimore, N. D. Application filed January 27, 1902.

A series of disks are loosely mounted on a frame and a series of contact blocks of different widths are arranged in the periphery of each disk and represent a single letter or character of the telegraph code. Contact brushes arranged in pairs are adapted to bear upon the peripheries of the disks, the brushes of each pair being insulated from each other and one being connected to the line-wire and the other to the battery. A series of levers with keys therefor are also provided.

706,281. Means for Transmitting Movements and Indicating Positions Electrically. Wilhelm A. Thiermann, Hanover, Germany. Original application filed November 12, 1901. Divided and this application filed April 4, 1902.

In the system are combined one apparatus consisting of a bipolar rotor without windings and a stator having a primary winding, which is connected to a source of electricity, and also a secondary winding, with one or more apparatuses, consisting of a bipolar rotor without windings and a stator having only one winding, whose sections are respectively connected to the sections of the secondary winding at the corresponding points

706,283. Electric Glass Furnace. August Voelker, Cologne, Germany, assignor to Company l'Industrie Verrières et ses Derivés, Brussels, Belgium. Application filed April 25, 1901.

See page 103.

706,286. Brush Holder. Frank T. Weidaw, Syracuse, N. Y. Application filed February 10, 1902.

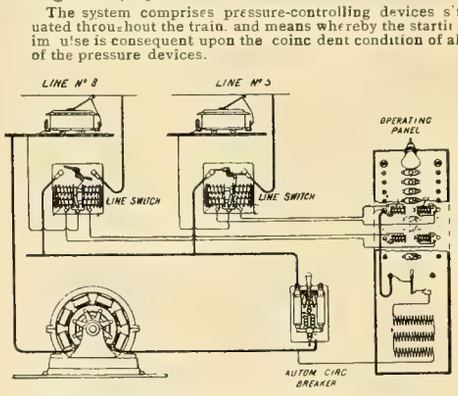
The holder comprises a support, a laminated bow-spring having opposite ends secured to the support and its central portion movable toward and away from the support, and a brush clamp secured to the central portion of the spring.

706,291. System and Apparatus for Transmitting Carriers in Pneumatic Dispatch Tubes. Birney C. Batcheller, Philadelphia, Pa. Application filed November 3, 1899.

The pneumatic transmission system described comprises a series of stations, outgoing and incoming transmission tubes connecting the stations in pairs, air compressors situated in separate stations of the series connected to force air into the receiving ends of the tubes and draw air from them at points adjacent to their delivery ends, electric motors in the separate stations connected to drive the compressors, an electric generator common to the system, and circuit connections leading therefrom to the motors.

706,295. Starting Mechanism for Trains. John B. Blood, Newburyport, Mass. Application filed August 28, 1901.

The system comprises pressure-controlling devices situated throughout the train, and means whereby the starting impulse is consequent upon the coincident condition of all of the pressure devices.



NO. 706,143.—CIRCUIT-CONTROLLING MEANS.

706,308. Telephone Circuit. Marcia J. Farnham, Wellesley, Mass., administratrix of Isaiah H. Farnham, deceased, assignor to the New England Telephone and Telegraph Company. Application filed July 2, 1901.

A number of pairs of paper-insulated conductors are mentioned the conductors of each pair being evenly and equally twisted together throughout their length, and each twisted pair evenly and equally twisted with another twisted pair, the two pairs that are twisted together being insulated from any other conductor.

706,313. Incandescent Electric Lamp. Howard Gilmore, Boston, Mass. Application filed April 7, 1900.

In the lamp are a leading-in wire comprising a piece of wire (such as platinum or nickel) coiled at one end and another piece of more fusible wire such as copper with its end in that coil and held therein by a melted portion of the more fusible metal flowing into the coil and cooling between the spires of the coil and the wire within the coil.

706,314. Compound Incandescent Electric Lamp. Howard Gilmore, Boston, Mass. Application filed February 7, 1901.

Two incandescent lamps are combined, one with a fine filament, the other with a coarser filament and means are provided for passing the current through the lamp with the coarser filament to bring that lamp alone to full glow. Means are also provided for passing the current through both lamps in series and so reducing the amperage that only the lamp with the fine filament will be brought to full glow. (See cut.)

706,317. Electric Motor. Albert B. Holson, Chicago, Ill. Application filed November 4, 1901.

One claim reads: In an electric motor, the combination of a rotary armature, a drive shaft rotating therewith, a pinion on each end of the shaft and a surrounding driven member provided with duplex parallel annular gears having their pinion-engaging surfaces facing toward each other and respectively engaged with the pinions in diametrically opposite relation, whereby the driving moment of the motor is simultaneously imparted to the driven element through both pinions.

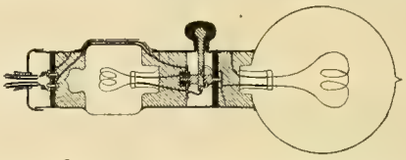
706,318. Composite Electric Circuit. Martin H. Howell, Melrose, Mass., assignor to the New England Telephone and Telegraph Company. Application filed June 24, 1901.

For this and succeeding patent see page 108

706,319. Telephone Circuit. Martin H. Howell, Melrose, Mass., assignor to the New England Telephone and Telegraph Company. Application filed June 19, 1901.

706,338. Trolley-wire Finder. Louis C. Nolan, St. Paul, Minn. Application filed April 11, 1902.

The wire finder has diverging extended forks adapted to guide the wire to the groove of the trolley wheel when the finder is actuated.



NO. 706,314.—COMPOUND INCANDESCENT LAMP.

706,340. Battery. William L. Panikoff, New Haven, Conn. Application filed March 18, 1902.

One claim reads: In a battery the combination with the plates thereof; of a cell; a rest upon which the cell is adapted to stand so that the mouth thereof will be under the plates and in a line therewith; an elevating lever one end of which is secured to the rest; and means for operating the other end of the lever so that the cell may be raised to contain the plates.

706,361. Instrument for Measuring Electric Currents. William Thomson, Glasgow, Scotland. Application filed December 30, 1897.

The instrument combines a coil or solenoid, a plunger reciprocating in the coil or solenoid, a beam carrying a pointer, a segment and an adjustable counterbalance weight a ligament secured at one end to the segment and at the other end supporting the plunger, a rod attached to the plunger, having a disk, and a vessel for containing fluid in which the disk is immersed to control the movement of the plunger.

706,384. Fire-alarm Telegraph System. Robert G. Callum, Washington, D. C., assignor to the Callum Fire Signal Company, Washington, D. C. Application filed October 5, 1899. Renewed January 11, 1902.

A normally closed main electric circuit is combined with a fire-alarm box included in the circuit, successively acting signal-transmitting instruments operated by clock-trains, a controlling electromagnet a closed local electric circuit, an open local electric circuit, and a thermostat adapted to open the closed circuit through the electromagnet and release the clock-trains when the temperature reaches a predetermined degree of heat and close the open circuit through the fire-alarm box when the temperature reaches a predetermined higher degree of heat.

706,406. Current Meter. George L. Gowlland, Peterborough, Canada. Application filed March 22, 1902.

The parts of a current-meter in which a magnetic flux is employed for giving movement to the indicating mechanism, comprise a revoluble member, a magnet and a flux plate connected with the magnet and extending therefrom to a point adjacent to the revoluble member.

706,436. Apparatus for the Electrolytical Treatment of Ores or Slimes. Frank T. Mumford, Kalgoorlie, Western Australia, Australia. Application filed September 30, 1901.

An apparatus for the extraction of metals from their ores and slimes comprises a metallic drum, a copper lining therein, means to maintain the lining continually amalgamated, a trailing electrical contact for the drum, a plurality of conductive bars passing longitudinally through the drum and insulated therefrom, and means to rotate the drum.

706,444. Composition for Use in Secondary Batteries. Carl T. J. Oppermann, London, England. Application filed January 11, 1902.

The lead oxide constituting the active material is combined with bitumen in solution so as to render the active material harder and more coherent.

706,478. Fluid-pressure Electric Switch-controlling Apparatus. August Sundh, Yonkers, N. Y., assignor to the Electrite Company, New York, N. Y. Application filed December 16, 1901.

A snap-switch is described which combines stationary and movable contacts, a lever carrying the movable contacts, and a fluid-pressure-operated lever whereon the contact-carrying lever is pivoted, and having opposing springs for actuating the contact-carrying lever in opposite directions.

706,500. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring and the Consolidated Wireless Telegraph and Telephone Company, Philadelphia, Pa. Original application filed October 25, 1901. Divided and this application filed May 10, 1902.

A receiver is described which comprises a plurality of plates in inductive relation, means for permanently charging the plates and a local circuit controlled by the plates.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, AUGUST 23, 1902. No. 8

Electrical Mine Equipment of the C. & C. Shaft at Virginia City, Nev.

By Leon M. Hall.

When the mining properties on the Comstock Lode were first developed operations were carried on by means of steam-generated power, wood being used as the fuel. This was very costly on account of the scarcity of wood. The milling was, until quite recently, done at a distance of some 15 miles from the mine, at a point on the Carson River where cheap waterpower could be obtained. About two years ago the question of electrical transmission for the purpose of supplying power for deep mining operations on the Comstock Lode was taken up, and since then extensive hydraulic developments have been carried out at Floriston, Cal., on the Truckee River. Power is now transmitted 35 miles to the mines in Storey County, and a dozen or more of the properties have been equipped with electrical machinery. Among these is the C. & C. shaft of the Consolidated California and Virginia Mining Company, which has a world-wide reputation as a bullion producer.

The power plant on the Truckee River is about two miles east of Floriston. The river is dammed just below the Floriston Pulp and Paper Mill, and the water is conveyed about 600 feet through a canal, and then 8,600 feet through a wooden flume six feet eight inches high and 10 feet wide, to a point directly above the generating station. It is then conducted through two wooden stave pipes, 160 feet long and six feet in diameter, to the wheels, upon which there is a head of 84½ feet. There are two pairs of 27-inch horizontal McCormick turbines, direct-connected to Westinghouse, three-phase, 60-cycle generators of the revolving-armature type. These generators are separately excited by two 22½-kilowatt, direct-current machines. The wheels will each develop 1,400 horsepower at 400 revolutions per minute, with the above head of water. They are regulated by two type-B Lombard governors. A view of this station is shown in Fig. 1.

Current is generated at 500 volts and is raised to 24,000 volts by means of six 300-kilowatt oil-insulated transformers, at which potential it is transmitted 33 miles over a double circuit of No. 4 hard-drawn copper wire, to the sub-station at Virginia City. The line is composed of square redwood poles 30 feet in length, with pine cross-arms and locust pins, upon which are mounted 7½-inch Locke insulators. The telephone circuit is carried on the same poles by oak brackets with pony insulators. At the sub-station at Virginia City the potential is lowered to 2,300 volts by means of six 450-kilowatt, Westinghouse, oil-insulated transformers, and at this potential current is distributed to the various mining companies. The distribution circuits are composed of weatherproof wire, and are designed for four per cent. drop under full load. The generating station at Floriston is constructed of brick, with a galvanized-iron roof, and the sub-station at Virginia City is entirely covered with corrugated galvanized iron. Fig. 3 gives a general view of the shaft and buildings of the Consolidated California and Virginia Mining Company and shows the sub-station at the left.

The plant has been in continuous operation since October 20, 1900. The Truckee River General Electric Company sells power to the various mining companies at $7 a horsepower a month, the amount used being based on a maximum-peak load of two minutes' duration. This, with other conditions, has made advisable the installation of machinery of the very highest grade and the introduction of some features which are rather unique in character. In the C. & C. shaft at Virginia City every precaution has been taken to secure thorough reliability and the highest efficiency.

The electrical machinery in operation on the surface comprises a 200-horsepower, 2,200-volt, three-phase induction motor, geared to a balanced electric hoist. This machine is shown in Fig. 5 and will be described later. A 100-horsepower, 2,200-volt induction motor is belted to a 16½ by 30-inch, single-stage air compressor, and other motors consist of a 30-horsepower, 440-volt motor, operating circular saws, a 15-horsepower motor, driving tools in the machine shop, and a 10-horsepower motor, operating a Blake rock-breaker at the ore bin. The transformer equipment consists of three 15-kilowatt, indoor-type transformers, stepping down from 2,200 volts to 440 volts, and one five-kilowatt lighting transformer, transforming from 2,200 volts to 110 volts. These transformers are shown in Fig. 2. Illumination is supplied by two Manhattan arc lamps and 50 incandescent lamps, the remainder of the electrical apparatus on the surface consisting of the necessary lightning arresters, fuse blocks, cut-outs and switches.

The motor apparatus underground consists of the following: A 15-horsepower induction motor, operating at 440 volts and driving a fan on the 2,150-foot level; two 10-horsepower motors, driving fans on the 1,950-foot and 2,150-foot levels (the latter showing in Fig. 4); three 225-horsepower motors, operating at 2,200 volts, and geared to three duplex double-acting Riedler pumps located on the 2,150-foot level. On the 1,750-foot level are three 10-kilowatt transformers, transforming from 2,200 to 440 volts, and a three-kilowatt lighting transformer, transforming from 2,200 volts to 110 volts. On the 1,950-foot level are installed three 15-kilowatt transformers, transforming to 440 volts; two 15-kilowatt lighting transformers, transforming from 2,200 volts to 110 volts; three 10-kilowatt transformers, transforming to 440 volts, and a five-kilowatt lighting transformer, transforming to 110 volts. These transformers supply the motor and lighting circuits within the mine. All the motors and transformers are of the Westinghouse type.

There are 250 16-candlepower incandescent lamps scattered through the workings underground. A No. 6 B. & S., three-conductor, lead-covered cable armored with iron wire extends from the surface to the 2,150-foot level, and a No. 0, three-conductor cable runs to the pumps on the same level. The

Fig. 1. Truckee River Power Station. Fig. 3. Mining Shaft and Buildings, and Electric Sub-station. Fig. 2. Transformer Equipment in Surface Station.
Fig. 4. Electrically Driven Fan at 2,150-foot Level. Fig. 5. 200-horsepower Motor Driving Electric Hoist.

ELECTRICAL MINE EQUIPMENT OF THE C. & C. SHAFT AT VIRGINIA CITY, NEV.

weight of the No. 6 cable is six tons and of the No. 0 cable 10 tons. The cables were lowered down the shaft by means of the hoisting rope and then securely clamped to the wall plates. At each station a water-tight junction box is used, and the lead covering sweated into a tight-fitting sleeve located in the side of the box.

The power is brought into the works over two separate circuits, each of which is provided with a single-pole switch at the entrance of the building, and also a Westinghouse integrating wattmeter with its transformer. The pump circuit is further equipped with an ammeter, a frequency-indicator, a power-

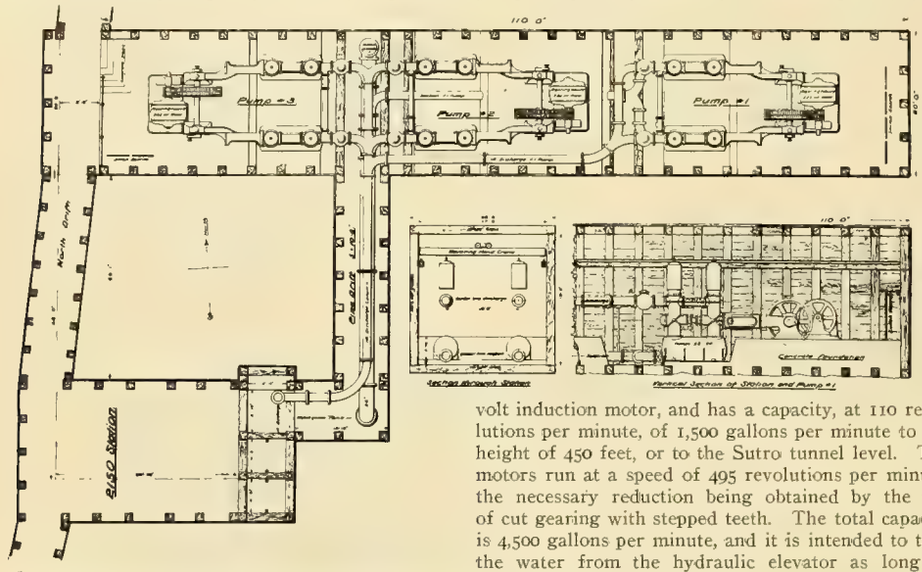


FIG. 6. ELECTRICAL MINE EQUIPMENT OF THE C. & C. SHAFT AT VIRGINIA CITY, NEV.—PUMPING STATION ON THE 2,150-FOOT LEVEL.

factor indicator and a static ground-detector. Oil-break switches are used on the cable circuits and upon all of the 2,200-volt motors. The smaller motors, both on the surface and underground, are equipped with auto-starters, quick-break switches and slate-base fuse blocks. Some of these machines are located in warm places and operate under severe conditions.

The entire installation is wired with lead-covered cables or with rubber-covered copper wire, mounted on glass insulators or porcelain knobs. The greatest care was used in installing the wiring, with the result that it is safe and gives absolutely no trouble. Candles have been entirely discarded, incandescent circuits having been carried directly to the working faces and into the stopes. The current is taken into the mine at a potential of 2,200 volts, through the cables above mentioned, and the potential is lowered in the mine by transformers, which are located as near as possible to the points of consumption.

The compressed-air plant on the surface, supplying air for drilling, for a number of underground hoists and for the hydraulic pump, consists of a 16½ by 30-inch Rand & Waring, single-stage air compressor, driven at 73 revolutions per minute by a 100-horsepower motor. The motor speed is 580 revolutions per minute, which is reduced by a countershaft with wooden-rim pulleys and rubber belting. No automatic regulator is used at the present time, as the compressor is working to its full capacity, and the motor is developing 96 horsepower.

The electric hoist is a decided departure from usual practice in deep-mine hoisting plants, and embodies what is commonly known as the balanced, continuous or tail-rope system. This was adopted in order to reduce the cost of operation, and also the size of the motor to the lowest size compatible with the duty required—viz., to hoist 500 tons daily from the 2,500-foot level by means of double-deck cages carrying 3,600 pounds of rock. The hoist consists, essentially, of a main driving drum and an idler, around which is wrapped a 1⅛-inch plow-steel wire rope. The rope passes down one compartment, around a movable tail sheave and up the other. One cage is inserted between the ends of the rope and the other fastened to it by means of heavy iron clamps. The main driving drum is geared to a 200-horsepower, type-F, variable-speed, Westinghouse, three-phase induction motor (Fig. 5), which operates at a maximum speed of 580 revolutions per minute, moving the cages through the shaft at 1,250 feet per minute. The speed of the motor is readily controlled by means of variable resistances inserted in the secondary winding, but external to the motor itself. The variation of the resistance is accomplished by the use of a special controller, resembling an ordinary street-car controller; the primary circuit is controlled by means of an oil-break switch. The hoist is equipped with heavy post brakes, hydraulically operated, and the machine is handled with remarkable ease. In tests that have been made these hoists show a net efficiency of about 75 per cent., counting all electrical and frictional losses.

The pumping plant consists of three duplex, double-acting 6 11-16 by 24-inch Riedler pumping engines, located on the 2,150-foot level, as shown in plan and elevation in Fig. 6. These pumps take their water supply from a tank on the east side of the shaft, just below the 2,150-foot station. Each pump is separately driven by a 220-horsepower, 2,200-volt induction motor, and has a capacity, at 110 revolutions per minute, of 1,500 gallons per minute to the height of 450 feet, or to the Sutro tunnel level. The motors run at a speed of 495 revolutions per minute, the necessary reduction being obtained by the use of cut gearing with stepped teeth. The total capacity is 4,500 gallons per minute, and it is intended to take the water from the hydraulic elevator as long as it is used as a sinking pump.

The pumps are located in a station 30 feet north of the shaft. This station is cut from the solid rock, and is 18 by 17 feet eight inches in section and 110 feet long. It is timbered with 14 by 14-inch pine timbers with three-inch planking. A drift, five by 10 feet six inches in section, connects it with the shaft, and ventilation is obtained by means of a small electrically driven blower. The motors are all wired with lead-covered cable and the station is lighted with incandescent lamps. A 10-ton hand crane travels the entire length of the station, so that the labor of handling and installing machinery has been reduced to a minimum.

This plant is undoubtedly one of the best and most complete mining installations in the world, and its operation has been entirely satisfactory, both in regard to economy and reliability. Up to the time when electrically transmitted power was adopted, the cost of motive power was never less than $20 per horsepower per month, while under existing conditions it is reduced to $7. For example, the cost of operating the 100-horsepower air compressor usually averaged about $1,800 per month, while to-day it is only $672. The entire plant was installed according to the plans and specifications of the writer and under the able direction of Superintendent Joseph R. Ryan. It has proved an unqualified success from the very beginning.

Cables Cut at Barcelona and Port au Prince.

The United States minister at Caracas, in Venezuela, gives the information that the revolutionists have cut the cable between Barcelona and Caracas. He says that cable connection stopped immediately after the receipt of a message at Caracas that the revolutionists were entering Barcelona (August 14). Information from Port au Prince, Haiti, brings news of the cutting of the cable between that point and Gonaives, Haiti. Port au Prince is situated on the west coast of the island to the south, and Gonaives is also on the west coast, on the bay of Gonaives, but toward the northwest corner of the island. The main cable, by means of which this information came, remains intact and will in all probability not be tampered with. This last-mentioned cable is the one the Machias was sent to protect, mention of which was made in the last issue of the Western Electrician.

Sandwich, Ill., has bonded itself in the sum of $9,000 to improve and remodel its lighting plant.

Carman Automatic Curtain Hoist.

Charles W. Carman of Chicago, formerly professor of physics at Lewis Institute, has devised a very useful automatic, electrical device by means of which the opaque shades of a lecture room or laboratory may be quickly closed or opened. The apparatus is perfectly automatic, all that is required of the operator being simply to turn the switch. As soon as the shades are closed or opened the mechanism is automatically cut out. The device, at the same time, operates the screen for projection.

Fig. 1 is a perspective view of a curtain-hoisting system that is constructed in accordance with Professor Carman's invention. The curtain (1) is connected to a drum by the rope (5) and the shades (3) (3) are each provided with a cord (11), which is secured to a rope (6), extending around the room beneath all the windows and wound about another flight of the same drum. The end of the

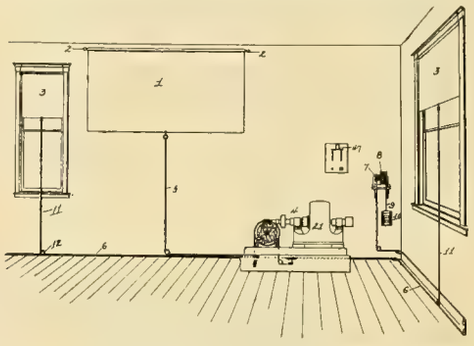


FIG. 1. CARMAN AUTOMATIC CURTAIN HOIST.—PERSPECTIVE VIEW OF SYSTEM.

rope (6) is provided with a weight (10), which tends to keep the rope taut, irrespective of the action of the curtain rollers. The two flights on the drum are of different diameters, to correspond to the different ranges of travel of the curtains.

The drum is connected to the motor (21), through a magnetic clutch and worm gear, as shown in Fig. 2. By means of the switch (47) the motor is operated in one direction or the other, depending upon whether the curtains are in their raised or lowered position. A limit stop is arranged to break the circuit through the motor armature and the magnetic clutch and change the connections when the curtains are in their extreme position. The clutch is immediately thrown out of action, holding the curtains in their position, while the armature comes to rest after overcoming its momentum. The curtains are restored to their original position by reversing the switch (47), which actuates the clutch and revolves the motor in the reverse direction until the circuit is again broken and the connection changed by the limit stop.

The invention of Professor Carman is covered by a United States patent (No. 706,019) issued on August 5th. It has been installed by him and is now in use in several high-school lecture rooms in this city and vicinity. Its operation is very satisfactory, especially as the curtain can be lowered or raised in less than half a minute, and after throwing the switch the operator can immediately give his attention to other work.

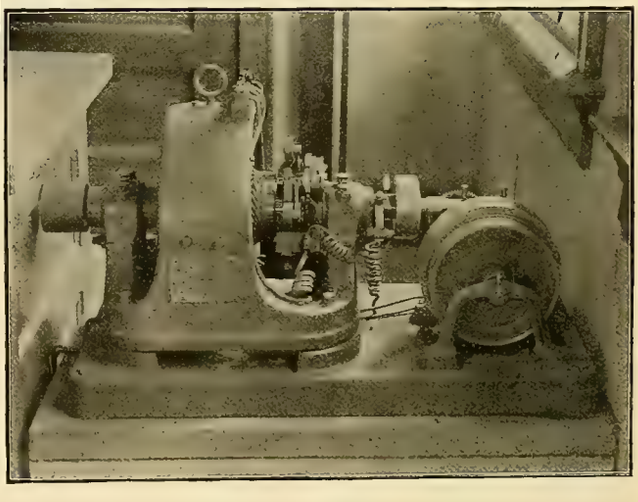


FIG. 2. CARMAN AUTOMATIC CURTAIN HOIST.—MOTOR AND HOISTING GEAR.

The large 47-foot electric cars on the Wentworth Avenue line in Chicago have cross-seats with center aisle and very large windows. They are used both summer and winter, but, although in other ways suitable for summer use, they afford smokers no place to enjoy the weed, except on the front platform. Many of the male passengers are now signing a petition asking the company to permit smoking on the three rear seats. Copies of the petition are found in the stores of druggists and cigar dealers along the line, who say the rule of the company has seriously injured their business.

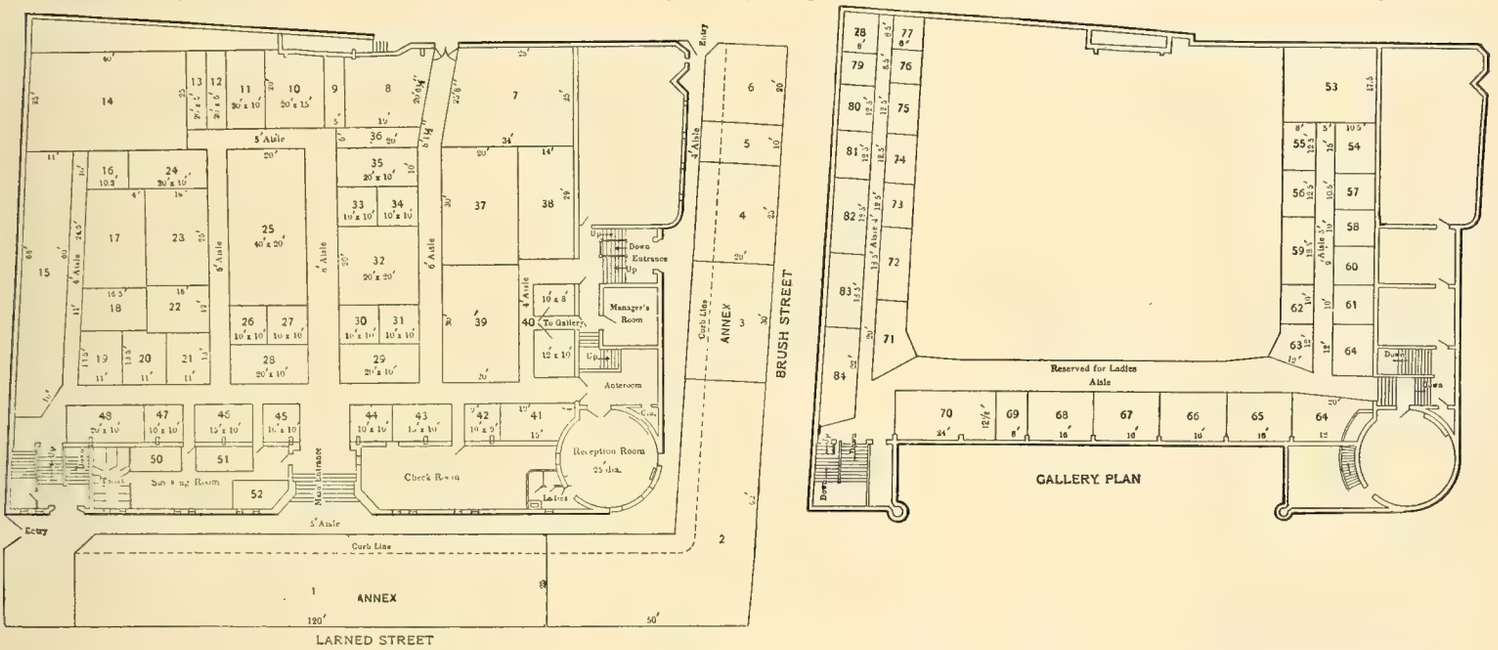
American Street Railway Association.

Practically all of the space available for exhibit purposes at the coming convention of the American Street Railway Association has been engaged. The convention is to be held in Detroit, Mich., on October 8th, 9th and 10th, and the exhibits will be displayed in the Light Guard Armory, a commodious hall, conveniently situated at the corner of Larned and Brush Streets, five blocks from the City Hall. The accompanying ground-floor and gallery plans of the building show the official arrangement of the floor space. The assignment of space is in charge of the chairman of the exhibit committee, John H. Fry, assistant general passenger agent Detroit United Railway Company, 12 Woodward Avenue.

Owing to the great demand for space it has been necessary to reduce the space of applicants for more than 100 feet by a reduction of about 33 per cent. The exhibition will open October 8th and the building will be open for the reception of exhibits, commencing Monday, October 6th. The building will be well lighted and current for special lighting and power will be furnished at the lowest market price. Other rules and regulations governing the exhibition have been issued in circular form by Mr. Fry.

A full list of exhibitors, giving the assignment and size of space with reference to the accompanying diagram is as follows:

Space.	Exhibitor.	Sq. Ft.
68	Adams & Westlake Company, 110 Ontario Street, Chicago	200
45	American Brake Shoe and Foundry Company, Mahwah, N. J.	100
42	American Car Seat Company, 18 Guernsey Street, Brooklyn	100
23	Knell Air Brake Company, Battle Creek, Mich.	400
5	Kuhlman, G. C., Car Company, Collingwood, Ohio	200
7	Lorain Steel Company, Lorain, Ohio	760
64	Ludlow Supply Company, Cleveland	300
63	Lumen Bearing Company, Buffalo	100
76	McLaughlin Car Coupler Company, 1624 North Ninth Street, Philadelphia	70
38	Magann, G. P., Air Brake Company, Detroit	450
52	Maltby Lumber Company, Bay City, Mich.	100
80	Monarch Fire Appliance Company, 27 William Street, New York	100
53	Morris Electric Company, 15 Cortlandt Street, New York	400
55	National Carbon Company, Cleveland	100
34	National Lock Washer Company, Newark, N. J.	100
73	Newcomb, F. H., 136 Flatbush Avenue, Brooklyn	100
83	New Haven Car Register Company, New Haven, Conn.	150
25	Northern Electric Manufacturing Company, Madison, Wis.	100
59	Nuttall, R. D., Company, Pittsburg	150
39	Ohio Brass Company, Mansfield, Ohio	600
71	Ohmer Car Register Company, Dayton	150
69	Pantasote Company, 29 Broadway, New York	100
14	Pennsylvania Steel Company, Philadelphia	1,000
40	Ridlon, Frank, Company, 200 Summit Street, Boston	200
61	Root Track Scraper Company, Kalamazoo, Mich.	100
19	Sherwin-Williams Company, Cleveland	150
46	Smith, Peter, Heater Company, Detroit, Mich.	150
57	Spear Carbon Company, St. Mary's, Pa.	100
1	Standard Traction Brake Company, New York.	
21	Standard Varnish Works, 29 Broadway, New York	150
25	Stanley Electric Manufacturing Company, Pittsfield, Mass.	400
60	Star Brass Works, Kalamazoo, Mich.	100
84	Sterling-Meaker Company,, Newark, N. J.	200
82	St. Louis Register Company, Security Building, St. Louis	150
29	Street Railway Journal, New York	200
28	Street Railway Review, Chicago	200



AMERICAN STREET RAILWAY ASSOCIATION.—DIAGRAM OF CONVENTION HALL IN DETROIT.

36	American Machinery Company, Grand Rapids, Mich.	100
33	American Railway Supply Company, 24 Park Place, New York	100
10	American Steel and Wire Company, Chicago	300
35	Atlas Railway Supply Company, 1523 Manhattan Building, Chicago	200
22	Berry Bros., Ltd., Detroit	200
51	Bidwell Car Telephone Company, Grand Rapids, Mich.	100
81	Bishop Gutta Percha Company, 420 East Twenty-fifth Street, New York	100
58	Brandeau, George F., 4 Oak Street, Utica, N. Y.	100
65	Brady Brass Company, 95 Liberty Street, New York	200
3	Brill, J. G., Company, Philadelphia	600
8	Brown, Harold P., 120 Liberty Street, New York	400
15	Christensen Engineering Company, Milwaukee.	800
44	Conant, R. W., 28 Williams Street, Cambridge, Mass.	100
37	Consolidated Car Fender Company, 39 Cortlandt Street, New York	600
47	Consolidated Car Heating Company, Albany, N. Y.	100
9	Continuous Rail Joint Company of America, Newark, N. J.	100
43	Crane Company, Chicago	150
11	Creaghead Engineering Company, Cincinnati	200
67	Curtain Supply Company, 93 Ohio Street, Chicago	200
66	Dearborn Drug and Chemical Works, Rialto Building, Chicago	200
20	Dolg-Stivers Manufacturing Company, Denver, Colo.	150
56	Duff Manufacturing Company, Pittsburg	100
30	Electrical Review, New York	100
25	Electric Storage Battery Company, Philadelphia	300
54	Garton-Daniels Company, Keokuk, Ia.	150
2	General Electric Company, Schenectady, N. Y.	2,000
62	Globe Ticket Company, Philadelphia	80
48	Gold Street Car Heating Company, New York.	200
31	Gould Storage Battery Company, 25 West Thirty-third Street, New York	100
18	Griffin Wheel Company, Chicago	150
70	Hale & Kilburn Manufacturing Company, Philadelphia	300
75	Ham Sand Box Company, Troy, N. Y.	100
6	Harrington, C. J., 15 Cortlandt Street, New York	400
12	Heywood Bros. & Wakefield Company, Wakefield, Mass.	100
72	International Register Company, 124 West Jackson Boulevard, Chicago	150
41	Johns (H. W.)-Manville Company, 100 Williams Street, New York	200
4	Taylor Electric Truck Company, Troy, N. Y.	500
26	Tramway and Railway World, London, Eng.	100
74	Union Stop and Signal Company, Fall River, Mass.	100
17	United States Steel Company, 145 Oliver Street, Boston	400
50	Universal Sanitary Cuspidor Company, Worcester, Mass.	100
24	Van Dorn & Dutton Company, Cleveland	200
24	Van Dorn-Elliott Electric Company	
13	Weber Railway Joint Manufacturing Company, 1645 Old Colony Building, Chicago	100
27	Western Electrician, Chicago	100
1	Westinghouse Electric Manufacturing Company, Pittsburg	3,000
1	Westinghouse Air Brake Company, Pittsburg.	
32	Wharton, William, Jr., & Co., Philadelphia	400
16	Wheel Truing Brake Shoe Company, 106 Miami Avenue, Detroit	100

The secretary of the association has announced a complete list of papers to be presented at the convention as follows: "The Registration of Transfers," by C. D. Meneely of the Brooklyn Heights Railroad Company; "The Benefit Associations," by Oren Root, Jr. of the Metropolitan Street Railway Company of New York city; "The Discipline of Employes by the Merit System," by W. A. Satterlee, general manager of the Metropolitan Street Railway Company of Kansas City, Mo.; "Transportation of Light Express and Parcel Delivery," by George W. Parker, general express and passenger agent Detroit United Railway Company; "Steam Turbine Engines," by E. H. Sniffin of New York; "Signals for Urban and Interurban Railways," by some officer of the Old Colony Street Railway Company of Boston; "Adjustment of Damage Claims," by M. B. Starring, counsel of the Chicago City Railway Company. Reports will also be presented by the committee on standards, through its chairman, N. H. Heft of New Haven, Conn., and by the committee on rules for the government of employes, through its chairman, J. C. Brackenridge of the Brooklyn Heights Railroad Company.

Winterset, Iowa, is to vote on further bonding the town to the extent of $10,000 for improvements in its light plant.

Admiral O'Neil on Submarine Boats.

Rear-Admiral O'Neil, chief of the Bureau of Ordnance of the Navy Department, in discussing submarine warfare recently gave out some interesting information in regard to the use of submarine boats in this country and abroad. He said:

"When I was in the harbor of Cherbourg, recently, I saw one of the French submarine torpedo boats darting around the harbor and apparently making very good speed. It sat very low in the water and was very pointed, and, in fact, one could not tell where it ended, except for a little flag which arose above the surface. We know very little about the French type of boat, as they are guarding it with the greatest of care. I understand, however, that it is run by storage batteries exclusively.

"The Holland, which is as yet the only submarine boat our navy has in commission, is propelled by gasoline on the surface and by storage batteries when running below. There was an explosion on board of the Holland the other day, and it was thought at first that it came from gasoline fumes, but the report of Lieutenant Caldwell states that the gasoline tanks were entirely empty at the time the explosion occurred, so that does away with the gasoline theory.

"The board of inquiry will probably find out what caused the explosion. Lieutenant Caldwell thinks it came from hydrogen gas, generated by the storage battery, which had just been charged, and ignited by a spark from a pipe or cigar, or something carried by the only man who was present when the explosion occurred. There may have been many accidents on the French torpedo boats from similar cause, as they are run by storage batteries, but, of course, they would not be made public.

"At the present time gasoline and storage batteries are used on all submarine craft, as far as I know. It would be impossible in those close quarters to use steam on account of the heat. Of course it will never be necessary for the United States to maintain as many submarine boats as France, but at the same time we should have a reasonable supply."

Electric-light Affairs in Edwardsville, Ill.

An unsuccessful attempt has been made to oust the Edwardsville (Ill.) Electric Light and Power Company from the town of Edwardsville. This company has been doing business in the town since 1892, and its franchise expires in October. It seems that there is bad feeling between the present company and the city officials, who have attempted to get a new company in the field. In this line the City Council granted a franchise for a lighting and power plant to J. R. Bennett, who was representing August Loeffler and William Gartner of Wyandotte, Mich. The last-named gentleman, after looking into the situation, decided that the old company could not be ousted, and that there was not enough business in the town (population, 4,200) to warrant the installing of a second plant, and withdrew from the field. In all probability the new franchise will be returned, as it is likely that Mr. Bennett will be unable to interest other capital in the enterprise. This is the second attempt that has been made to oust the established company, which, though having its troubles, still holds undisputed possession of the field. The first franchise was granted to Clark Smith of Muscatine, Iowa. Charles A. Vallette is secretary and treasurer of the Edwardsville Electric Light and Power Company.

Fessenden Wireless-telegraph System.

The technical features of the system of wireless telegraphy which has been developed by Professor Reginald A. Fessenden, under the auspices of the United States Weather Bureau, during the last two years, are covered in a series of patents issued last week. There are 13 of the patents, and they are numbered consecutively from 706,735 to 706,747.

The application for the first patent of the series was filed on December 15, 1899. This invention covers broadly Professor Fessenden's system of wireless telegraphy.

The object of the invention is to provide for the generation by currents produced by electromagnetic waves of currents in a second element or circuit and by the reaction of the current in this second element or circuit on the field formed or produced by the currents in the receiving wire to produce motion which is directly or indirectly observable. In general terms, the invention consists in the generation by electromagnetic waves of a current directly or indirectly in coils at the receiving station, the current in the coils inducing a current in another element or circuit which is arranged in such relation to the coils that the current induced therein reacts with the field produced by the coils, thereby producing motion.

Fig. 1 is a diagrammatic view showing the arrangements employed at the sending and receiving stations. The apparatus employed at the sending station may be similar to that now in use for the generation of electromagnetic waves and consists of an induction coil (1), having its primary coil in circuit with a generator (2), the circuit having a make-and-break mechanism (3) included therein. One of the discharging knobs or terminals (4) is connected with the vertical sending conductor (5), while the other knob or terminal is grounded. The inventor has found that by placing a capacity formed by a body (5^a) of conducting material having a comparatively large radiating surface the waves generated at the sending station have a very much higher energy, thereby correspondingly increasing the effect or energy of the current produced in the receiving conductor.

At the receiving station the receiving conductor is formed by a wire or wires (6), projecting up vertically or at an inclination to a suitable height, which are also grounded. A coil or coils (7) are arranged in the circuit of the receiving conductor (6), and an element or coil of wire (8), forming a closed circuit, is supported with a freedom of movement in such relation to the coil or coils (7) that the current produced by the electromagnetic waves will induce a current in the element (8). The element (8) is supported, preferably, in such manner that a plane at right angles to its axis will form an angle of approximately 45 degrees with a plane at right angles to the axis of the coils (7), so that the reaction of the current induced in the element with the field produced by the coils (7) will cause the element (8) to move with reference to the coils (7). This motion of the element may be observable by means of a mirror (9), attached thereto, reflecting a beam of light on a scale, or the element may form a part of the circuit of a recording siphon, etc.

A desirable means for transforming the electromagnetic waves into recordable motion is shown in Fig. 2. The element (8) is balanced on supporting rods or knife edges (13), one of which is formed of a good electrical conductor, as silver, the element (8) being preferably formed by a silver ring. A carbon block (14) is so arranged that a portion of the ring between the supporting rods will normally rest lightly thereon. This microphonic contact, the conducting pivotal support, and the portion of the

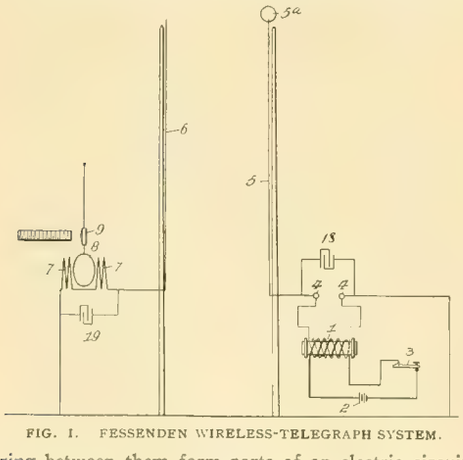


FIG. 1. FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

ring between them form parts of an electric circuit, which also includes a generator (15) and a recording instrument (16) as a telegraphic sounder or the receiver of a telephone. When a current is generated, as above described, in the coil (7), the element or ring (8) will be caused to press on the carbon block, thereby increasing its conductivity. When using a telephone receiver as a recording instrument, the generator (15) is preferably of a character capable of producing an alternating current, as such current causes a constant vibration of the diaphragm, the vibrations increasing in intensity with an increased flow of current in the circuit. This increase in intensity of action with increased flow of current is characteristic of this form of receiver and also of the form shown in Fig. 1. In this it is sharply differentiated from such devices as the coherer, which either give a strong indication or do not give any. This characteristic is advantageous, in that if the signal sent—say, a dot—be too weak to give an action of the full intensity, it may still in most cases be read and not missed entirely, which is of value in sending code messages.

As shown in Fig. 1, a condenser (19) may be connected in shunt with the field coil or coils (7) for the purpose of obtaining as large a current as possible in the field coil (7), as this increase in current will give a greater torque to the ring (8). When no condenser is employed, this large current must flow in the vertical wire, and there would be great loss of energy on account of the resistance of wire (6), and, further, without the condenser a large amount of energy will be required to give the statical charge to the receiving conductor. Hence, on account of the small energy furnished by the wave, a large current cannot be obtained in field coil or coils (7) without the condenser. By employing a condenser of the proper size current in wire (6) may be made to have a value equal to the difference between the current in the field coil or coils and the current in the condenser. Either of these currents may therefore be large, and either or both may be used to produce motion, while the current in wire (6) may be kept so small that there is practically no loss of energy on account of its resistance or of the statical charging of the receiver, and all the energy may be used in producing motion.

It is preferred to place a shunt circuit containing a condenser across the terminals of the induction coil at the sending station for the purpose of maintaining sustained radiation. This shunt circuit must be tuned to the receiving conductor; otherwise the oscillations produced by it will have no action upon the wave-responsive device at the receiving station. This shunt circuit, by virtue of its capacity, stores up an additional amount of energy, and when a spark passes across the gap, since the sending conductor can radiate energy at a given rate, it must continue to radiate for a longer time in order to dissipate this additional stored-up energy.

By the employment in the receiving instrument of a fixed coil or coils of few turns and a movable member formed by a thin light ring of highly conducting wire, high resonance effects combined

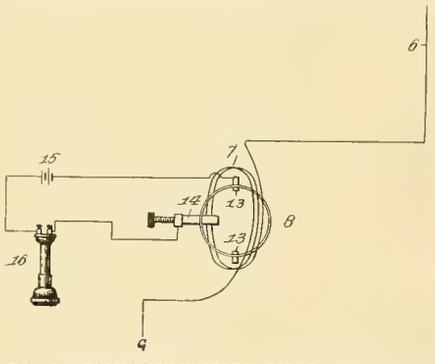


FIG. 2. FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

with a rapid natural period of the moving part and a maximum efficiency are attained, and the advantageous use of transformers is rendered possible.

It is characteristic of Professor Fessenden's method that the receiving mechanisms are actuated by currents produced by electromagnetic waves and not by voltages, as in the case of the coherer. Hence when the receiving mechanisms described herein are used in connection with a secondary circuit, the circuit is controlled by the currents generated by electromagnetic waves, and not by voltages. It is also characteristic that when a secondary circuit is used in connection with the type of wave-responsive device shown in Fig. 2, a portion of the secondary circuit is traversed and controlled by currents produced by electromagnetic waves. It is further characteristic of the system that the indications produced by the receiving mechanism described are dependent upon the total amount of energy emitted to form the signal, and are not, as in the case of the coherer, dependent upon the maximum of the voltage.

Another invention made by Professor Fessenden involves the "discovery of the desirability and practicability of using radiant electromagnetic waves of a frequency lower than has heretofore been recognized as desirable or practicable and in the devising of a considerable number of very meritorious features combined in an apparatus or system whereby the energy of such waves may be successfully radiated in quantities sufficient for practical use over long distances."

The amount of radiation possible for a given system is dependent, among other things, upon the frequency, and, other things being equal, the amount is less for the lower frequencies. In order, therefore, to radiate large amounts of energy by low-frequency waves, he takes advantage of the rise of voltage due to resonance effects brought about by a proper proportioning of inductance and capacity, so that the phases of the impressed electromotive force and the current coincide in time.

He makes the capacity large and the induction correspondingly small, thereby shortening the sending conductor and greatly reducing the resistance. The large capacity is distributed uniformly over substantially all of the radiating portion of the conductor, thereby further reducing instead of increasing the resistance and at the same time providing a large effective radiating surface. The further reason why the capacity is thus distributed is that with any other arrangement it is difficult to get a pure sine form of electromagnetic wave, because any local increase of capacity tends to produce two or more sets of waves of different periodicities. In order that large amounts of energy may be radiated, the radiating conductor over which the capacity is distributed is made a large fraction of the total length of the sending conductor. With this system, whereby large amounts of energy may be radiated at a low frequency, the inventor is able to substitute for the induction coil and spark gap now in use a dynamo or similar source of alternating voltage.

The invention described under patent No. 706,738,

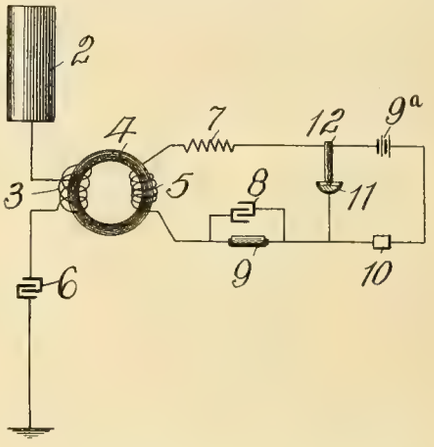


FIG. 3. FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

has as its object the provision of suitable means whereby a transformer or other inductive means may be employed for raising the voltage at the receiving station. It is also an object of the invention to increase the number of oscillations in the conductor during its discharging period, so that only a small fraction of the energy will be discharged or radiated at each oscillation, and also to provide for selective signaling by so tuning the receiving apparatus that it will respond solely to waves of one periodicity.

Fig. 3 illustrates diagrammatically the apparatus for the receiving station. At the sending station is employed a sending conductor, having a large capacity relative to that of a wire of the same height and of low self-inductance and resistance. At the receiving station the receiving conductor (2) may be similar to that at the sending station or of any other suitable form or construction. This receiving conductor, which is connected to ground, includes as a part thereof a transformer, as the inductance or coil (3), forming the primary of an induction coil, the core (4) of which is preferably formed of fine wire. The secondary coil (5) of the transformer forms a part of another or secondary circuit, which circuit, as well as the prime receiving circuit, consisting of the conductor (2), inductance (3), and capacity (6), (when used), is so proportioned that its natural period of electric oscillation is identical with that of the sending system. The tuning of the secondary circuit is effected by means of an inductance (7), and a capacity (8), included in the circuit. The inductance (7) employed in tuning the secondary circuit may be combined with and form a part of the secondary coil (5). When a coherer (9) or similar instrument is used as a receiver, the capacity (8) should be placed (if used) in shunt to the coherer, because thus advantage is taken of the resonant rise of potential in a shunt path between the lump inductance and capacity of a resonant circuit. The secondary circuit also includes a battery (9^a) and a relay (10) or other translating device. In order to prevent the local battery from operating the relay except when the coherer has been rendered conductive, an opposing source of voltage, preferably an electrolytic cell (11), (12), is bridged across the secondary circuit. This cell is so connected as to present a counter electromotive force to the local battery when the coherer is inoperative, but to permit the alternating current flowing through it, and so render the coherer operative.

By constructing the sending conductor so the oscillations for each total discharge are increased and by employing at the receiving station two or more tuned circuits a very perfect resonance or tuning between the stations can be attained.

One of the most important patents of the series is No. 706,742, and is entitled "Wireless Signaling." The invention has for its object a construction and arrangement of parts or elements whereby a rate of signaling higher than heretofore possible can be attained and over greater distances with much smaller expenditure of power than in any of the systems now in use. It is a further object of the invention to render the operation of the receiving mechanisms so positive and reliable as to make

possible the transmission of "code messages" and other desirable classes of work.

Fig. 4 is a diagrammatic view illustrating a form of sending and receiving apparatus. The inventor employs at each station a conductor (1) of any suitable form or construction, connected to one of the terminals of an induction coil (2) or other suitable voltage generator, the other terminal of the generator being grounded. A switch (3) is arranged in the controlling circuit of the generator, so as to permit of the generator being rendered inoperative when the apparatus is to be employed for receiving purposes. When sending, it is preferred that the generator—e. g., an induction coil—should be kept continuously in action; but the invention is not limited to such method of operation, as the ordinary method of sending by making and breaking the controlling circuit of the generator can be employed. When the generator is in continuous operation, a key (4) is employed for throwing the sending conductor out of tune with the station to which signals are being sent. This is effected not by making and breaking, but by short-circuiting, more or less, of the tuning device, which is arranged in series with the conductor (1), and preferably between the generator and ground. While any suitable form or construction of tuning mechanism may be employed, the construction shown in Fig. 4 is preferred. This construction consists, primarily, of one or more connected pairs of parallel wires or strips (5), forming a tuning grid and one or more movable contacts (6), adapted electrically to connect the wires or conductors of each pair. These wires are preferably arranged in a box (7), containing sufficient oil to cover the wires to a depth of an inch, more or less. This construction permits of the proportioning of the capacity and self-inductance, so as to obtain a pure sine wave, as is necessary to give good resonance.

The receiving circuit consists of the conductor (1), condenser (12), a combined capacity and inductance, as the tuning grid (13), preferably of the construction herein described, a receiver (14), and the combined capacity and inductance, as the tuning device (x). These several parts of the receiving circuit are arranged in series with each other; but the condenser (12), combined capacity and inductance (13) are arranged in shunt to the spark gap—i. e., in parallel to the sending conductor—as clearly shown in Fig. 4. The indicating mechanism, which may be in the form of a single or double-head telephone (15), forms a part of a circuit also including the receiver (14) and a low-voltage generator (15^a) of any suitable construction—as, for example, two cells of slightly different voltage, so connected as to oppose each other. As the receiver must change from and back to normal condition for each signal received, it is necessary for rapid and distinct signaling that these changes should occur nearly instantaneously, dependent only upon the length of the signal—i. e., whether long or short. As signaling at the receiving station is dependent upon currents produced by electromagnetic waves, the requirement above stated is best attained by the employment of a receiver having a small heat capacity.

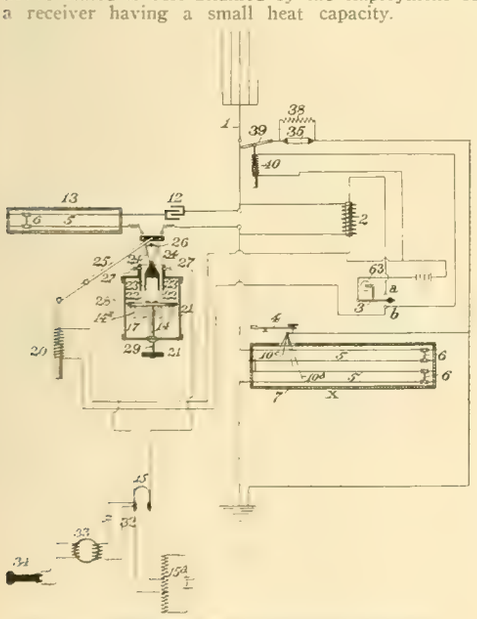


FIG. 4. FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

As the receiver is extremely delicate, it is preferred to protect it from extraneous electrical disturbances by a metal case (21), the leading-in wires of the bulb having connections extending out of the case through sleeves formed of insulating material. It is preferred that the leading-in wires should be connected to rods (22), fixed in the insulating sleeves (23), and that movable rods (24) should extend down into the sleeves and make contact with the rods (22). This arrangement forms the switch whereby the receiver is cut out of the receiving circuit, the rods (24) being connected to a lever (25), operated by the motor (20). In order to close the circuit, including the condenser (12) and tuning device (13) around the receiver, thereby transforming it into a circuit parallel with the sending circuit, contacts (26) are carried by the rods (24), which are adapted to be swung in toward each other by weights or other suitable means when drawn out of the sleeve, and thereby bringing the contacts (26) together immediately after the rods (24) are moved out of contact with the rods (23).

Selective signaling features of the system are covered by patent No. 706,740, which has for its object the generation at one station of persistent signaling impulses or waves differing in character—e. g., period—and to the generation of beats by the waves or impulses and the employment of suitable receiving apparatus at the other station responsive only to the combined action of waves or impulses corresponding in period or other characteristics to those generated.

In the practice of his invention Professor Fessenden employs at the sending station two or more sources of radiation, constructed to generate persistent waves or impulses, the waves or impulses proceeding from one of the sources of radiation differing in character from those produced by the other source. At the receiving station he employs a corresponding number of suitably tuned or adjusted receiving conductors, which, by their conjoint action, produce beats of any suitable character to operate an indicator, but are incapable of operating it except by conjoint action.

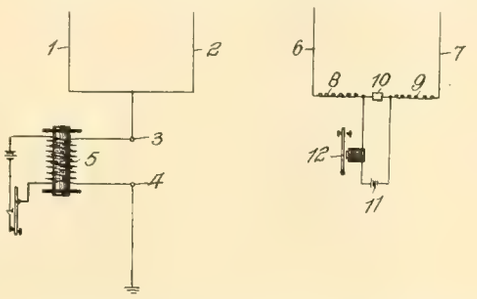


FIG. 5. FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

A convenient apparatus for this purpose is shown in Fig. 5, and consists at the sending station of two or more conductors having radiating portions (1) and (2), each being connected to a terminal or knob of an induction coil, while the opposite terminal of the coil is connected to ground. In the form shown both the radiating portions of conductors are connected to the terminal or knobs (3) of the induction coil (5), the other knob or terminal (4) being grounded. By any suitable means known in the art persistent oscillations are produced. This persistence can be effected by so proportioning the resistance, self-inductance, and capacity that only a small portion of the energy is radiated at each oscillation. When two conductors are employed, they should be so constructed and proportioned as to have different periods of oscillation—as, for example, the period of conductor (2) should be 25 per cent. greater than that of conductor (1). In general, a smaller difference, as five per cent., is preferred.

At the receiving station there are employed two or more conductors (6) and (7), which are tuned to the respective sending conductors by any suitable means, as by wires (8) and (9), which connect the conductors to a coherer (10) or other suitable wave-responsive mechanism. Each of the wires (8) and (9) is preferably of approximately the same length as the conductor to which it is connected. A grounding of the receiving conductors is not necessary, as efficient signaling can be effected without a ground. When employing a coherer, it is connected, as usual, in the circuit of a battery (11) and with a relay or other translating mechanism (12).

When a spark passes between (3) and (4), waves of different periodicities are generated by the respective sending conductors at the sending station, and such waves will produce in the respective receiving conductors (6) and (7) correspondingly varying, but persistent, oscillations of potential.

Other patents of the series relate to the transmission of the signals and their reception in cities by artificial ground or wave chutes, and on rocky shores or other non-conducting ground by other devices; to details of his current-actuated wave-responsive device; to various forms of conductors, and to other interesting variations of the system.

Electric-railway Consolidation Proposed in Michigan.

A plan of consolidating electric railways in Michigan is announced which will embrace the Detroit, Ypsilanti, Ann Arbor and Jackson; the Grand Rapids, Grand Haven and Muskegon; the extension of the Detroit, Ypsilanti, Ann Arbor and Jackson from Jackson to Lansing, and the lines of the Railways Company General from Battle Creek to Kalamazoo, with a link between Jackson and Battle Creek and the Grand Rapids city lines. It is believed that after the amalgamation of the West Michigan lines is completed arrangements will probably be made to consolidate with the Detroit United Railway Company, making one large corporation to control all the principal electric lines in Michigan.

Some Recent Developments in Space Telegraphy.

It is reported that Mr. Marconi will go to Rome shortly to establish contiguous to the town an important wireless-telegraphy station, which it is understood will be provided with the most improved instruments, notably such as are calculated to increase the perceptibility of the receivers. The station will be established near the Italian capital, for it has been sufficiently demonstrated that the electrical waves are not affected by passage across land even if the latter be hilly.

Elaborate comparative experiments with rival systems of wireless telegraphy are to be carried out along the northern coasts of Spain during King Alfonso's yachting cruise. A Spanish officer named Cervera has brought out an independent system, and this is to be tested against that of Marconi. The cruiser Lepanto has been fitted with the Marconi system, while Cervera's has been installed upon the King's own yacht La Giralda. The system which gives the best results will be adopted for exclusive use in the Spanish Navy and public services generally.

A preliminary report in regard to the first experiments with space telegraphy by the board of naval officers has been submitted to the Navy Department. The board reported that it tried the Rochefort system with some success, messages having been received and sent with accuracy. It is now proposed to test in turn a French and two German systems. Information received by Rear-Admiral Bradford in regard to the experiments of foreign countries with wireless telegraphy shows that the United States is way behind other nations in this work. Italy has over a dozen naval officers conducting separate experiments. France has three boards of officers at work and several ships fitted with instruments. England has 30 ships equipped with the Marconi system, and Germany has at least 10 vessels thus provided. In the United States, on the other hand, but a single officer, Lieutenant Hudgins, so far has been detailed exclusively to this subject. The lack of progress along these lines in the navy, however, is not to be charged to Admiral Bradford, who believes that a number of capable naval officers should be assigned to the work of thoroughly equipping themselves by investigation and experimentation with this important field, and who has already recommended that such assignments could be made.

The Swedish government has adopted the Marconi system of wireless telegraphy. A large station is in process of erection on the island of Gotland. This station will communicate with the mainland near the city of Stockholm. Several Swedish warships have already been equipped with the Marconi apparatus.

Illumination of English Fleet During Royal Review.

On August 16th King Edward completed the coronation festivities by a review of a fleet of the English Navy off Portsmouth, England. A review took place by daylight and then an electric illumination of all the ships occurred at night. A popular report of the spectacle reads as follows: "At 9 o'clock a rocket was sent up from the royal yacht, and a moment later the dim outline of the yacht burst out in thousands of incandescent lights. This was the signal for the hundreds of other ships lying in the harbor, and, as if by magic, the entire fleet was illuminated in a great blaze of light. The sudden change from dusky shadows of battleships to one of electric brilliancy had a startling effect on the crowds ashore and afloat, and they made manifest their delight by rounds of cheers. The lines of the funnels, masts and upper decks of the ships were outlined in mellow, glowing lines, and the flagships by a clear, pale light, mast high. The brilliant lights of the merchant ships and pleasure craft added to the splendor of the maritime fête. Simultaneously hundreds of public and private buildings ashore were illuminated, while an imposing display of fireworks, varied in color and form, gave fresh interest to the carnival."

The Cleveland Three-cent Fare Situation.

Mention was made in the Western Electrician on August 16th that the injunction suit in the Cleveland three-cent fare struggle would be carried to the Supreme Court, the Circuit Court having dissolved the injunction issued by a lower court, restraining the City Council from issuing franchises for three-cent roads. The case was appealed and the Supreme Court now reverses the decision of the Circuit Court, thereby sustaining the original injunction and stopping any further action until a complete hearing can be had. This may not occur until spring, as the higher court can hold it over if so inclined. This may mean the end of three-cent-fare lines in Cleveland for a long time, as the state Legislature, which meets in the early fall, may remove franchise-granting powers from the City Council. At any rate, the mayor's scheme is for the present completely blocked.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Electrical Mine Equipment of the C. & C. Shaft at Virginia City, Nev. By Leon M. Hall. Illustrated....117, 118
Cables Cut at Barcelona and Port au Prince....118
Carman Automatic Curtain Hoist....118
American Street Railway Association. Illustrated....119
Admiral O'Neil on Submarine Boats....119
Electric-light Affairs in Edwardsville, Illinois....119
Fessenden Wireless-telegraph System. Illustrated....120, 121
Electric-railway Consolidation Proposed in Michigan....121
Some Recent Developments in Space Telegraphy....121
Illumination of English Fleet During Royal Review....121
The Cleveland Three-cent Fare Situation....121
Editorial....122
Three-phase Electric Railway in Switzerland....123
Progress on Canadian Niagara Power Plant....123
The Drainage-canal Power Development Situation....123
Automatic Selective System for Space Telegraphy. Illustrated....123
Direct United States Cable Company's Report....123
Mineral Products of the United States....123
Development of the Telephone Field....124, 125
Growth of Independent Companies in Ohio and Surrounding States....124
The Evansville Situation....124
Experiments with Ruhmer Wireless Telephony....124
Telephone News from the Northwest....124
Indiana Telephone Items....124
Southern Telephone Developments....124
Telegraphy and Telephony in New Zealand....125
Competition Forces Reductions in Bell Rates in Pittsburg. 125
New Companies....125
Extensions and Improvements....125
General Telephone News....125
Manufacturers and Dealers....125
Steam Turbines. By S. E. Fedden, (Municipal Electrical Association of England)....125, 126
Westinghouse Automatic Car Circuit-breaker. Illustrated.. 126
New York-Philadelphia Electric Railway....126
British General Electric Company Manufacturing Carbons.. 126
Correspondence-school System for England....126
Power-plant Extensions for Des Moines City Railway....126, 127
Sterling Spiral-filament Lamp Illustrated....127
White Speed-regulating Device. Illustrated....127

DEPARTMENTS.

Correspondence....127, 128, 129, 130
New York Notes....127, 128
New England News....128
Southern Developments....128
Canadian Intelligence....128
Information from Indiana....128, 129
Mexico and Texas....129
Northwestern Notations....129
Among the Rockies....129
On the Pacific Slope....129, 130
Personal....130
Electric Lighting....130
Electric Railways....130
Telegraph....130
Automobiles....130
Publications....130
Miscellaneous....130
Trade News....130, 131
Business....131
Illustrated Electrical Patent Record....131, 132

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.
New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.
Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.
Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.
American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.
Indiana Electrical Association, Indianapolis, September 17th and 18th.
International Association of Municipal Electricians, Richmond Va., October 7th, 8th and 9th.
American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

AN ABLE and timely paper on steam turbines is presented elsewhere in this issue of the Western Electrician. The author, Mr. S. E. Fedden, is city electrical engineer of Sheffield, England, and after considering the many disadvantageous factors necessitated in installing large reciprocating engines for electric-generator driving—such as the increased cost of building, the larger floor space required, the longer lengths of steam and exhaust piping, and the heavy cranes required for lifting—he directed his attention toward the steam turbine as a possible solution of the difficulty. His experience with the new machines has been so satisfactory and he is so confident that progress in the generation of electrical energy lies in this direction that he is equipping a large power station at Sheffield with turbines. This same degree of confidence in the future of the steam turbine is now spreading to the engineering staffs of many central-station companies in the United States, and from present indications, this efficient, high-speed, compact machine will soon have a permanent and very important position in the electrical industry of the country.

THE ever-increasing commercial invasion of the United States into foreign countries is beginning to be viewed with alarm by many of the European nations. In Germany is this fact especially apparent and prominent public leaders are seeking for remedies to combat the growing tendency of this country to gain commercial supremacy over the world. One well-known authority on political economy proposes the formation of a mutual commercial union between the Middle European States for moderate duties, with higher duties for those nations outside of the union. He also proposes mutual consuls, mutual coaling stations and mutual cables. Evidently some such plan would prove of great advantage to the different nations entering the union, but it remains to be seen if it would stem or merely divert the tide of our large and growing export trade.

In this connection it is interesting to note that the proprietors of electrical works in Germany are bent on finding a remedy for the present ruinous competition in the electrical field, and are endeavoring to bring the producing capacity of the plants more in harmony with the market's demands. One plan proposed for relieving the present crisis is to adopt the American trust idea in meeting the competition. This scheme is offered by the Bank for Electrical Undertakings of Zurich, which is owned by the Allgemeine Elektricitaets Gesellschaft of Berlin. It suggests that the European electrical companies must get all their works under one management and then shut down the unprofitable ones till the situation improves. This would be fighting American competition with American methods, but no doubt the beneficial features of our trusts would also be helpful to German manufacturers.

A BRANCH of German industry that has become quite prominent during the last decade and one from which Americans might take some profitable lessons is the manufacture of briquettes from brown coal, peat and the dust and waste of coal mines. This form of fuel is now used largely for domestic purposes in Berlin and other cities and districts in Germany. The briquettes are also employed as fuel for locomotives and other steam-boiler firing, and they are used for heating in various processes of manufacture. Frank H. Mason, United States consul-general at Berlin, writes that for all these uses the briquettes have three tangible advantages: They are clean and convenient to handle; they make practically no smoke, and are, withal, the cheapest form of fuel for most purposes. During last year 1,643,416 tons was produced, and the average selling price in large quantities was 13.33 marks ($3.16) a ton. Although this price is not exceptionally low, it is still not so high but that the new fuel can be manufactured at a profit and employed with an economy and convenience above that of ordinary coal. The advantages derived from its use, it would seem, might apply equally well to this country, and it may not be long before the great quantity of waste from our coal mines will be utilized in the manufacture of some such cheap and highly calorific fuel. In view of the present extremely high prices asked for anthracite coal, and with a threatened higher advance staring the consumer in the face, a consideration of this useful German product is of timely interest.

Another factor entering into the employment of briquettes for fuel, especially for generating steam in large electric generating stations and in factories, is that they have a decided and beneficial influence in reducing the smoke. There is scarcely a large city in the United States at the present time but that is experiencing an energetic crusade against the smoke nuisance, and each could profit by the example of Berlin and other German cities. Berlin, although a busy manufacturing city, ranks as one of the cleanest and best kept in Europe. This condition, Mr. Mason says, is due to the preponderant use of coke and briquettes, which are practically smokeless; the skillful scientific construction of boiler furnaces and chimneys; and, finally, the high standard of skill that is required among firemen. The importance of the last two requirements is quite well appreciated in this country, but the use of prepared fuel has by no means become general. Mr. Mason is a careful student of engineering and technical matters and undoubtedly his suggestion, that American municipalities might be freed from the smoke incubus through the enforced use of one or more of these forms of prepared fuel, viz., coke and fuel gas made in closed ovens from bituminous coal and briquettes made from lignite, peat and other inferior materials, could be taken to heart by the American engineer and manufacturer generally.

MR. MARCONI'S recent successful transmission of messages by space telegraphy between Poldhu, England, and Cronstadt, Russia, a distance of 1,400 miles, the messages crossing England at its widest part and a portion of Denmark, has a deep significance when the difficulty of transmitting electromagnetic waves across land is considered. It has been the general opinion that wireless signals could not be carried for any great distance over land, but Mr. Marconi's success and some observations submitted by Captain H. B. Jackson to the Royal Society of England throw new light on the subject, especially when the signals are sent at sea across intervening land.

Captain Jackson finds that some of the waves are capable of passing through, over, and possibly around the land, though in doing so their energy is reduced to an extent depending upon the height, extent and nature of the obstruction. He describes a remarkable case of an extremely precipitous, narrow, but high promontory jutting out from the mainland, and consisting of hard rock containing iron ore. Its height was 800 feet, and signals were sent from a vessel 18 miles off to a ship cruising about the promontory. The distance at which signals could be exchanged in the open sea was 45 miles, but the promontory cut them off entirely. It cast, indeed, a sharp "shadow," the signals ceasing abruptly as the receiver disappeared behind the cliff. In other cases the effect was less marked. Limestone was found to be less obstructive, and sandstone still less so. A cliff of porous coral sandstone 250 feet high and six miles across reduced the signaling distance from 25 to 20 miles.

It has also been shown that weather conditions have an important influence on space telegraphy, especially in sub-tropical regions. In the Mediterranean, a scirocco wind, holding moisture, salt and dust in suspension, absorbs the waves to a great extent. Lightning flashes always produce signals, and sometimes spell words in the Morse code, though the usual type is that of the letters "ei" in the Morse code. Mr. Marconi's recent observations on the effect of daylight upon the propagation of electromagnetic impulses over long distances (noted in the Western Electrician of August 9th) also have a close bearing on Captain Jackson's observations. The inference may readily be drawn from all these experiments that the field of space telegraphy is very broad and one in which there is room for a great development along scientific as well as commercial lines. New systems are continually being evolved, and one of the most interesting of these is that invented by Professor Reginald A. Fessenden and described in some detail elsewhere in this issue.

Three-phase Electric Railway in Switzerland.

The Berthoud-Thoune electric railway of Switzerland is one of the few roads to use the three-phase alternating-current system. Before the railroad was built, the company had installed a large generating plant at Spiez, near Lake Thoune, which was designed to furnish light and power to the neighboring towns of Berne, Berthoud, Spiez and others. The distribution was made by a three-phase 16,000-volt system. It is probably for this reason that the three-phase system was adopted for the railroad, although it is a disadvantage in a line with variable grades. The generating station furnishes current at 4,000 volts, which is raised to 16,000 by oil transformers for the line. The primary line is overhead and uses a 0.2-inch wire upon porcelain insulators, the total length being 29 miles and containing 27 tons of copper. Besides the lightning arresters at the station, the line is protected every five poles by an arrester of the curved-arm type. Along the line are 14 sub-stations, which are placed wherever possible at the railroad stations, for easy inspection. The sub-stations have 450-kilowatt transformers which lower the voltage from 16,000 to 750.

The electric railroad is of standard gauge. Special attention has been given to the rail joints, so as to have a good contact. In place of ordinary rail bonds, the contact is assured by a special metallic paste, which is introduced between the rail and the fishplate. The paste is a composition patented by Brown, Boveri & Co., who have furnished the electrical outfit for the road. Rubbing contacts take the current from the overhead wires, there being four sets of contacts for each locomotive. The rubbing part is made of a metal tube of triangular section, and when one face is worn down another is used. The overhead line is formed of two bronze wires, 0.32 inch in diameter, with a rail return, making the third side of the circuit. The locomotives are mounted on two axles, each of which is driven by a non-synchronous motor of 150 horsepower. A constant speed of 22 miles an hour is used, no matter what the load. The total expense is estimated at $1,100,000.

Progress on Canadian Niagara Power Plant.

Contractor A. C. Douglass is getting along nicely with the construction of the tunnel for the Canadian Niagara Power Company. This tunnel, when completed, will have a length of 2,200 feet, and of this entire length only about 248 feet remains to be opened. About 900 feet from the wheel-pit and 1,300 feet from the portal a shaft was sunk to the required depth. Then from the bottom of this shaft excavation has been carried on in both directions, so that between the pit and the shaft about 48 feet are still to be removed, and between the shaft and the portal there is about 200 feet of rock to be taken out. Work is progressing from the face of the cliff at the portal, as well as from the bottom of the shaft, so that good progress is made. Throughout the whole length of the tunnel the bottom bench is left to be taken out last, in order that the rock may be used in concrete and for filling. When started, the work of removing this bottom bench will go forward rapidly.

Both the tunnel and wheel-pit are to be lined with brick throughout. So far as the tunnel is concerned, Contractor Douglass expects to start laying brick about December, and this work will occupy the winter. Owing to the ice formation about the Horseshoe Falls during the cold weather, the granite work at the portal of the tunnel will not be commenced until next spring.

The wheel-pit has reached a depth of about 60 feet, or one-third of its contemplated depth. The sides are being channeled, and 10 cuts have so far been made. The length of this first section of pit is about 250 feet.

The Drainage-canal Power Development Situation.

A meeting of the Illinois River Valley Improvement Association was held in Joliet, Ill., on August 12th, at which James A. Seddon, engineer for the Gaylord syndicate, presented a comprehensive review of the waterpower possibilities along the Desplaines Valley, south of Joliet. He explained his company's plans, which he claimed were far superior to those of the Sanitary District from a waterway point of view. There was a very small attendance at the meeting, and no one representing the Sanitary District appeared to combat his views and statements. The meeting dispersed without the passage of resolutions or formal action of any kind.

It is announced that the Gaylord syndicate is now securing options on property along the Desplaines River below its present proposed dam at Patterson Island. This is construed to mean that the syndicate is taking precaution so that it will be cared for if the Sanitary District defeats it finally in the contest now waging.

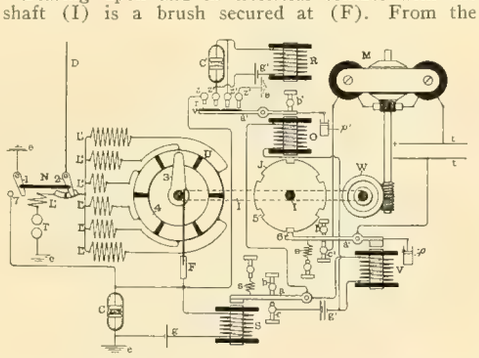
Automatic Selective System for Space Telegraphy.

An interesting automatic selective device for use with space-telegraphy systems, has been devised by Cornelius D. Ehret of Philadelphia, Pa. By means of the device, which is shown in the accompanying drawing, one station may be put into communication with any other of a series or group, each station always transmitting messages by energy of a definite frequency or frequencies.

At each station are located a number of receiving conductors equal to the remaining number of stations in the series or group, and each conductor is syntonized with the frequency of the energy waves radiated from some certain other station in the group. A sunflower or commutator is arranged for throwing the syntonized conductors successively into electrical communication with wave-responsive devices. The invention comprises, further, a pilot wave-responsive device, which, if energy of a certain frequency persists for a predetermined interval of time, causes a main message-receiving wave-responsive device to be brought into the influence of the arriving energy.

Referring to the drawing, (D) is the receiving conductor, which connects through switch-arm (2) with a segment in electrical communication with six different inductances (L'), (L^2), (L^3), (L^4), (L^5), (L^6), which in turn connect, respectively, with separate segments of the sunflower (U), each being represented by a conducting mass (4) and with intervening insulation between successive segments. Over these segments trails a brush or trailer (3), rigid with the shaft (I), which is driven by a motor (shown in plan view at M). Secured to this shaft (I) is a notched disk (J), having as many notches (5) as there are segments in the sunflower. Into these notches is adapted to fall or be raised a lug (6) on the armature (a'), controlled by the relay (V).

Bearing upon and in electrical contact with the shaft (I) is a brush secured at (F). From the



AUTOMATIC SELECTIVE SYSTEM FOR SPACE TELEGRAPHY.

brush there is a connection to earth plate (e) through wave-responsive device (C). In shunt around the wave-responsive device is the winding of the relay (S), which is energized upon a change of condition in the wave-responsive device by battery (g). The armature (a) of the relay (S) is normally retracted by a spring (s) against stop (b). When attracted, however, it contacts with a screw (c), causing the energization of relay coils (O) and (V) from the battery (g').

The motor (M) receives its current from the supply circuit (t t), which communicates through the armature (a') and contact screw (c'). Upon the energization of the relay (V) armature (a') is attracted in opposition to the force exerted by a spring (s), resulting in the movement of the armature against the stop (b'), when the lug (6) comes opposite a notch (5) in the disk (J), and also resulting in the rupture of the motor circuit at contact screw (c'). At the same time relay (V) operates relay (O) attracts its armature (a^2) away from back-stop (b^2) and causes the metallic bridges (r), carried by the armature and insulated from it by material (v), to bridge the contact points (z'), (z^2), and (z^3), (z^4). This latter operation throws the wave-responsive device (C') into communication with the brush bearing upon the shaft (I) and puts the other terminal of the device in connection with the earth plate (e'). A change of condition in the wave-responsive device (C'), due to the received energy, is manifested by a change of current strength through the winding of the relay (R), such current being derived from the battery (g^2).

The operation of the device is as follows: The trailer (3) is constantly rotating in passing over the segments of the sunflower successively. Supposing station No. 2 is calling station No. 7 (the station here shown), when trailer (3) has come into connection with the segment with which the inductance (L^2) is connected the wave-responsive device (C) has its condition altered, with a resulting energization of the relay coil (S). This occurs the instant that trailer (3) moves onto the segment in connection with the inductance (L^2). Armature (a) is attracted and contacts with screw (c). This causes the energization of the relays (O) and (V), as above described; but the armatures (a') and (a^2) are retarded by means of dash-pots or equivalent devices (p'), (p^2), respectively, and do not reach the limit of their travel unless the energy radiated from station No. 2 is persistent for a sufficiently long time. If this should be the case, lug (6) engages after a time in a notch (5), locking the disk (J) and preventing the trailer (3) from leaving the segment in connection with the inductance (L^2). At the same time the circuit of the motor (M) is broken at screw (c'). The armature of the relay (O) has caused the bridging of the contacts and the throwing into operation of the wave-responsive device (C'), as before described. The relay (R) then records the messages. The angular position of disk (J) with respect to sunflower (U) is such that it is locked before the trailer leaves the segment representing the proper station.

This invention is covered by a patent No. 707,056, issued on August 12th to Mr. Ehret. The patent is assigned to the American Wireless Telephone and Telegraph Company and the Consolidated Wireless Telegraph and Telephone Company.

Direct United States Cable Company's Report.

At the fiftieth ordinary general meeting of the Direct United States Cable Company, held recently in London, England, President E. M. Underdown made some interesting statements in his semi-annual report. This company operates one of the 14 effective cables working for the North Atlantic business, its cable having been laid 27 years ago. The chairman stated that during the whole of the 12 months ended June 30th and up to the present the company had had to spend nothing upon the repair and renewal of its cable. He considered it a very remarkable thing, after the cable had been down for so many years, that they should have incurred no expense upon it for more than 12 months, and that it is working now perfectly, both simplex and duplex.

In reference to wireless telegraphy, the chairman had the following to say: "If anything has ever been advertised in every possible direction, that subject has been now for some years. We know perfectly well that these inventions may be of value, but it seems to have escaped the attention of our rivals that if they are of value, there is nothing in the world to prevent us—who have large staffs and communications with the principal companies in the United States and with our own government—from making use of them in so far as they may be useful. I do not think that the attacks on cable property are warranted, and I may say that I have had an interview with the greatest authority on the subject (Lord Kelvin), who is strongly of opinion that however valuable wireless telegraphy may be for certain purposes, it cannot affect the transmission of messages over great distances through cables. Although it has made people nervous with respect to cable property, I do not think their fears are justified."

A concluding section of the report was as follows: "I should like to refer to the death of Mr. Mackay, the chairman of the Commercial company, which, of course, is one of our great rivals. As a man of very remarkable energy and very considerable business qualifications, his death is to be regretted. I see it is reported that he is succeeded by Mr. George Gray Ward, who is a very able gentleman, whom we ourselves were once connected with. It is impossible for us to keep all the Atlantic traffic to ourselves, and therefore we can only express our sympathy for the loss which has been sustained by the public through the death of Mr. Mackay, and I trust that our relations with this company may go on in a satisfactory manner."

Mineral Products of the United States.

A table showing the production of minerals in the United States during the last 10 years (1892-1901) has recently been issued by the Division of Mining and Mineral Resources of the United States Geological Survey. Below is given a comparison of these products during the years 1900 and 1901. The copper product for the year 1901 amounted to 597,443,212 pounds, with a value of $86,629,266, to be compared with 606,117,166 pounds at a value of $98,494,039 in the year 1900. Lead also shows a decrease in production, there being produced 270,700 short tons at a value of $23,280,200 in 1901, as compared with 270,824 short tons at a value of $23,561,824 in 1900. Zinc, on the contrary, shows an increase, the year 1901 yielding 123,886 short tons, valued at $10,654,196 in oppositon to 140,822 short tons at a value of $11,265,760 produced in the year 1900. Quicksilver likewise took an upward turn, the mines putting on the market 29,727 flasks (76½ avoirdupois pounds) at $1,382,305, while in 1900 the production was 28,317 flasks at $1,302,586. Last year saw the same amount of aluminum produced, 7,150,000 pounds, as 1900, and valued the same at $1,920,000. Platinum shows the largest proportionate increase of any of the metals, 1901 having produced 1,827 troy ounces at a market value of $13,000, as compared with 1900, with 400 at $2,500. Asbestos dropped away in the last year, the production only amounting to 747 short tons at $13,498, as compared with 1,054 in 1900 at $16,310. The total value of all metallic products for the year 1901 amounted to $524,873,284, which is considerably less than that of 1900, which was $550,425,286. The above statistics were compiled under the supervision of David D. Day, chief of the Division of Mining and Mineral Resources.

The Mountain City Mill Company of Fairmont, W. Va., is in the field for a lighting dynamo.

DEVELOPMENT OF THE TELEPHONE FIELD.

Growth of Independent Companies in Ohio and Surrounding States.

The United States Telephone Company, which has headquarters in Cleveland, Ohio, and is operating long-distance telephone lines connecting with Independent companies, on August 15th opened up connections with West Virginia through connections at Huntington and Charlestown, W. Va. The final test was made from Cleveland over 400 miles of wire and was pronounced most satisfactory in every particular. This enables the tapping of the whole of southern West Virginia, including the Pocahontas coal district. The connection over the Ohio River is made across from Ironton, Ohio, by means of two 90-foot towers, one on each bank with a single span containing 10 Phono-electric wires.

The Michigan connections of the United States company will be completed by September 1st through a connecting station at Toledo. The company will be located in a separate building from the local Toledo exchange and is now installing a long-distance switchboard with a capacity of 60 toll lines. The completion of the Toledo plant will connect the Independent telephone interests of Ohio, Michigan, Indiana, Pennsylvania and West Virginia.

There are said to be 106,000 Independent telephone subscribers in Ohio, 34,000 in the southern peninsula of Michigan, 65,000 in Indiana, 20,000 in the western part of Pennsylvania and 12,000 in West Virginia. At present the Independents have no connection with eastern Pennsylvania, but these are now under construction. Lines are now being put through from Philadelphia to Harrisburg, Johnstown and on to Pittsburg.

With the opening of navigation next year or by April 15th, the United States Telephone Company expects to have its test station at Buffalo ready for operation. By means of this station the United States company expects to reach every important center in New York state outside of New York city.

Independent operators are rapidly acquiring local interests throughout New York state, which will use the United States company as their basis of long-distance service. The American Construction Company of Elyria, in which Cleveland capitalists are largely interested, is now operating exchanges at Niagara Falls, both the Towandas, Lockport, Lewiston, Batavia, Warsaw and Dunkirk. It is also rapidly constructing plants at Albany, Schenectady, Troy, Waterloo, Coxsackie, Pougkeepsie and Newburg, and has, in fact, in process of construction a toll-line system across New York state from Buffalo to Albany, taking in all the New York central towns.

Barber and Brailey of Wauseon, Ohio, who are backed heavily by Cleveland capital, are now operating plants at Utica and Rome. The Interocean Telephone Company, in which Luther Allen is prominently connected, is operating at Corning, Salamanca, Hornellsville and all the small towns throughout the cheese district. The United States Telephone Company is the long-distance line of these vast interests.

The Evansville Situation.

The movement to establish a municipal telephone plant at Evansville, Ind., is, it is claimed, on the verge of failure. The city is desirous of awarding a franchise to the best bidder, but is by no way certain that it is free to do so. The Cumberland Telephone and Telegraph Company, the present occupant of the field, holds out for preferred terms on the theory that its franchise can be defended. The city must first free itself of the present entanglement before satisfactory bids can be expected. The people and the press urge the council to revoke the company's franchise, if it has not already expired, on the ground that a proposition equal to the best offered the city has not been submitted by the Cumberland company, provided, however, that there be no legal entanglement. Whether the city has the right and power to dispossess the Cumberland Telephone and Telegraph Company of the Evansville field is the stumbling block, and if the matter was settled, the city could make a splendid telephone contract.

Experiments with Ruhmer Wireless Telephony.

Further and more successful experiments with wireless telephony are reported as having been made near Berlin, Germany, recently, by Ernst Ruhmer. Improved apparatus was used, and it is stated that the speakers at each station could make themselves clearly understood over the intervening distance, which was 4½ miles. The clearness and loudness were principally achieved with the aid of an "electrical eye," very sensitive to the light, which has now been applied for the first time. The trials will now be continued between two fixed stations, and it is hoped to render possible a conversation over 20 to 25 miles by means of large reflectors of one to two meters diameter. So far, only one with a diameter of 35 centimeters has been used.

The Western Telephone and Telegraph Company has declared a semi-annual dividend of two per cent. on its preferred stock, payable August 30th.

Telephone News from the Northwest.

The Northwestern Telephone Exchange Company has awarded contracts for the erection of a new central-exchange building at Grand Forks, N. D.

The H. H. Heath Telephone Company has asked a franchise of the village of Abbottsford, Wis.

A recent severe windstorm in Minneapolis disabled from 400 to 500 wires of the South branch and 200 to 250 of the main office of the Northwestern Telephone Exchange Company.

The Southern Electric Telephone Company has been granted a franchise for a local system for Morgan, Minn.

The Twin City Telephone Company and the Mankato Citizens' Telephone Company will join in the construction of a copper-circuit line from the Twin Cities to Mankato, Minn.

Cralle Bros. have completed the construction of 102 miles of telephone lines for the Dakota Central Telephone Company in South Dakota.

The Scott Grain and Telephone Company of Duluth, Minn., has been incorporated with $15,000 capital. The company is authorized to build elevators, feed mills and public and private telephone systems.

The Minnesota Central Telephone Company is enlarging its central-exchange room at New Paynesville, putting in a new switchboard and making other changes.

A young man of Duluth, Minn., has been detected in the act of using metal slugs in a slot telephone of the Duluth Telephone Company for long-distance service. The company has been getting a large number of slugs in the instrument at which he was detected and caught.

The Great Western Telephone Company proposes to build a line from Breckenridge, Minn., to Barnesville, and has asked a franchise to enter the latter city.

A local exchange is to be installed for Buffalo Lake, Minn., at once.

The Iowa Telephone Company has removed the city telephones in Des Moines, in accordance with an order from the council. The company has made a proposition to the City Council to put in a separate fire-alarm system, to serve in place of the instruments which were removed. This meets with an objection from the labor unions. It is claimed that a fund of $186,000 has been raised to carry on the strike, which has now been in progress for several weeks.

The council of Fort Dodge, Iowa, received a request from Dr. Emil Dorn of Chicago for a franchise for a local exchange. As Fort Dodge now has two complete systems in operation, the request did not receive very much consideration.

The Independent Mutual Telephone Company of Shenandoah, Iowa, has let contracts for the construction of a local exchange.

The Northern Telephone Company seeks a franchise for a local exchange for Storm Lake, Iowa.

The Dubuque Telephone Company at Dubuque, Iowa, has increased the wages of operators $5 a month, and will give them a week's vacation a year with pay.

The New State Telephone Company has sold all its Carroll County lines, including the local exchange at Carroll, Iowa, to the Carroll County Telephone Company. The new company has a capital stock of $75,000.

The Union Electric Telephone and Telegraph Company has awarded contracts for the erection of a modern exchange building, in Davenport, Iowa, for a new system soon to be installed there.

The Home Telephone Company of Oskaloosa, Iowa, has completed arrangements with the Long-Distance Copper Telephone Company for toll connections, giving connections with a large number of new towns. R.

Indiana Telephone Items.

Two new telephone companies were incorporated during last week. The Cowan Rural Telephone Company of Delaware County, capital stock $4,000; and the Amboy Home Telephone Company of Miami County, with a capital stock of $5,000.

The Central Union Telephone Company has decided to increase the size of its plant and the efficiency of its service at Alexandria. H. T. Liddle, who has been manager of the local service for a year, submitted plans for the improvement which the company readily approved. From 100 subscribers he has increased the list to 400, the full capacity of the plant, during his brief administration. The cables will now be extended and the switchboard increased so as to accommodate as many more subscribers.

The Newcastle Telephone Company is confronted with another strike, the second within two months. Ten men and the superintendent quit work on August 14th. The system has been under construction since the beginning of the year and is not yet completed.

Bunker Hill is to have an Independent telephone system. A company for building the line and exchange has already been organized by W. H. Wiles, president of the Bunker Hill bank, and will soon begin stretching the wires.

The New Haven Telephone Company of New Haven, Allen County, has been placed in the hands of a receiver. The stock of the company is nearly all owned by Noblesville men. W. L. Mallering was appointed receiver. The exchange is a small one and has not proved profitable from the beginning.

The Mishawaka council has voted in favor of granting a franchise to the Home Telephone Company, an Independent corporation, despite strong opposition. The Bell company at once announced a reduction in rates to residents of $3 and $5 a year. Business service is also to be very much cheaper, and it is declared that this is the initial step in a movement to meet the prices fixed in the Home company's franchise. F.

Southern Telephone Developments.

The Home Telephone Company of Louisville, Ky., has just secured a controlling interest in the New Albany (Ky.) Home Telephone Company which has been in operation since 1896. The New Albany company has a capital of $100,000. The Louisville company, which will build connections with the New Albany company, is now issuing its first regular directory, containing about 3,200 names.

The Strowger Telephone Company of Augusta, Ga., is making long-distance connections toward the north and the south by special arrangement with the numerous Independent lines in that section, and soon expects to have connection with at least 1,000 miles of long-distance lines.

The city of Hopkinsville, Ky., has accepted a proposition from the Cumberland Telephone and Telegraph Company, whereby this company will furnish long-distance connections and reduce the price of the service. This settles the question of competition in that town, at least for the present.

The town of Shelbyville, Ky., will sell a local telephone franchise during the month of September. The Cumberland Telephone Company is already operating in the town. It is said that the Louisville Home Telephone Company is back of the movement. The new franchise will forbid consolidation with any other company on the part of the owners of the franchise.

An effort is being made to construct rural telephones in Gaston County, N. C. Gus Shannon of Gastonia, N. C., is interested. It is stated in this connection that in Union County, N. C., rural telephones were started two years ago, and now over 1,500 telephones are in use, more than half of them being in the homes of the farmers.

The International Telephone Company has recently purchased the charters of several concerns in Maryland, among them the charter of the Maryland Telegraph and Telephone Company. The International Company will begin the building of lines through the state, and will have a maximum charge of two cents per call. This company is understood to be buying up Independent companies over the United States.

A charter has been granted to the District Telephone Company of Shelby County, Tenn., with a capital of $100,000. Those interested are E. Howard, J. Compton, W. T. Gentry and others of Shelby County.

J. E. Wright, manager of the West Kentucky Telephone Company, denies the report that his company has sold out to the Cumberland Telephone Company.

D. J. Kavanaugh, one of the electricians of the Illinois Central Railroad Company, with headquarters in Memphis, Tenn., has made the trip from New Orleans to Chicago on a motor car inspecting the railroad's telephone line, which was found to be in good order.

The absorption of the Winchester (Va.) Telephone Company by the United Telegraph and Telephone Company of Philadelphia is announced. R. T. Barton of Winchester was elected president. The company controls 30,000 telephones and, it is said, will acquire 30,000 more, and enter New York.

The Boiling Springs Telephone Company of Cleveland County, N. C., has been incorporated with $1,000 capital. D. J. Hamrick and others are stockholders.

A long-distance line is being built between Fredericksburg, Va., and Tappahannock, which will give long-distance connection with nearly 200 exchanges in the state of Virginia.

It is said that a great part of the force of the American Telephone Company now engaged in South Carolina will go north on the completion of the work to build a line from a point in Maryland not yet determined upon, to Watertown, N. Y.

The City Council of Clarksville, Tenn., has granted to R. B. Crane of Toledo, Ohio, and others a franchise to build a competing telephone system, to be completed within 15 months. The Cumberland Telephone Company, it is said, attempted to have the council defer action, promising to make a better proposition. L.

M. H. Bentley, chief engineer of the International Telephone Manufacturing Company, Chicago, has just returned from an extended tour through England and the principal countries of Europe, where he has been making a careful study and investigation of the telephone field, and the possibilities of equipment from this country. Mr. Bentley is well known in the electrical and telephone field as one of the foremost in his line, and was well fitted for representing his company on a trip of this kind.

Telegraphy and Telephony in New Zealand.

The Annual Report of the Post and Telegraph Department of New Zealand for the year ended March 31, 1902, gives interesting news in both the telegraph and telephone fields. A growth in both departments is seen, particularly in the telegraph, although the telephone is not far behind.

During the year ended March 31, 1902, 4,167,981 telegrams had been sent over the various telegraph lines, of which number 3,850,391 were paid messages. The revenue on these amounted to $707,905. During the year ended April 1, 1901, a total of 3,898,128 messages were recorded, which shows a gain for the last year of 269,853. The value of paid messages for 1900-1901 was $613,905, showing a gain in revenue of $76,000. There was 21,705 miles of telegraph wire in use at the close of the present fiscal year, as compared with 20,682 last year, thereby giving an increase of 1,023.

In the telephone field, improvement is also seen, as is evidenced by the following: The subscribers registered during the year were 9,260 against 8,210 the previous year, thereby giving an increase of 1,050. With this increase, the revenue also increased $277,710 for 1901-1902, being compared with $245,585 in 1900-1901. The number of miles of wire in use at the close of the present fiscal year was 7,767, in opposition to 6,987, the previous year, thus showing an increase of 780 miles. There were on March 31st last 23 central exchanges and 35 sub-exchanges. The working expenses for the year amounted to $253,865 and the revenue, given above, to $277,710, a net balance remaining of $23,845.

The submarine cables laid during the year for telegraphic purposes brings the total knots from 244 up to 248, and for telephonic purposes from 11.6 up to 12.5.

Since last year's report a practical advance has been made with the British Pacific cable, the sections, Queensland-Norfolk Island, Norfolk Island-New Zealand, Norfolk Island-Fiji having been laid by the cable steamer Anglia, which sailed from London on January 8th last. The cable is expected to be completed to Vancouver and opened for through traffic about November next. The through rate to and from Europe by that route will be 75 cents a word.

Competition Forces Reductions in Bell Rates in Pittsburg.

The effects of telephone competition in Pittsburg are shown in the sweeping reductions in rates which have just been announced by the Central District and Printing Telegraph Company, the Bell company operating in Pittsburg. About three weeks ago the company started the fight by reducing the prices on physicians' telephones. The latest reductions affect all of the company's system, embracing Homestead, Braddock, McKeesport, Duquesne, Turtle Creek, Wilkinsburg, Swissvale, Rankin, Wilmerding and East Pittsburg. The new schedule reduces one-party lines from $75 to $25 per year; two-party lines from $60 to $22; four-party, $48 to $18. This applies to business houses. The new rates for residences are much lower. Party-line telephones are cut from $60 to $15; four-party lines from $39 to $12. Agents have been sent into the district to get subscribers as quickly as possible. A complete new system will be established up the valley. It is said work will be started at once to put in direct lines from Pittsburg to Homestead, Braddock and McKeesport in addition to those already in use. Direct lines between the important towns are also to be erected.

NEW COMPANIES.

The Farmers' Telephone Company has been incorporated in High, Lamar County, Texas, with a capital stock of $7,000. The company will construct lines to Roxton, Brookston and Netty. The incorporators are M. D. High, Fred Roach and D. W. Price.

The Sanford (Ga.) Telephone Company has been incorporated with a capital of $2,500. The following-named officers were elected: President, C. R. Walker; vice-president, W. H. Mitchell; secretary, W. B. Mitchell. Work will be commenced on the company's system in Sanford at once.

EXTENSIONS AND IMPROVEMENTS.

A municipal telephone line is being constructed at Fort Williams, Ont., and the Bell Telephone Company is also constructing a system.

The Knoxville (Iowa) Electric Company has recently overhauled its entire telephone system, installing a new metallic circuit to Des Moines, Iowa.

The Lewiston-Great Falls (Mont.) telephone line has been rebuilt. A line will at once be built from Great Falls via Stockett, Sand Coulee and Belt, to Armington.

The Sunset Telephone Company has doubled its subscribers of the Alcambra (Cal.) exchange in the last 90 days. A new exchange will be installed and a number of line improvements made.

Citizens of Rosewater, Wash., have raised by public subscription money enough to buy wire and instruments for a telephone connection with the Hagerman system. Efforts will be made to induce the company at Butte to co-operate and extend its line to that place.

The Rocky Mountain Bell Telephone Company will at once extend its line from Beaver to Cedar and St. George, Utah, and to Pioche, Nev. At Pioche connections will be made with the Sunset system from the Pacific coast.

GENERAL TELEPHONE NEWS.

The Modern Electric Company of Burlington, Iowa, reports an increase in its capital stock to $50,000. An amendment to its articles of incorporation grants the company the right to establish and maintain telephone or telegraph lines.

The Granite Hill Telephone Company has completed its line from Thornton to Oakesdale, Wash. Efforts are now making to install a local exchange in Oakesdale, in connection with this line. About $400 has been raised by public subscription for this improvement.

At a recent meeting of the finance committee of the City Council of Hamilton, Ont., it was decided to draft an agreement and by-law between the Modern Telephone Company and the city of Hamilton. This company is the one that proposes to give the city subscribers $10 telephones.

The Cumberland Telephone and Telegraph Company of New Orleans has petitioned for an injunction against the striking linemen, alleging that they are persuading other men not to work for the company and that they are crossing the wires throughout the city, burning out the lines and putting them out of business.

While the name of the Illinois Telephone and Telegraph Company does not appear among the bidders for the contract to install pneumatic tubes in Chicago, there is said to be a close connection between that concern and the companies seeking the work. This is denied, however, by President Wheeler of the Illinois company.

Up to April 1st last the German Postoffice had spent on its telephone system throughout the empire the sum of $40,000,000. On the same date 2,024 towns and villages were supplied with telephones, the wires in use measuring 322,281 miles in length. Berlin comes first, with 51,561 public and private subscribers, including the public call offices, then comes Hamburg, with 8,914, Leipsic, with 8,724, and Cologne, with 7,484 subscribers. The daily calls amount in Berlin to 403,000, in Hamburg to 231,000, in Frankfort to 123,000, and in Cologne to 83,000. The entire telephone service employs 8,189 officials, of whom 1,712 are stationed in Berlin.

MANUFACTURERS AND DEALERS.

The large increase in orders for telephones and telephone accessories since the distribution of the St. Louis (Mo.) Electrical Supply Company's telephone catalogue indicates that the publication was well received.

The Vought-Berger Electrical Company of La Crosse, Wis., will increase its capital stock from $30,000 to $100,000. A new factory building is to be erected, and the scope of the business will be enlarged. The company produces telephone and electrical supplies.

The Electric Appliance Company, Chicago, is sending out booklets describing the push-button telephone, the "latest thing" in the telephone line. The company says the device looks like a push button, acts like one when desired and is a complete telephone as well.

The Metropolitan Telephone and Electric Company of Chicago, manufacturer of the Leich four-party-line selective-signaling system, states that its system is now in practical operation in a number of exchanges and is giving the best of satisfaction. The system has many features which appeal to practical telephone men, and, judging from the results already attained, it promises to fill a "long-felt" want.

The Automatic Electric Company of Chicago, manufacturing under the Strowger automatic-telephone patents, has increased its capital stock from $2,000,000 to $3,000,000. It is stated that the company's business has increased so rapidly that more room and machinery have become absolutely necessary, and in order to put the plant on a basis that will enable it to live up to its contracts permission to increase its capital was requested.

A representative of the Western Electrician recently visited the factory of the Sterling Electric Company at Lafayette, Ind., and was shown through the many interesting departments which comprise the birthplace of the Sterling telephone. The growth of the Sterling plant has been very rapid and substantial, and there are now employed in the various departments a total of 576 employes. The company recently closed contracts for a number of telephone exchanges in Illinois and neighboring states. The company is contemplating the erection of an extensive addition to its plant to care for the rapidly increasing business.

Steam Turbines.[1]

By S. E. Fedden.

The technical details of the steam turbine have been so very prominently placed before engineers lately, in numerous able papers, that the author does not consider it necessary to go over this ground again. Suffice it to say that the construction of the steam turbine is simplicity itself, as it consists only of a hollow drum revolving in a stationary drum or cylinder, each with teeth or vanes attached, and so arranged that they clear each other. The two cylinders are steam-packed, and, of course, the thrust guides require careful adjustment so that the vanes do not clash. Of late years this turbine engine has been meeting with signal success, and many engineers are now considering whether it is not destined to revolutionize the means of obtaining power from steam, both by land and by sea. The author suggests, however, that engineers and inventors should turn their attention toward bringing to perfection gas turbines, now that cheap gas is available, and the ideal engine, combined with the most economical way of obtaining electrical energy from coal, may then result.

The fundamental principle attending all methods of electrical working is implied by the word "velocity," a requirement eminently possessed by the dynamo, motor and rotary converter, owing to the entire absence from these machines of reciprocating parts. This requirement, however, is not possessed by the prime mover—the modern reciprocating engine. Velocity was first obtained on the dynamo by means of belts or ropes, but this method of driving was soon discarded; it took up too much available floor space, and was an unsatisfactory and inefficient arrangement at the best. The attention, therefore, of the most prominent engineers in the world was directed toward increasing the speed of the engine, so as to adapt it for direct coupling to the high-speed dynamo or alternator. The efforts of these engineers were attended with very great success in Britain, and they were able, not only to couple their new high-speed engines to the dynamos, but they also obtained those qualities of economy and reliability of working claimed for the slow-speed engine, with its belt drive, and the market now supplies high-speed engines of moderate sizes and of British manufacture, which are second to none in the world.

The demand for electrical energy for all purposes has, however, increased by leaps and bounds, and has thus called for larger generators and larger engines with heavy reciprocating parts; therefore, more strain and wear, bringing increased engine troubles. High-speed engines are now being built with pistons considerably over two tons weight. Such a piston will have to start and stop from 400 to 500 times per minute. When this enormous weight, making so many reversals per minute, is considered, it will not be difficult to imagine the steam-hammer effect obtained if the least thing goes wrong with the valve setting or the compression. On account of the increased engine troubles with high-speed engines, manufacturers are now falling back to moderate speeds, and many to slow speeds, although this is attendant with an increased cost of the plant.

Taking into consideration the large demands for electrical energy which must be made in the near future, it seems probable that the size of the generator and slow-speed engine will become unmanageable; also great difficulties will be experienced in shipping and erecting the same. The aim of all engineers should be simplicity, and the modern reciprocating engine, with its numerous complications, cannot by any means be considered the embodiment of this principle of simplicity. The great number of its moving parts, which require watching and adjustment, increases the cost of maintenance and attendance. Engineers who have had charge of power stations of from 6,000 horsepower to 10,000 horsepower are fully aware of the laborious and never-ending work and watchfulness required to maintain their reciprocating engines in fair running order; the station calls, incident to the taking up of brasses, repairs and adjustments to valves, gland packing, cylinder lubrication, automatic governors, trip-valve gears, and many other things, are items that go to build up the daily and nightly experience of the present-day station engineer.

Engineers laying down new plant have to consider the increased cost of building, the larger floor space required, the longer lengths of steam and exhaust piping, valve-opening gears, and heavy cranes for lifting, which are required in the case of large reciprocating engines, as against the requirements of a station laid out with steam turbines. The massive nature of foundations, the time required for delivery and erection of large plants, are items which often seriously delay the speedy completion of contracts. It was owing to these and similar reasons that the author's attention became directed toward the steam turbine offering a possible solution of the difficulty, and a short experience with generators of this type has since formulated his belief that progress in the generation of electrical energy lies in this direction.

The failure of the steam turbine to secure earlier appreciation was probably due in great measure to that inherent conservatism to which British engineers are only too liable. Two years ago the author

1. Paper read before the Municipal Electrical Association of England, July 3, 1902. The author is city electrical engineer of Sheffield.

had the opportunity of going through the country to inspect all the larger turbine installations, and the conclusions then arrived at were: (1) It was inadvisable to put down a steam turbine to exhaust to atmosphere; (2) it was inadvisable to put down a steam turbine of a small size; (3) it would be policy to install steam turbines from 200 kilowatts to 300 kilowatts, and upward, either for alternating or continuous-current generation for lighting or power, provided there was a plentiful supply of cold water available for condensing purposes, and also provided that surface condensers were used, all the water being returned to the boilers.

From the year 1885 until 1890 nearly all the turbines manufactured were non-condensing and of comparatively small type. They were not economical—in fact, many engineers called them steam eaters; but great improvement, both in construction and design, has since been made in them, and this has led to a very much smaller steam consumption, so that there is now on the market a steam turbine, which, in the larger sizes, and in the matter of steam consumption, is capable of holding its own against any triple-expansion engine yet produced. Even in the early days, when they were considered steam eaters, their smooth running and general adaptability to the driving of electrical machinery was the subject of much comment. The author, however, wishes to call the attention of the members to a few of the advantages which the adoption of the steam turbine, when running under ordinary conditions for working in a power station, has impressed upon his mind.

As many members are no doubt aware, a steam turbine of 500 kilowatts' capacity, 100 cycles, single-phase, was brought from the Paris Exhibition into the Sheffield station about 18 months ago, and was running on the town load within three days of the time of its arrival at the station doors, and within about three weeks of the date of the order by telegram. It was simply dropped down on the station floor without any preparation in the way of foundations, and has since, over the period stated above, run more or less continuously, and during longer hours than any other plant in the station. It runs in parallel with alternators both of the iron and copper type, with engines of the triple and compound type, and can be brought up to speed to meet the demands of a sudden load much more quickly than any other of the neighboring plants.

Boiler priming or wet steam simply causes momentary slackening of speed until the turbine clears itself of water. Other advantages are as follows: (1) Absolutely steady nature of turning moment. (2) Entire absence of cylinder lubrication, which, therefore, allows of all the condensed steam being returned to the boilers. The saving in this one item alone materially assists in the reduction of station costs. (3) The time occupied in cleaning down is brought to a minimum, and is about one-sixth of that required with a reciprocating engine of similar capacity. (4) The entire absence of rubbing surfaces and packed glands within the steam chamber will permit of the use of superheated steam without fear or injury. The turbine specially lends itself to the use of superheat of a high temperature, and in this respect possesses a considerable advantage over a reciprocating engine. (5) Exceedingly small costs for attention and repairs and great reliability of working. These last items bring home to the engineer more forcibly than anything else the advantages of a purely rotary, as opposed to a reciprocating, motion.

When considering the laying down of a steam-turbine plant, the main factors to be considered are:

First—Good vacuum in the condenser. This is even more necessary than with an ordinary engine, as the makers claim that the turbo expands the steam right down to the vacuum of the condenser. The following table of actual tests taken on a 500-kilowatt set illustrates how important it is to obtain a high vacuum:

CONSUMPTION OF 500-KILOWATT TURBO-ALTERNATORS, RUNNING AT 2,500 REVOLUTIONS, WITH 140 POUNDS' STEAM PRESSURE AT THE STOP VALVE AND NO SUPERHEAT.

Vacuum Constant from Full Load to No Load.	Consumption per Kilowatt-hour.			
Inches of Mercury.	Full Load.	Half Load.	Quarter Load.	No Load.
29	.....	.....	.....	1,500
28	22.2	25.6	32.4	1,700
27	23.1	26.9	34.5	1,900
26	24	28.2	36.6	2,100
25	25.1	29.7	39	2,300
24	26.2	31.2	41.2	2,500
23	27.5	32.9	44.8	2,700
22	28.9	34.7	46.3	2,900

Second—Arrangements for high superheat, as tests show that with 50° F. of superheat, there is eight per cent., and with 100° F., 12 per cent. economy in steam consumption. From the tests taken on the 1,250-kilowatt steam-turbine sets which are now working satisfactorily at Elberfeld, in parallel with Sulzer engines, where the speed ratio is something like 16 to 1, it was shown that there was a gain of 12 per cent. with 55° C. superheat, and that every inch of vacuum improves the steam consumption by four per cent. It was also shown that the steam consumption in the turbines, other things being equal, decreased constantly with increasing loads, whereas the Sulzer engines showed a less economy over three-quarter load.

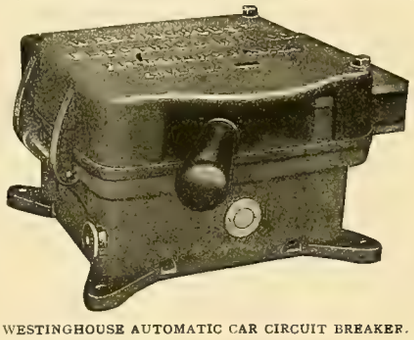
The steam consumption in a turbine closely follows the right-line law, or is proportional to the load added to a constant quantity which represents the consumption of steam at no load.

The new 1,500-kilowatt turbo-alternators which the author is installing at Sheffield power station will, with their own condensers, only occupy the space of 730 square feet. The foundations will be of the simplest description, and the general compactness of the sets and the ease of erection are expected to effect a considerable saving of time and money. The appearance of the station will be improved by the absence of ugly lengths of steam piping, or cylinders poised up in midair to obstruct the lighting of the building; and, altogether, the author hopes that there will be a general absence of that complexity of moving parts which, to the trained eye of a station engineer, offers so many possibilities of failure.

The author has been severely criticized for starting a large power house with steam turbines, but time may show whether this criticism is deserved. At present, however, he feels quite confident, after considering the problem from all points, that the steam turbine stands in a most favorable position, when compared with reciprocating engines of large powers, for the supply of electrical energy.

Westinghouse Automatic Car Circuit-breaker.

The protection of railway-motor equipments by the use of a fuse has until recently been the standard practice and recommendation of electrical manufacturing companies. The results obtained have been satisfactory only to a limited degree, as the fuse frequently fails to blow at the proper time, or to give the equipment the best protection under all conditions of service. The necessity of carrying extra fuses, as well as the inconvenience of stopping the car to replace a blown-out fuse is more or less of an objection to this method, and many of the largest



WESTINGHOUSE AUTOMATIC CAR CIRCUIT BREAKER.

street-railway companies have replaced the fuse block with the automatic car circuit-breaker. This practice offers better protection to the equipment, as it reduces to a minimum the possibility of injury to the apparatus arising from the carelessness of the motorman in improperly cutting out resistances—the circuit-breaker will open automatically when the current reaches the value for which it is set.

Aside from the protective feature of a circuit-breaker, the convenience in resetting it is obviously of great value. The motorman in throwing the handle of the breaker, after the occurrence of a heavy overload or short-circuit, is not required to leave his position at the controller to put the car in service. In most cases it is not necessary to stop the car, as the breaker can be reset while drifting.

The automatic car circuit-breaker manufactured by the Westinghouse Electric and Manufacturing Company performs the function of the fuse block by opening an overload or short-circuit; it also replaces the platform or canopy switch, in that it provides a hand opening for the circuit. In construction, the instrument, which is illustrated herewith, is thoroughly fireproof, of the best material and workmanship throughout, and all parts are interchangeable. Its design prevents any arcing at the current-carrying contacts, as the arc is broken on extra contacts especially provided for the purpose, and assisted by a powerful magnetic blow-out, which will open the severest short-circuit without damage. The breaker is calibrated, and can be set to open at any current within the limits of its range. The automatic opening device insures absolute certainty in opening when the current reaches the predetermined value.

New York-Philadelphia Electric Railway.

The Union Trust Company of Baltimore, Md., recently closed the underwriting syndicate for an interurban trolley line between Torresdale, Pa., and Trenton, N. J., via Bristol, Pa. The proposed railway, part of which is now in operation, will fill the last link of a long-distance electric railway between New York and Philadelphia. The underwriting covers a bond issue of $600,000 of first-mortgage five per cent. bonds of the Philadelphia, Bristol and Trenton Electric Railway Company. This line now operates between Torresdale and Bristol, and will be extended to Trenton as rapidly as possible. The link, when complete, will be 22 miles long. The company will have an authorized capital stock of $1,000,000, all of which is held by New York, Baltimore and Philadelphia capitalists, and a bond issue of the same amount. Cars will be running over the full 22 miles of line by December 1st.

British General Electric Company Manufacturing Carbons.

An interesting feature of the report of the chairman, G. Byng, of the British General Electric Company, presented at the company's last general meeting, was in reference to its second big works at Wilton. These works, now complete and in full swing, comprise the company's new electric-carbon factory, which practically represents a new industry in that country. So far no successful attempt had been made to produce in the country carbons for electric lighting that could compare in quality with those supplied from the Continent during the last 15 years. The company's officers had carefully considered the subject, and saw no reason why they, who prided themselves on being manufacturers of every electrical article, should not manufacture one of the most important articles of consumption. They had turned out carbons with raw material bought in England, and every test that they and some of their customers had so far made, proved them to be in every respect equal or superior to any carbons they had handled during the last 15 years. They had found employment for an additional 200 hands, and had succeeded in training them for this new work. It would be premature in a free-trade country to predict financial success for those works; they did not know how far their foreign competitors might wish to fight them on their own ground.

The chairman believed that at the present moment very few people were aware that almost every arc lamp in the streets of every town in the kingdom, every lamp in the docks or railway companies' stations, etc., every search-light in a man-of-war, or used for the protection of the English coasts, was lighted with carbons imported from abroad; considering what possibilities might arise under these conditions, it was not quite out of place to appeal for support from public bodies at the commencement. He might add that the officials of the Admiralty had shown themselves alive to the importance of the new carbon factory, and had shown every desire to give them a fair chance. In conclusion, he said that their Manchester, Sherlock Street, Birmingham and other works, had all done exceedingly well during the last year.

Correspondence-school System for England.

It is announced that the correspondence methods of technical instruction so well patronized in the United States are to be introduced in England. Two officers of an American correspondence school have recently been in London making arrangements for the establishment of a British branch that may be the beginning of a chain of similar institutions throughout Europe. Herbert Burrows, son of the well-known English labor advocate, is coming to this country and will spend six months in Chicago familiarizing himself with the correspondence system of instruction as practiced in the Armour Institute, with a view to undertaking the management of the work in his country.

Speaking to The Daily News correspondent the secretary of the London branch said: "The dearth of technical education in the United Kingdom opens up a wide field for the system of instruction by mail that has proved so popular and beneficial to a vast number of mechanics and artisans in the United States. We shall also profit by the magic influence that attaches everywhere throughout Great Britain to the industrial life and methods of the United States. Existing technical institutions in Great Britain are in most cases beyond the financial reach of wage-earners, who are thus without the means of developing their natural capacity in order to rise above the drudgery of the engine-room or boiler shop. Leading trades unionists and labor leaders assure us that they will welcome the introduction of the scheme. They assert that until British private benevolence has been moved by the examples of Carnegie, Armour and Schwab, British workingmen's hopes of increased efficiency must depend on such individual initiative as we purpose enabling them to exhibit."

Power-plant Extensions for Des Moines City Railway.

The Des Moines City Railway Company has built an addition to its old power house, the idea being in the near future to tear down the old one and build on to this new addition, thereby having a complete new building. The old engines and boilers have been in use since 1888, and new ones were sorely needed by the company. Another reason for the extension is found in the fact that the company is building a suburban line, the load of which added to the present one would have been too much for the old machines, the capacity of which was only 1,050 kilowatts, while the peak of the load sometimes reached 1,400 kilowatts. The new machinery being added is of the most improved type and will give

the company, when it is all installed, a model, complete and up-to-date plant. The present machinery in the new part comprises four horizontal water-tube boilers built by the Aultman & Taylor Machine Company, and an Allis-Chalmers engine direct-connected to a General Electric 16-pole, 1,000-kilowatt 575-volt generator. This unit alone, it is seen, will, on necessity, carry the present load. It is intended to install another similar unit in the near future, at which time the old part of the plant can be entirely shut down..

Sterling Spiral-filament Lamp.

The distribution of light in vertical and horizontal planes from many of the standard incandescent-lamp filaments is unsymmetrical, the old-fashioned hair-pin or single-loop filament giving the nearest approximation to perfect distribution in a horizontal plane. The lack of symmetry in incandescent-light distribution has been recognized for many years, and numerous forms of filament have been devised with a view to approximating more and more closely perfect symmetrical distribution. The accompanying diagrams, taken from some prepared by Francis W. Willcox, show roughly the results of these efforts:

Fig. 1 shows the vertical and horizontal distribution at 45° intervals from the single-loop or hair-pin filament just referred to; it will be observed that the horizontal distribution is almost perfect, full candlepower being obtained in six out of eight radial directions about the axis of the lamp. The vertical distribution, however, shows a small percentage of maximum candlepower measured straight downward through the tip of the lamp.

Fig. 2 is the single-coil filament, which was the next development. This form gives a slightly better distribution in a vertical plane, the candlepower downward through the tip being 6½, and at 45° 13

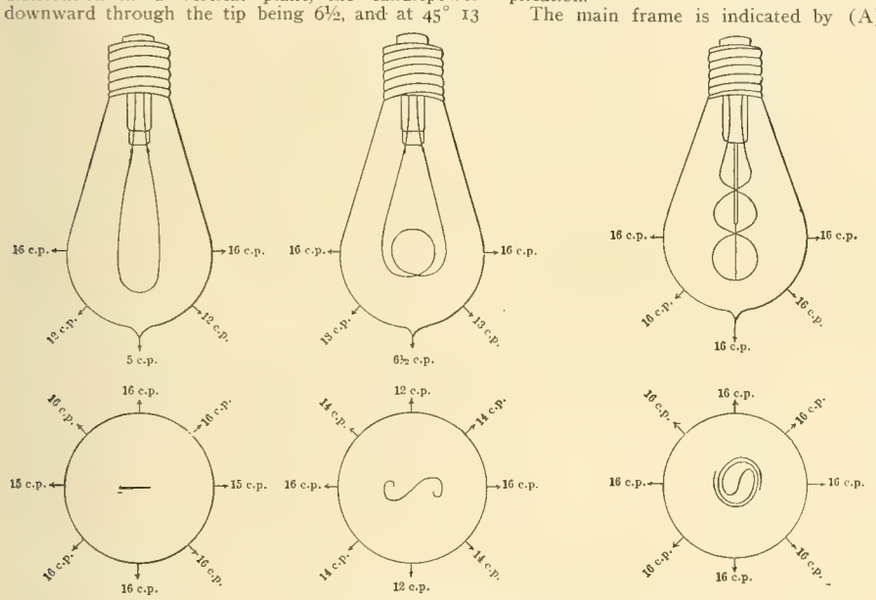


Fig. 1. Single-loop Filament. Fig. 2. Single-coil Filament. Fig. 3. Sterling Spiral Filament.

CANDLEPOWER DIAGRAMS OF INCANDESCENT LAMPS.

candlepower. The horizontal distribution is more irregular than that from the single loop, ranging from 12 candlepower to maximum. Of the more recent types, the double-loop or twin-filament lamp gives approximately the same vertical distribution, but considerably better horizontal distribution than the single-coil filament, the horizontal distribution ranging from 15 to 17 candlepower in a 16-candlepower lamp.

The oval anchored-filament lamp that is quite commonly used, gives further improvement in the vertical plane, the candlepower through the tip being seven, and that at 45° being 13. The horizontal distribution is also excellent, ranging from 14 to 16 candlepower. The double-coil filament gives considerably better distribution in the vertical plane than any of those previously mentioned, but its horizontal distribution is less symmetrical than that of the other filaments.

One of the latest developments in this direction is a spiral filament, represented diagrammatically in Fig. 3. A lamp having a filament of this sort is manufactured by the Sterling Electrical Manufacturing Company, Warren, Ohio. The diagram of light distribution shows perfect symmetry in both the vertical and horizontal planes, 16 candlepower being obtained at each of the angles. The manufacturer states that this result is actually obtained by photometric measurements with the lamp stationary. These lamps are manufactured in the usual voltages and candlepowers, and supplied with standard bases to fit all commercial sockets. It is claimed that this is the only lamp made that will give the same candlepower measurement when revolved or stationary and at any angle.

Henry A. Everett of the Everett-Moore syndicate was in Detroit recently attempting an arrangement with the Toledo and Monroe Short Line by means of which cars might be run between Toledo and Detroit either through a purchase of the above-mentioned line or by some traffic arrangement.

White Speed-regulating Device.

A new device along the line on which many inventors are just now approaching the Patent Office—another attempt to solve the problem of greater convenience in speed variation of machinery—is illustrated in the accompanying diagrams. The views illustrate a speed-regulator invented by Henry P. White of Kalamazoo, Mich. Fig. 1 is an end elevation, and Fig. 2 is a side view, the former having the tight and loose pulleys removed. The inventor has set out with the intention of providing a speed-regulator of the cone-pulley type, which may be applied in combination with any desired source of power, and to every class of machines, which, in practice, are required to run at various speeds. The design also embodies a construction in which the different portions of the contact surface of the belt travel at the same relative speed upon the surface of each cone, thus avoiding the necessity of a compensating constant slip at the contact surface of the belt.

The natural advantages which the inventor claims for this improved mechanical speed-regulator are, first, its range of variations in speed is practically unlimited, as it may be designed to secure any variation which practice will demand; second, its spring-regulated belt tension acts as a safety governor in the operation of machinery; third, its automatic speed-indicator makes it possible for the operator to know always at what speed his machine is running; fourth, the easy and practical means it provides for securing any speed intermediate to the two extremes embodied in the design of the machine does not require the operator's hands to come in contact with the belt; fifth, its simplicity of construction, which eliminates every undesirable complication.

The main frame is indicated by (A), and (B) is the driven cone mounted upon a shaft which carries the tight and loose pulleys, through which power may be applied to the machine. A corresponding cone (C) is mounted upon a shaft located at right angles to the one on which cone (B) is fastened, the pulley (C') being the medium by which power may be delivered from the machine. A track (E) is fastened to the main frame, or is a part of (A), having a sliding frame (D) with a shaft (I) and idlers (H). (G) is a screw and hand wheel, by means of which the sliding frame may be moved along the track (E).

The dotted lines show the position of the belts when the sliding frame is moved to the opposite end of the track, and the relative places at which the belts are applied also indicate the proportionate speeds of the cones. Of all frictional devices used to transmit mechanical force the belt and pulley has proved the most practical and economical. Where the contact surfaces of the belts travel at the same relative speed on all the pulley involved, there is practically no loss from friction, except in the journals of the revolving portions of the machine. It is said the devices shown embody this feature, which is of such vital importance to success in practice. The device is not patented in combination with any particular field of practice, but is covered in the broadest sense of the term as a speed-regulating device.

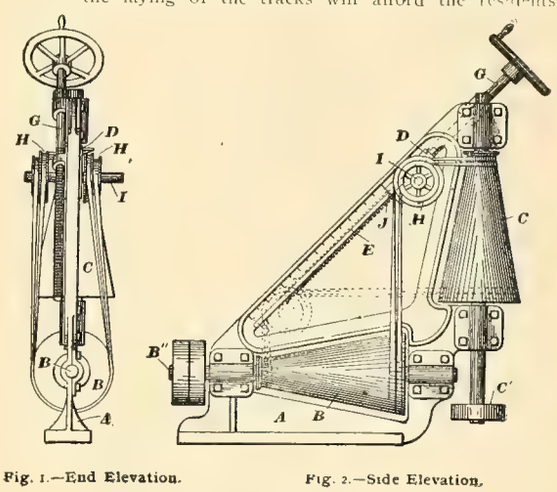


Fig. 1.—End Elevation. Fig. 2.—Side Elevation.

WHITE SPEED-REGULATING DEVICE.

A strike on the Lafayette (Ind.) Railway Company's lines was declared on August 17th, and promises interesting developments. A refusal to recognize the union and also to re-employ discharged union men is the cause of the trouble. The Central Labor Union, in sympathy, declared a boycott against the company, and, as a result of the concerted movement the cars, which are continuing to run, carry few passengers. Only the union men left their work, and no attempt has been made to interfere with non-union men.

CORRESPONDENCE.

New York Notes.

New York, August 16.—The great subway being built by the Rapid Transit Commission is advancing rapidly. The only break in the stretch of the subway between the Postoffice and One-hundred-and-fourth Street now is at the Hall of Records in City Hall Park. The building is a land-mark, and the historical societies are doing their best to preserve it. The subway builders, if they have to tunnel under the old building, will expend considerably more money than is desirable, hence the point arises of hastening the building of a new Hall of Records, proposed some time ago, and the demolishing of the old one. No decision has yet been reached in the matter. On the east side branch of the subway which diverges at One-hundred-and-fourth Street work is progressing on schedule, and there is no extraordinary complication except the Harlem River tunnel where the building of a box-like wooden frame under the water is being done successfully. The remainder of this branch is nearly completed, and most of the concrete for the elevated section of the road in the Bronx has been laid. The proposed subway when completed, will have necessitated the removal of 3,212,000 cubic yards of earth and rock. The total length of the new track, including elevated portion, will be nearly 58 miles, of which 11 miles will be on elevated structure. When finished the construction work will have made use of 65,000 tons of steel, 8,000 tons of cast iron, 551,000 cubic yards of concrete and 910,000 square yards of waterproofing. Up to the present $19,172,000—more than half the total cost of construction—has been expended on the road.

Mayor Low, before leaving the city on his vacation, signed a franchise granting the Union Railway Company the right to lay tracks across Macomb's Dam Bridge. The granting of the franchise will be cause for much rejoicing in the Bronx, since the laying of the tracks will afford the residents a continuous ride to their homes where formerly they were compelled to walk across the bridge.

The strike, which I stated in my last letter as imminent on the Manhattan elevated road, has been averted through the intercession of Russel Sage, who is a large stockholder in the Manhattan company. The men were granted the concessions asked, which referred mainly to the length of a working day and pay for overtime.

Commissioner Monroe of the Department of Water Supply, Gas and Electricity has appointed Professor George F. Sever as consulting electrical engineer at a salary of $4,000. The position was created by the Board of Aldermen at one of the recent meetings and affirmed by the mayor. Professor Sever's first work will be in connection with the preparation of a report from the department on the overhead wires in the Borough of Brooklyn, which is to be submitted to Mayor Low by September 12th. At the present time Professor Sever is adjunct professor of electrical engineering at Columbia University and vice-president of the American Institute of Electrical Engineers. During 1900 and 1901 he was superintendent of the department of electrical exhibits at the Pan-American Exposition.

H. H. Vreeland, president of the Interurban Railroad Company, recently tendered a clam-bake to the men at the heads of the various departments under him at Brewsters, N. Y., where Mr. Vreeland has his country home. Over 80 of the employes of the system attended. After the clam-bake Mrs. Vreeland tendered the party a reception at Rest-a-While, the Vreeland country home. The outing lasted from 11 o'clock in the morning until 9 at night and the employes are high in their praises of Mr. Vreeland's hospitality.

The heads of the various departments of the Brooklyn Rapid Transit Company and the members of the clerical force have been instructed to fill out personal record blanks, so that an accurate record of each employe may be filed away. The

idea of the company is to obtain and keep information pertaining to the members of its clerical force for ready use in cases of promotion, accident, etc.

The New York Municipal Civil Service Commission has issued notice that an examination for electrical engineer will be held on Friday, August 29th, at 10 a. m. Applications for this examination will close August 25th at 4 p. m. Technical knowledge and experience will be required of the applicants. The positions filled by this examination entitle a man to a salary of $3,000 per annum.

Mayor Low has signed an ordinance providing for $200,000 corporate stock for the construction and installation of a new heating and lighting plant in the American Museum of Natural History.

The International Railway Company of New York city certifies to an increase of its capital stock from $10,120,500 to $17,000,000. The National Electric Clock Company of this city has been incorporated with a capital of $250,000. Joseph Butcher and W. L. Rose of this city are interested.

New England News.

Boston, Mass., August 15.—Last Saturday papers applying for a receiver for the Fairhaven and Westville Railway Company were forwarded to the attorney-general of Connecticut. The signers were prominent citizens of New Haven. The application calls attention to the strike of the company's employes and states that since about five o'clock on the morning of August 6th, the company has absolutely failed to perform the great public duty intrusted to it by the General Assembly, and has failed to operate a single car for the carrying of passengers. The petitioners ask that a temporary receiver be appointed immediately, to take possession of the appliances of the company and to resume instanter the performance of the service. The New Haven business men espoused the strikers' cause, and there was an almost complete boycott of the company.

The Connecticut Railway and Lighting Company is making a survey for an electric railway between Waterbury and Milldale, Conn. This line will put Waterbury in direct electric-railway connection with Hartford, New Haven and Meriden, Conn.

A controlling interest in the Adams (Mass.) Gas Light Company and an option in the Adams Electric Light Company have been obtained by the North Adams Gas and Electric Light Company, which will now supply light to the towns of Adams and Williamstown.

The commissioners appointed in the case of the Holyoke Water Power Company vs. the city of Holyoke, Mass., have decided that the city should pay $329,874 for the company's electric-light plant and an annual rental of $1,500 per mill power for eight mill-powers, the city to have the privilege of taking eight more mill powers at the same rental. The city is also to pay a bonus of $53,356 for the mill powers, that amount being included in the amount paid for the lighting plant.

The Massachusetts Railroad Commission has approved the lease of the Worcester and Webster street railway to the Webster and Douglas Street Railway Company, and has authorized the issue of 3,500 shares of new stock, at $1.16 per share, by the Worcester Consolidated Street Railway Company. The latter company is to use the proceeds from the new stock for the purchase of real estate, rolling stock, equipment, and extension of buildings. It will order 20 new open cars, to cost $100,000.

The Fall River (Mass.) aldermen have granted franchises to the Old Colony Street Railway Company for an extension and relocation of its tracks, to the Taunton, Assonet and Fall River Air Line Street Railway Company for a location into the city, and to the Dartmouth and Westport Street Railway Company for carrying freight.

The Massachusetts Electric Companies report that the gross earnings for June were $8,048 less than they were in June, 1901. This is the first time that the companies' receipts for any month have been less than for the corresponding month of the previous year. The July earnings are estimated at about $650,000, or about the same as those for July, 1901. The June decrease was due to weather conditions.

The street-railway employes of Hartford, Conn., are discussing the advisability of striking for definite hours and extra pay for extra runs. They want time and a half for overtime.

The Electric Vehicle Company of Hartford, Conn., has received an order for six electric automobiles for the New York Edison Company. The vehicles are to be used by the superintendents of the Edison illuminating and power companies in New York and Brooklyn.

The Concord and Manchester (N. H.) half of the Concord, Manchester and Nashua street railway is in operation. It is 16.79 miles long and the running time is one hour and 30 minutes.

There has been considerable discussion of the advisability of establishing a municipal electric-lighting plant in Fall River, Mass. The Fall River Electric Company has been charging 35 cents per light per night but it now offers to do the service for 30 cents per light per night on a contract running five years, thus allowing the city to save $20,000 per year. The city government will soon act on the matter.

Over 100 employes of the Rhode Island Company have each had their wages increased 12½ cents per day, because they did not participate in the recent strike of the Union Traction Company's employes at Providence and Pawtucket, R. I. In addition, each man was given $7.87, the increase in their wages for the nine weeks since the strike began.

The Seekonk (Mass.) selectmen have granted a location through that town to the Norton and Taunton Street Railway Company. The Bristol County Street Railway Company had also petitioned for a location through Seekonk.

The Massachusetts railroad commissioners have reached a decision holding the conductor and motorman of car No. 54 responsible for the fatal collision on the Marlboro street railway on June 28th last. The decision says that they apparently received no order that authorized them to pass the turnout on which they usually waited for the special workingmen's car with which car 54 collided. The decision criticizes the company for not having a power brake on car No. 54 and for the character and method of publication of its timetable. B.

Southern Developments.

Charlotte, N. C., August 16.—C. Jerome Simmons is reported to be at the head of a new electric-light and power company seeking the right to supply Atlanta, Ga., with light and power. The company proposes to build a big plant on Chattahoochee River, near Atlanta. The application for a charter has been filed.

All property of the Norfolk (Va.) Heat, Light and Power Company has passed into the hands of the Norfolk, Portsmouth and Newport News Company, the consideration being about $115,000.

The electrical department has begun wiring the Textile Building at the St. Louis Exposition. The wires are run from the electric subway through the court of the building to the transformer room, where the current is diminished from a voltage of 6,000 to one of 100.

The Talladega Lighting Company has secured the gas plant at Talladega, Ala., and is under contract to have a power plant for lighting and power built in two years; also to have electric lights ready for use in six months. Steam will be used for power until the waterpower can be developed.

C. B. Huggins, Jr., and S. B. Christy have bought the electric-light and gas plant at Murfreesboro, Tenn. The plant will be removed to the site of an ice and cold-storage plant owned by the purchasers. The price paid for the plant was $15,000.

The Pearson syndicate has bought a controlling interest in the St. Charles Street Railway Company. This is the fourth line secured in New Orleans by this syndicate.

R. R. Robinson and others have transferred a street-railway franchise in Jacksonville, Fla., to the North Jacksonville Street Railway, Land and Improvement Company.

Three electric-railway lines, traversing the tri-cities, near St. Louis, Mo., have been combined under one name as the Granite City and St. Louis Railway Company. The companies combined thus are the Granite City and Edwardsville; the Granite City, Venice and East St. Louis; and the Venice, Madison and Granite City railway. These lines were constructed and operated by Fred E. Allen and others. The transfers represent about $500,000.

C. R. Caldwell and others have accepted a proposition from the owners of the street-railway, gas and electric-light plants of Staunton, Va., and have agreed to take the plants at a rumored figure of $85,000.

R. S. Williams, president of the Railways and Lights Company of America, has inspected the power plant at Knoxville, Tenn., and states that improvements will be made in the way of new apparatus and needed changes.

The Georgia Railway and Electric Company is contemplating an extension of its service from Atlanta to Hapeville, building a spur from East Point.

Residents along the Olive Street road, St. Louis, Mo., on account of their objections to outsiders owning a street railway, have asked for a franchise themselves to incorporate under the name of the West Olive Street Railway Company. Dr. W. Carl Feld and others are interested.

August 26th has been named as the day for the formal opening of the new electric line between Augusta, Ga., and Aiken, S. C.

It is rumored that the Hagerstown (Md.) Electric Railway Company has bought the old trolley roadbed from Boonsboro to Keedysville, a line having recently been completed to Boonsboro from Hagerstown.

The Electrical Construction Company of Richmond, Va., has the contract for a $20,000 electric plant at Warrenton, Va.

The town of Plaquemine, La., has granted a franchise to Dr. W. A. Holloway and associates for an electric power plant, to furnish light to the town, work to begin within one year.

The city of Fernandina, Fla., will begin at once several municipal improvements, including an extension of the lighting plant.

The Charleston (S. C.) Light and Water Company has filed notice of an increase of capital stock from $500,000 to $1,000,000.

Four large engines, costing $60,000, are being installed for the Birmingham Railway, Light and Power Company. The engines are capable of generating 10,000 horsepower. L.

Canadian Intelligence.

Toronto, Ont., August 15.—The Southwestern Traction Company has made an application to the London (Ont.) City Council for the privilege of running another electric railway in the city. This company is already chartered to run an electric-railroad line from Hamilton through to Glencoe and Strathroy, passing through the towns of Brantford, Paris, Woodstock, Ingersoll and London. The company has mapped out a route from east to west on the south side of the city, connecting with radial railway lines proposed to be run to Delaware on the west and Ingersoll on the east. It offers 10 fares for 25 cents. The present company has a six months' option to build any proposed electric line.

The Hamilton and Caledonia Electric Railway Company has made satisfactory arrangements with the Walpole Township Council for right-of-way. The company originally intended to build the road in sections, but has met with such a cordial reception and approval all along the line, that it has determined to build the entire line at once. The road will run as far as Selkirk, by way of Cayuga, out of Hamilton by the James Street incline.

The Hamilton, Grimsby and Beamsville Electric Railway Company has accepted the by-law for a right-of-way through Beamsville, and the extension of its line to Vinemount, about 4½ miles, will be begun shortly. It is the intention of this company to extend its line eventually on to St. Catharines, 12 miles from Beamsville, there to connect with the Niagara, St. Catharines and Toronto electric railway which runs from St. Catharines to Niagara Falls. H.

Information from Indiana.

Indianapolis, August 18.—The franchise of the Indianapolis Traction and Terminal Company and the eight interurban electric roads was passed by the City Council on Monday night and has since been signed by the mayor and representatives of all the roads interested. President McCulloch of the Union Traction Company said that he was not only highly satisfied with the way in which the interurban question had been settled, but that he was proud of the progressive spirit displayed by the city. It means, he said, that Indianapolis stands alone as the only city that has recognized the immense value of interurban traffic, and has provided for its proper and systematic operation through the city. President McGowan of the Indianapolis Street Railway Company, who has been active in bringing about the solution of the interurban problem, said that the passage of the ordinance means that within 18 months Indianapolis will be the greatest electrical center in the world, and will be visited by thousands who will come merely to see the extraordinarily perfect local and interurban street-railway systems. One million two hundred thousand dollars will be expended in constructing the two loops, a magnificent passenger station, and perhaps two freight stations.

During the last week plans were projected for three big interstate electric-railway enterprises. A trolley line from Indianapolis to Springfield, Ill., by way of Terre Haute and Paris, is the ambition of A. J. Hunter of Paris and other Illinois and Indiana capitalists. The Indianapolis and Plainfield line is finished, and cars will be running soon. Mr. Lieber will build on to Terre Haute. The Paris and Terre Haute Traction Company has already been formed and Mr. Hunter says work will begin soon. He says the ultimate object is a trunk line from Indianapolis to Springfield, by way of Terre Haute, Paris, Charleston, Mattoon and Decatur.

The Fort Wayne, Dayton and Cincinnati Traction Company has planned the biggest electrical-railway project yet outlined for eastern and northern Indiana. It is planning to build a road from Cincinnati to Fort Wayne, thence to Warsaw, there to connect lines already being built through Goshen, South Bend, Elkhart and Laporte, to Michigan City, and to secure entrance to Chicago by establishing a line of steamers. The above-named company is backed by an eastern syndicate of capitalists.

The Indianapolis Street Railway Company has put representatives to work organizing a company to construct an interurban line between Indianapolis and Cincinnati. The route selected is through Morgantown, Rushville, Liberty and Hamilton. Mr. McGowan says that the interests controlling the Indianapolis and Cincinnati local companies already own the line from Cincinnati to Hamilton. Efforts to purchase the Shelbyville line and the Aurora-Cincinnati line having failed, the Rushville-Hamilton route is the only remaining desirable route to be built. It is the plan to have two separate companies build parts of the line—one from Indianapolis to Rushville, and the other from Hamilton, Ohio, to Rushville. These plans have been carried so far as to dispose of considerable stock. Portland, the capital of Jay County, is destined to be an interurban center. In addition to the Muncie and Portland Traction Company's line, the Ohio and Indiana has received a franchise through the county to Portland, and the Fort Wayne, Dayton and Cincinnati Traction Company promises to make Portland a stopping place, and the Eastern Indiana Traction Company says it is getting in shape to push the work of construction to Portland, and now comes

the Western Ohio, which has its line in operation to Celina, Ohio, and says it will extend its line to Portland, to connect with that of the Muncie and Portland Traction Company.

The Terre Haute Electric Railway Company has decided to build a line from the city of Brazil south to Poland. The farmers have agreed to give the right-of-way, and the line will open up a section void of railroads.

President Irwin of the Indianapolis, Greenwood and Franklin line announces that a contract has been let for an extension to the road from Franklin to Columbus, a distance of 20 miles, and that the work will be pushed to a speedy completion.

The Elkhart, South Bend and Chicago Electric Railway Company has filed articles of incorporation. The company proposes to connect Elkhart, South Bend and Mishawaka by an electric road. The capital stock is $15,000.

The Fort Wayne and Southwestern Traction Company has completed its line to Wabash, and has begun operating cars on schedule time. A limited service will be established soon. The Wabash Railway Company has announced a 60 and 75-cent round-trip fare between Wabash and Fort Wayne, in opposition to the Traction company's 70-cent fare for one way.

The Evansville and Terre Haute Railroad Company will adopt electric-car service on its line between Evansville and Princeton, in opposition to the electric line almost completed between the two cities. The roads parallel and pass through one of the richest stretches of country in Indiana. There are signs of preparation for the equipment of the steam road with electricity, and the Traction people are considerably agitated over it. F.

Mexico and Texas.

Austin, Texas, August 16.—There are a number of new interurban lines of electric railway projected in Texas, and if the plans of the promoters of these enterprises are carried out, there will be a large amount of electric-railway building done in this state during the next few years. The success of the interurban lines which are now in operation between Fort Worth and Dallas and between Sherman and Denison has acted as an incentive for the building of similar lines between cities in other parts of the state. An effort is being made to organize a company of home capitalists to build an electric line between Houston and Galveston, a distance of 50 miles, and it is believed that the project will be successfully accomplished. The question of building an electric road to connect Austin and San Antonio is also being agitated. The distance between the two places is 81 miles. The proposed line would pass through a number of thriving towns, among them being Kyle, San Marcos and New Braumfels. The latter place has a splendid fishing and pleasure resort, which is visited by thousands of people each Sunday and at intervals during the week, excursions to the place being run by the steam railroad from surrounding towns. The project of building an electric line between Temple and Belton, a distance of about 12 miles, is practically assured, and the work of construction will soon begin. An interurban electric line is now being built between Beaumont and Port Arthur, a distance of 25 miles, and there is talk of the same company building a line between Beaumont and Orange, also a distance of 25 miles. There are a number of towns in North Texas around Fort Worth and Dallas which will probably be connected with the latter two cities by interurban lines within the next few years.

There are also a number of interurban electric lines projected in Mexico. The first of these lines to be built in that country was placed in operation between Torreon and Lerdo several months ago, and it is said to be doing a profitable business in the matter of handling both freight and passengers. The City of Mexico is already connected with many of her principal suburbs by interurban lines, and extensive additions to the existing system are projected. A company has been organized and the work of construction begun on an electric line which is to connect the city of Linares, state of Tamaulipas, and the thriving town of Teran, in the same state. Several enterprises of this nature are at present lying dormant in Mexico owing to the high rate of foreign exchange which has been prevailing for the last few months. This high rate of exchange makes the purchasing of foreign electric and other equipment and goods almost prohibitive, and the promoters of these enterprises are patiently awaiting an improvement in the financial situation, when they will carry their plans to fulfillment.

The Austin Electric Railway Company, which recently passed out of the hands of a receiver and has been reorganized on a sound business basis, is making extensive improvements, such as the rebuilding of its track, the purchase of new cars etc. Important extensions are also to be built.

The work of constructing the great electrical transmission plant of the Guanajuato Power and Tranmission Company in the state of Guanajuato, Mexico, has begun, and will be pushed to completion as rapidly as possible. The company has a capital stock of $1,800,000. United States money, all of which has been subscribed. The project embraces a number of engineering difficulties, all of which have been carefully considered and solved by skilled American engineers. The generating plant is to be located near the city of Zamora, on the Duero River, the waters of which stream are to be utilized in furnishing the necessary generating power. The transmission lines of the company will run from this generating plant to the city of Guanajuato, a distance of 110 miles. At Guanajuato a distributing plant will be located, which will carry the electric power to many surrounding mines and factories. These distributing lines will be more than 50 miles in length. It is expected that the operation of this great electric generating and transmission system will afford the mines such cheap power that many properties which cannot now be worked will be opened up and made to return a handsome profit to their respective owners. W. D. H.

Northwestern Notations.

Minneapolis, Minn., August 16.—The Fargo and Moorhead Street Railway Company has been granted a franchise in Fargo, N. D., and in Moorhead, Minn.

The Seattle Electric Company of Seattle, Wash., will make a number of changes and improvements. Permits have been taken out for the erection of the Olive Street car barns, to cost $40,000. Underground-wire work is to be constructed at a total cost of $300,000. A number of changes in the routes of car lines are to be made in order to relieve congestion and to expedite traffic. Extensions of a number of lines are also in prospect. The company has just installed a new 4,000-horsepower engine, which will be used to furnish power for the new interurban line to Tacoma.

The Vinton, Independence and Bell Plaine Railroad Company has been organized to operate an electric-railroad line between the cities named, in Iowa.

The Twin City Rapid Transit Company is considering sites along the river bank in Minneapolis for the construction of an immense power plant to cost $1,500,000. The plant will be used in the event of failing power from the waterpower of the Mississippi River, which has frequently been overtaxed in low water.

The Suburban Rapid Transit Company has begun the construction of a line from Winnipeg, Man., to Headingly.

Contracts are let for the erection of a new power station for an electric-light plant at Plainview, Minn.

A brick station is being erected at Devils Lake, N. D., for an electric-light and water plant.

The voters of Mantorville, Minn., have pledged Wedge & Son a bonus of $1,000 to aid in rebuilding their flour mill and electric-light plant in connection.

C. M. Humphrey of Ironwood, Mich., is promoting an electric railway from Fairmont, Minn., to Armstrong, Iowa. He also proposes to purchase the electric-light plant from the village of Fairmont, if the latter will sell.

A crew of surveyors has been at work around the waterfall at Taylor's Falls, Minn., and there has been a great deal of curiosity as to who was behind the move. It has been credited to the Twin City Rapid Transit Company and to the General Electric Company of Minneapolis, both of which deny all connection. It has been credited also to eastern capitalists, who are supposed to intend to develop the power and transmit it electrically to all cities within a reasonable distance.

R. E. Lester of Little Falls, Minn., has made a proposition to establish an electric-light plant for Royalton, Minn.

The council of Fergus Falls, Minn., has decided to place all private consumers of electric light on a meter basis on and after October 1st.

The council of Grand Rapids, Minn., has awarded a contract for the erection of a power station for the electric-light and water systems.

T. W. Warwick and L. G. Hopkins have bought the business of the Waterloo Electrical Supply Company of Waterloo, Iowa.

The Tri-City Railway Company of Davenport, Iowa, will make extensive changes and improvements to its barns.

The John U. May Company has been granted a franchise through Clinton, Iowa, for its line which is projected to Davenport.

The Dundee Water Power and Electric Light Company of Dundee, Wis., has been incorporated with a capital of $25,000.

The new municipal plant being installed for New Ulm, Minn., is expected to be completed by September 1st.

The St. Mary's Traction Company of Sault Ste. Marie, in Michigan and in Ontario, has awarded contracts for the construction of eight miles of street-railway line in the Twin Soos, to the Falk Company of Milwaukee.

A formal transfer has been made of the properties of the Fargo Gas and Electric Company and of the Fargo-Edison Company at Fargo, N. D., to the new Union Light, Heat and Power Company.

An electric railway is projected from Mount Ayr, Iowa, to Creston. Two routes are suggested, one via Diagonal and the other via Tingley.

The Jamestown (N. D.) Electric Light Company is undergoing reorganization, having been sold to Mr. Canham and O. McHarg, the former holding a two-thirds interest and the latter one-third. Mr. Canham has been manager of the old company. R.

Among the Rockies.

Salt Lake City, Augunt 15.—Franchises for a water and light system have been granted by the city of Havre, Mont. Work will be begun at once.

The Cascade Water Power and Light Company of Cascade, British Columbia, will turn on power between that place and Phœnix within 60 days. The double-pole line, of some 22 miles, has been completed. There has been some delay in the delivery of machinery, but now a large part of it has arrived. Actual work on the plant was started some four years ago, and since then about $500,000 has been expended. All work has been carried on by W. Anderson, the present engineer in charge.

The Telluride Power Company of Provo, Utah, has been made defendant in a suit brought by irrigation companies, asserting that the power company is wasting the water unnecessarily.

Work will at once commence on the new electric-car line to connect Pueblo and Beulah, Colo., a distance of 30 miles. The franchise has been granted to the Rapid Transit Company of Pueblo. The company has agreed to pay the city one per cent. of the gross earnings within the city limits. The new company is capitalized for $100,000.

The Consolidated Railway and Power Company of Salt Lake City will extend its Murray line to the smelters which lie south of that town. It is also reported that the railway company will ask for a franchise to extend its lines to Sandy, 3½ miles south of Murray.

Boise, Idaho, has accepted the bid of the Capital Electric Light, Motor and Gas Company to furnish that city with electric lights. The company agrees to furnish 54 450-watt arc lamps at $6.50 each per month, and current to light the city hall by meter at 10 cents per kilowatt-hour.

The Denver Tramway Company of Denver, Colo., has filed papers for the taking of 600 cubic feet of water a second from the Grand River, near Glenwood Springs, Colo. The object of the company is stated to be the generation of electricity to be supplied for power purposes to Leadville, Aspen and other points.

The Wabash Mining Company of Park City, Utah, has installed a complete electric-light and power plant on its properties.

A company has been formed in Butte and Helena, Mont., to be known as the Crooked River Electric Mining and Power Company. The new company will erect a 2,000-horsepower plant, using the waters of Crooked River. Power will be supplied to the company's quartz mine and other mining properties.

A contract has been awarded to C. G. Cunningham, electrician of Greenwood, British Columbia, for the installation of an electric-light plant at Fairview, British Columbia.

Farson, Leach & Co. and Devitt, Tremble & Co., Chicago bankers, have closed a deal for the purchase of the Pueblo (Colo.) Gas and Electric Light Company's property, the consideration being about $500,000. Lewis E. Eyman of Chicago, it is understood, will be at the head of the new company.

The American Falls Power, Light and Water Company has commenced delivering current into Pocatello, Idaho, over a transmission line of 24.8 miles. The new plant has a capacity of 4,500 horsepower. The entire proposition was engineered by J. H. Brady, the president of the company.

The Colorado Electric Power Company, working under the Kurren franchise, has commenced delivering power into Cripple Creek, Colo., as has also the People's Electric Company. This gives the residents of that city the benefit of three electric-light lines, and a merry war is anticipated.

The Hercules Power Company of Logan, Utah, has, without warning, raised the rates from 35 to 75 cents for one 16-candlepower lamp per month. A number of business houses have ordered all lights to be taken out. This action of the company will hasten the work on Logan's municipal plant now being built.

The Telluride Power Company, Provo, Utah, has secured the contract to furnish light and power for the driving of the long Niagara tunnel in Bingham district.

The owners of the Pearce mine will build an electric railroad from Willcox, Ariz., on the Southern Pacific, to its property, a distance of 20 miles.

The Cheyenne (Wyo.) Electric Light and Fuel Company has installed two 150-horsepower and two 60-horsepower boilers, and later will add another boiler of 150 horsepower. Two new generators of 1,000 lights each will be installed to take the place of two 450-light dynamos. A new engine of 200 horsepower will also be added. A new switchboard of the latest pattern, and numerous other improvements will be installed at once. A new building, 24 by 38 feet, will also be built. A. W. C.

On the Pacific Slope.

San Francisco, August 14.—Contracts for the electric line from Pendleton to Dayton, Ore., have been let and work on the power house will be commenced at once. The Northwest Power Company has the contract to furnish the machinery, erect the power houses and furnish and lay the track.

G. H. Headlee of Silverton, Wash., has been granted a franchise for a waterpower plant at Everett, Wash.

The contract for driving the 14,000-foot tunnel through the mountain separating Lakes Beautiful and Coquitlam in British Columbia has been awarded by the Vancouver Power Company to the Ironsides, Rannie and Campbell Company for $250,000. The

project, when completed, including the power plant, will cost about $1,000,000. The waters of Lake Coquitlam will be piped through the tunnel under the mountain separating the two lakes.

It is reported that every operator and lineman of the Yukon telegraph lines from Ogilvie station, 50 miles from Dawson, to Caribou Crossing, 400 miles from Dawson, have signed a declaration to the minister of public works that they would go on a strike at once unless the former scale of wages was established.

The Washington and Oregon Electric Railway, Light and Power Company has secured the franchise for its road through Pomeroy, Wash. A. W. C.

PERSONAL.

Charles T. Yerkes sailed from Liverpool Wednesday for New York city. It is stated that he is coming to this country in the interests of his London underground railways.

Mr. Muraki, post and telegraph inspector in the Japanese Kingdom, recently arrived in San Francisco. He comes to the United States to study the telegraph and postoffice systems.

John Lambert, president of the American Steel and Wire Company, is reported to be critically ill in Denver, Colo., where he went recently to attend the election of the Colorado Fuel and Iron Company.

Edward B. Ellicott, city electrician of Chicago, has gone West on a hunting and fishing trip. He will make his first stop at Monida, a town on the state line of Montana and Idaho. He expects to be absent from Chicago for two weeks.

W. G. Rowen has resigned as superintendent of the city electric-light plant of Rochester, Minn. He will go to Portland, Ore., where he will engage in the electrical contracting business and will have an interest in the Northwest Electric Company.

E. E. Torrey, for 18 years superintendent of telegraph for the Michigan Central Railroad Company, has retired from the service. A large party of his associates met at his home in Detroit, Mich., recently and presented to him a $250 diamond ring.

Mrs. Nellie Farr, vice-president of the Farr Telephone and Construction Company, Chicago, and Edward Hurst, manager for the same company, were severely injured in a runaway accident in Chicago on August 17th. Neither Mrs. Farr nor Mr. Hurst are thought to be seriously hurt, although both received painful bruises.

Lyman M. Darling, a director of the Pawtucket (R. I.) Electric Company, died at Sugar Hill, N. H., on August 10th. He was born in Bellingham, Mass., 52 years ago. He was president of the Darling Company of Chicago, the Metropolitan Hotel Supply Company of New York and the Pawtucket Gas Company, and an officer of other corporations and institutions.

General Irving Hale, the Denver (Colo.) representative of the General Electric Company, has been elected president of the National Society of the Army of the Philippines. General Hale won his rank of brigadier general by his gallant conduct as colonel of a Colorado regiment in the Philippine campaign. He graduated from West Point in 1884 and was an officer in the Engineers' Corps of the army until 1890, when he resigned to enter commercial life.

Frank Kurz has resigned his position as superintendent of the electric-lighting department in Appleton, Wis., of the Wisconsin Traction, Light, Heat and Power Company. Mr. Kurz had been connected with the local lighting companies in Appleton for 22 years and during that time had taken no vacation. With his brother, William Kurz, he was instrumental in erecting in Appleton what is claimed to be the first dynamo for electric lighting in the United States.

George H. Hopkins, associate editor of the Scientific American and a well-known and progressive scientist, died at his summer home in Cheshire, Mass., on Sunday, August 17th, as a result of a three days' illness, brought on by uræmic poisoning. Mr. Hopkins was 60 years old, and had spent much of his life in the advancement of science. He was a well-known writer on scientific subjects, and was the author of "Experimental Science," a popular book on physics. His family, who reside in Brooklyn, N. Y., were at his bedside when he died.

J. P. Cook of Chicago, J. J. Dickey of Omaha, Neb., and Major Sells, Western Union employes, while exploring on Pike's Peak recently, in an endeavor to look into the feasibility of laying a surface cable connecting the summit station with the lower levels, had a narrow escape from death, the danger being caused by mountain sheep above them loosening rocks which rolled down the mountain side. The men were kept busy dodging these stones for almost a half hour. They, however, completed their survey of the situation and proposed the laying of a half mile of cable, this to be held to the mountain side by granite blocks.

ELECTRIC LIGHTING.

At a special election held in Charles City, Iowa, August 15th, a 25-year franchise was granted to the Charles City Electric Light and Heating Company. The company, of which G. E. May and H. V. Fussell are the promotors, will at once begin the erection of the plant.

Jordan, Minn., has voted to issue bonds for the construction and operation of a city lighting plant.

Frankfort, N. Y., is preparing to erect an electric-light plant. E. R. Weaver, city clerk, may be addressed.

The Washtenaw Light and Power Company of Ann Arbor, Mich., has been incorporated with $200,000 capital stock.

Emporia, Kan., invites bids on electric-lighting machinery for a new plant. The city will spend $20,000 on the plant.

Zeeland, Mich., will vote on a proposition to issue $18,000 in bonds for the purpose of building an electric-light plant and waterworks system.

Foreclosure suit has been commenced in the Superior Court of Illinois by the Northern Trust Company, as trustee, against the Evanston (Ill.) Yaryan Company. The bill alleges that the property covered by the trust deed is not sufficient security, and asks that a receiver be appointed. The Yaryan Company has filed an answer to the bill, in which the default and all of the allegations in the bill are admitted.

ELECTRIC RAILWAYS.

The Illinois Valley Traction Company has increased its capital from $550,000 to $700,000.

Engineers are surveying the proposed route of the electric road to be built between Winona, Minn., and Rushford, Minn.

The Rapid Transit Electric Company (Pueblo, Colo.) has been incorporated. Charles Henkel is president of the company. The company intends to build a road from Pueblo to Beulah, a distance of 35 miles.

The council of East St. Louis, Ill., granted the East St. Louis Electric Street Railway Company the right to connect with the lines on the Eads Bridge. The East St. Louis cars will now run over the bridge into St. Louis, Mo.

The Kewanee (Ill.), Cambridge and Geneseo Railway Company has been incorporated with a capital of $100,000 to operate a street railway between Kewanee and Geneseo, via Cambridge. George A. Anthony is interested.

There has been considerable talk during the last few days that a general strike of all the surface street-railway employes in Chicago was imminent. The men appear to have certain grievances against the companies, but it is likely that they may be settled by arbitration.

The Superior Court of Ohio, through Judges Dempsey, Smith and Ferris, recently rendered a decision declaring unconstitutional the Rogers Law under which the Cincinnati Street Railway Company received an extension to its franchise of 50 years. If the Supreme Court sustains the lower court all franchises existing under the Rogers Law will be invalid. The railway officials expect a reversal, but, in any event, they will seek relief at the extra session of the Legislature, to be held next week.

Mention was made in the Western Electrician August 16th of a proposed railway deal in Omaha, Neb., through which the Omaha Street Railway Company obtained control of all the railway lines in Omaha, Neb., and Council Bluffs, Iowa. This deal went through, and now another is reported. It is the purchase, by J. and W. Seligman & Co., New York bankers, of all the Omaha City Railway Company's lines. The consideration, it is said, was $6,000,000. The Seligmans represent a syndicate composed of New York men. As a result of the first deal the syndicate will control the entire street-car service in and around Council Bluffs, Iowa, and Omaha, Neb.

TELEGRAPH.

Advices from Honolulu state that the Commercial Pacific Cable Company has purchased a site for landing its cable from San Francisco on the beach at Waikiki. The company is said to have paid $5,000 for the property.

On August 12th the Pere Marquette Railway Company opened up telegraph service over a private system which that company has been installing between its lake ports and all points in Michigan along its line. Heretofore all the company's business has been transacted over Western Union lines.

The Franklin Telegraph Company has filed with the corporation commissioner at Boston its certificate of condition. The statement gives the fixed capital as $1,000,000, all of which has been paid in. There are no assets or liabilities outside of the capital stock. This company is controlled by the American Telegraph and Telephone Company, with Robert C. Clowry, president.

The convention of the International Union of Commercial Telegraphers will be held in Chicago on September 20th. The movement to organize the commercial telegraphers began in Chicago two months ago. Locals have been formed in 15 cities extending from San Francisco to Boston. About 20 cities are now ready and will elect officers during the week.

General A. W. Greely, chief signal officer, has returned after an extended visit to Alaska, where he has been completing arrangements for the extension of the telegraph system of that territory. General Greely will now give active attention to the army and navy maneuvers, as the army depends upon the Signal Corps for information concerning the approach of the war vessels. Already the telegraph system has been put in thorough repair and perfect order, while experiments are being made with wireless telegraphy and balloons.

AUTOMOBILES.

A New York firm, it is said, has recently contracted for $1,000,000 worth of French automobiles. The deal is the largest of the kind on record. The purchase calls for the delivery within one year of 300 order machines, ranging in value from $4,000 to $12,000 each.

The Fifth Annual International Automobile and Bicycle Exposition will be held under the auspices of the Society of German Bicycle Manufacturers at the Crystal Palace, Leipsic, from the 18th to the 27th of October next. There is already a great demand for floor space at the exposition, detailed information in regard to which can be obtained by writing to Herrn A. v. Slawinski, General-Secretair, Internationaler Markt & Ausstellung von Motarfahrzeugen, etc., Krystall Palast, Leipsic, Germany.

PUBLICATIONS.

The Jeffrey Manufacturing Company of Columbus, Ohio, has issued a special price list of its water elevators.

The American Blower Company issues an illustrated sectional catalogue devoted to its ABC pressure and volume blowers. These are shown in various types and sizes and some are arranged for electric driving.

A new general supply catalogue (No. 16), a new telephone and telephone supply catalogue (No. 17), a new catalogue of Gutmann alternating-current wattmeters and a new catalogue showing a full line of rubber-covered wires and cables, have just been issued by the Electric Appliance Company of Chicago.

Paranite and Peerless rubber-covered wires and cables are treated in an attractive catalogue, recently issued by the Indiana Rubber and Insulated Wire Company of Jonesboro, Ind. Various styles of high and low-tension and telephone wires are listed. Several extracts are made from the National Electrical Code, and the catalogue closes with several pages of useful weight and measurement tables and other useful information.

One of the most complete and perhaps the largest catalogue on electric-hoisting apparatus that has been issued in this country is being distributed by the Denver Engineering Works Company of Denver, Colo. A feature of the publication is the general drawing of each hoist listed, accompanied by a table giving all of the dimensions which are necessary for the location of the hoist in the plans of the constructing engineers. The company manufactures a great range of sizes, and many prominent companies are using its hoists. A large number of its machines are used in the Cripple Creek Mining District. The catalogue is neatly illustrated and contains some valuable engineering data and tables.

MISCELLANEOUS.

A consular report gives the exportation of rubber this season from the Amazon Valley as amounting to 29,997 tons, this being 2,317 tons more than in 1900-1901.

Harry B. and Hector Owsley have begun suit against the Northwestern Elevated Railroad Company of Chicago for $100,000 damages. The complainants allege that their building in Fullerton Avenue has been made almost uninhabitable since the erection of the Northwestern company's power house, near their structure; that, because of vibrations, a section of their building collapsed, causing the death of a child, for which they had to pay heavy damages, and that their structure is partly undermined. The Owsleys further allege that the foundations of the power house are not sufficiently strong to bear the load of machinery placed on them.

TRADE NEWS.

The Nungesser Electric Battery Company of Cleveland, Ohio, certifies to an increase in capital stock from $25,000 to $100,000.

A dispatch from Erie, Pa., dated August 11th, states that the Keystone Electric Company of that city, manufacturer of electrical machinery, was sold on that day to a New York company, headed by P. B. Clarke. Its capital will be increased to $400,000.

Report says that the American Steel and Wire Company is having a Philadelphia architect prepare plans to be used as a basis for the construction of emergency hospitals at each one of its 22 plants.

This is a novel scheme, and one that will undoubtedly be appreciated by the employes of the company. The cost of the buildings and equipment will be in the neighborhood of $300,000.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until September 3d, for the installation of a conduit and electric-wiring system for the Hygienic Laboratory, United States Marine Hospital Service, Washington, D. C., in accordance with the drawings and specifications, copies of which may be obtained at the architect's office.

The Ritter Electrical Company and the Cincinnati Machine Works of Cincinnati, Ohio, have combined and will hereafter operate under the name of the Ritter Electrical Company, at 118-120 West Second Street. The company manufactures arc lamps, dynamos and motors and does electrical and mechanical repairing and general machine work. John C. Mulvihill is president of the new company.

The Dearborn Drug and Chemical Works have offered their offices and laboratories at 145 Van Buren Street, Chicago, as headquarters for the delegates and visitors going through Chicago on August 30th and 31st on their way to the convention of the National Association of Stationary Engineers at Boston. Refreshments will be served and special arrangements will be made to provide for the convenience of the visitors.

Westinghouse, Church, Kerr & Co. announce the removal of their New York offices from the Havemeyer Building, 26 Cortlandt Street, to the Maritime Building, 8 to 10 Bridge Street, opposite the new Custom House and near Bowling Green. The change is the result of a largely increased business. Three floors, the first, second and third, will be devoted to their uses. The new quarters will afford about double the floor space available in their present location.

A very successful picnic was enjoyed on Saturday, August 9th, by the drafting department of the Western Electric Company of Chicago. A special car having been engaged, a party of 80 went by train to Cedar Lake, Ind. The ride was enlivened by music and singing, furnished by an orchestra, ably supplemented by members of the party. A steamer conveyed the party across the lake to Cedar Point Hotel, where arrangement had been prepared before for having a good time. The party then proceeded to take possession of the hotel and grounds, and sports were soon in full swing. After various games, for which prizes were awarded to the victors, an enjoyable dinner was served and the party returned by the same route. It is expected that this will become an annual event, everyone voting that it was a complete success.

BUSINESS.

The Holly steam-loop system is being introducel in a large number of steam plants. A few representative installations are the Chicago Edison Company, and Armour & Co., Chicago; American Smelting and Refining Company, Leadville, Colo.; Denver Tramways and Power Company, Denver, Colo.; Atchison, Topeka and Santa Fe railway, Topeka, Kan.; American Cigar Company, Richmond, Va.; J. B. Stetson, Philadelphia, Pa.; Lake Shore and Michigan Southern, Collinwood, Ohio.

The Consumers Carbon Company of Lancaster, Ohio, is now running to its utmost capacity. Manager M. M. Hayden, who only recently returned from an extensive business trip, reports the carbon business very active for this time of the year. Mr. Hayden while in Chicago recently closed a contract with the Electric Lighting Department of the city of Chicago for 1,000,000 carbons. It is not at all unlikely that the near future will see an increase in the Consumers company's factory plant at Lancaster.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 12, 1902.

706,508. Armature Winding for Induction Motors. Albert H. Armstrong, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 3, 1897.

The invention combines a number of conductors of drawn metal, and end connections formed integral therewith uniting the conductors in closed-circuit relation.

706,527. Electric Switch. Eugene R. Carichoff, East Orange, N. J., assignor to the Otis Elevator Company, East Orange, N. J. Application filed February 8, 1901.

The apparatus consists of an electric switch or circuit-closer comprising a contact constituting one terminal of a circuit, a second contact constituting the other terminal of the circuit, and a movable jointed contact-carrier supporting the second contact, means for moving the carrier initially to close the circuit between the second contact and a portion of the first contact, and means for subsequently rotating the second contact bodily about the first contact on the face of the same, and simultaneously therewith sliding the second contact along the face of the first contact to a new portion of the face of the same entirely clear of the portion of the face upon which circuit was initially closed.

706,529. Electrochemical Apparatus. Chauncey C. Clark, Philadelphia, Pa., assignor of one-half to James G. Carson, Philadelphia, Pa. Application filed September 20, 1901.

The apparatus consists of two cylinders, one surrounding the other, and an enclosed space between the cylinders, a chamber at each end of the cylinders, means of communication from each chamber to the space between the cylinders, a fluid inlet to one chamber, a fluid outlet from the other chamber, means of communication from chamber to chamber through the surrounded cylinder, and a series of electrodes within the cylinder.

706,540. Electrically Controlled Switch. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company. Application filed November 3, 1899.

The switch comprises fixed contact terminals, an armature carrying a bridging contact, auxiliary shunting contacts to absorb the spark of rupture, a switch-operating magnet housed between the armature and the base, and a releasing magnet and tripping devices between the plane of the switching armature and the base.

706,544. System of Electrical Distribution. Richard Fleming, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 26, 1900.

The system employs an alternating-current circuit, means for maintaining a substantially constant current in the circuit, a number of compensators in series in the circuit, the points of connection of the circuit to each compensator being such as to include less than the whole length of the compensatory coil, and a translating device supplied from each compensator and connected thereto so as to include the whole length of the compensator coil. (See cut.)

706,545. Electric Arc Lamp. Richard Fleming, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 23, 1901.

A suspension device for arc lamps combines a support which is secured to the lamp, a fixed support, a spring located between the supports and arranged to sustain the weight of the lamp, and insulating bushings which prevent current from being transferred from one support to the other, at the same time permitting the parts to move slightly with respect to each other.

706,547. Electric Arc Lamp. Frederick A. Gilbert, Brookline, and Emil O. Lundin, Beachmont, Mass., assignors to the General Electric Company, Schenectady, N. Y. Application filed March 24, 1898.

The lamp is provided with a contact device for the movable carbon, means for connecting and disconnecting the same from the carbon, and a rigid lever yieldingly mounted on the contact device and effecting a sliding frictional contact between the carbon-follower and the circuit terminal.

706,553. Process of Manufacturing Alumina. Charles M. Hall, Niagara Falls, N. Y. Application filed August 10, 1901.

A method of purifying bauxite or other impure oxide of aluminum consists in heating the same in admixture with a reducing agent by means of an electric current without substantial fusion, and afterward fusing it in an electric furnace.

706,554. Speed-indicating System. John L. Hall, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 29, 1901.

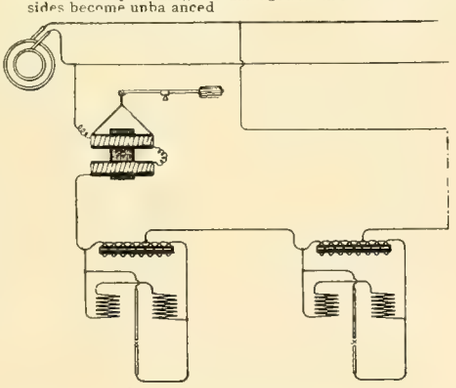
The system comprises two sources of alternating current, synchronous motors driven thereby, and differential gearing driven by the joint action of the two motors to show the speed relation of the two machines.

706,555. Electric Meter. Caryl D. Haskins, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 13, 1901.

The meter contains a starting coil wound in halves symmetrically disposed with relation to the armature shaft, and means for adjusting the coil angularly around the shaft.

706,559. Electric Transmission of Power. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 23, 1901.

The system comprises duplicate transmission mains connected in parallel at the sub-station or local distributing point, and differential means responsive to both mains for automatically opening the damaged main in case the two sides become unbalanced



NO. 706,544.—DISTRIBUTION SYSTEM.

706,567. Telephone Cable Connection. Thomas P. Jones, Olyphant, Pa. Application filed June 27, 1901.

The cable connection consists of the combination of a casing comprising two tubular parts adapted to receive the spliced wires and contracted portions on the outer ends of the tubular parts, a covering wrapped around the wires and occupying the space between the wires and the interior of the tubular parts, and means carried by the tubular parts whereby the other ends thereof may be brought together and the covering compressed.

706,568. Electrode for Storage Batteries. Charles W. Kennedy, Rutledge, Pa. Application filed July 30, 1901.

The electrode is a grid for storage batteries. It comprises a frame provided with recesses and has series of horizontal and vertical members forming the recesses, each of the vertical members being disposed opposite one or more of the recesses and serving to resist the pressure caused by the expansion of the active material during the "forming" period.

706,575. Multirate Metering System. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 31, 1901.

The system employs a combination of a direct-current meter, and means controlled by an alternating electromotive force for changing the rate of the meter.

706,577. Electric Switch for Flashing Lighthouse Lanterns. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 9, 1899.

The switch comprises a number of relatively rotary contacts, a drive shaft, a gear-train connecting the same with the rotary-switch element, and an adjustable journal for one of the gear wheels to permit changeable gearing to vary the rate of change in the control circuit.

706,578. Marine Electric-light Fixture. George L. Martin, New York, N. Y. Application filed December 10, 1900.

The fixture combines with an outlet-box, a bracket secured thereto in a water-tight manner, the bracket consisting of a base, a contracted neck, and a head formed of one piece of metal, the head being provided with a socket adapted to receive a globe, a seat for a gasket beneath the globe and a seat for a lamp-socket.

706,581. Electric Switch. Frank A. Merrick, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 26, 1901.

The switch combines an inclosing casing having vent openings in one wall, a rotary drum of conducting material journaled in the casing and insulated from it, the drum having two sets of contacts, and a set of contact fingers for connection with each set of contacts, the fingers of each set being connected in multiple with each other, and those fingers of each set nearest the vent openings being set to retain their contact engagement longer than the other fingers of each set.

706,586. Automatic Electromechanical Semaphore Signal. John J. McGill, Chicago, Ill., assignor of two-thirds to Eugene W. Richey and Samuel A. Johnson, Chicago, Ill. Application filed August 19, 1901.

The mechanism combines a mechanically operated connection between the signal and railway track whereby the signal is released by the passing train, and mechanically moved to danger position, an electric switch-shifting magnet for controlling the electric circuits of the signal, a motor magnet for moving and setting the signal to safety position when the maguet is energized, a circuit closed by the passing train for energizing the switch-shifting magnet, and a circuit subsequently closed by the train for energizing the motor magnet.

706,591. System of Electric Distribution. Horace F. Parshall, London, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed December 7, 1899.

The system comprises a generator, a booster, and a motor driving the booster, the motor having a constant-field magnet, and an armature current fluctuating with the load on the system.

706,598. Rotary Transforming Apparatus. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 30, 1899.

A rotary transforming device employs a number of massed coils connected to alternating-current terminals, a commutator, and a number of distributed coils connected to the commutator.

706,599. Electric Cable. Tito Rosati, Florence, Italy. Application filed January 30, 1901.

The cable combines an inner cable composed of sections, hollow coupling sleeves connecting the ends of the sections and having an opening in them, tube sections encircling the cable sections having couplings connecting the adjoining ends thereof, the outer coupling sleeves having an opening aligning with the opening in the inner coupling sleeve and means for closing the opening.

706,602. Therapeutic Electrical Apparatus. Ira E. Shaffer, Mount Vernon, N. Y. Application filed November 27, 1901.

An apparatus for carrying a liquid charged with electricity to any part of the body being treated is described.

706,607. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 2, 1901.

The system combines reactances of opposite sign connected together, a consumption circuit, and an inductive connection between the consumption circuit and each of the reactances.

706,608. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 2, 1901. Renewed December 26, 1901.

The system combines constant-potential mains, reactances of opposite sign connected in series across the mains, a consumption circuit operatively connected across one of the reactances, and an additional reactance operatively connected in shunt to the mains.

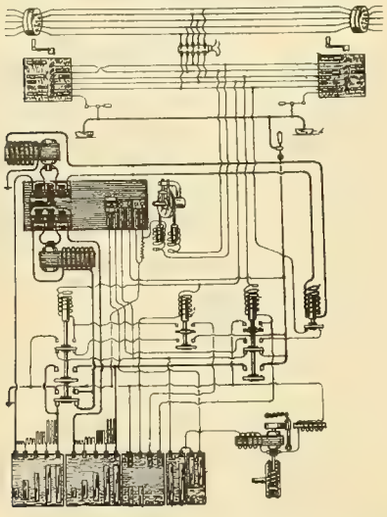
706,609. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to

the General Electric Company, Schenectady, N. Y. Application filed January 2, 1901.

The system employs a combination of supply mains, consumption circuits fed therefrom, and means for automatically maintaining a constant consumption of power in the circuits regardless of variation of the aggregate resistance of the circuits.

706,612. Electric Meter. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 18, 1900.

A retarding-magnet system, the magnetization of which gradually increases with the load to a certain point and thereafter remains substantially constant is used in the meter.



NO. 706,723.—ELECTRIC CONTROL SYSTEM.

706,631. Chemical Generator of Electricity. Edward L. Anderson, St. Louis, Mo., assignor to John A. Gilliam, trustee, St. Louis, Mo. Application filed September 30, 1901.

An aluminum electrode, a negative electrode, and an electrolyte in contact with both of the electrodes containing a suitable halogen salt and nitric acid are used in a liquid cell.

706,632. Armature Winding for Induction Motors. Albert H. Armstrong, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed November 3, 1897. Divided and this application filed January 17, 1901.

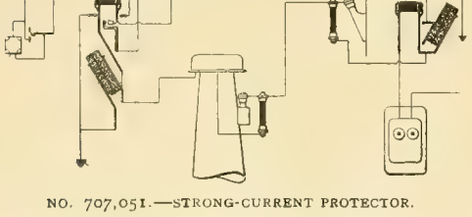
The winding comprises a number of parallel bars connected at their ends by flexible integral intermediate portions.

706,671. Electric Road-grading Machine. John W. Langfitt, Adel, Iowa. Application filed June 29, 1901.

A road-grading machine to be driven and operated by electricity is described.

706,699. Process of Treating Trolley Wires. Alfred Springer, Cincinnati, Ohio. Application filed February 7, 1902.

The method consists in treating the wire in situ at successive substantially adjacent points in its length by a total or partial interruption of the circuit at each of the points in succession.



NO. 707,051.—STRONG-CURRENT PROTECTOR.

706,723. Control of Dynamo-electric Machinery. Eugene R. Carichoff, East Orange, N. J., assignor to the Sprague Electric Company. Application filed January 18, 1901.

A system of control of electric motors combines a rheostatic switch, a pilot switch, a motor-grouping switch, means controlled by the rheostatic switch for operating the pilot switch, means controlled by the rheostatic switch and the pilot switch for operating the motor-grouping switch, and means controlled by the pilot switch for operating the rheostatic switch. (See cut.)

706,735. Wireless Telegraphy. Reginald A. Fessenden, Allegheny, Pa. Application filed December 15, 1899.

For this and 12 succeeding patents see page 120.

706,736. Apparatus for Wireless Telegraphy. Reginald A. Fessenden, Allegheny, Pa. Original application filed December 15, 1899. Divided and this application filed May 17, 1900. Renewed November 29, 1901.

706,737. Wireless Telegraph. Reginald A. Fessenden, Allegheny, Pa. Application filed May 29, 1901.

706,738. Wireless Telegraphy. Reginald A. Fessenden, Allegheny, Pa. Application filed May 29, 1901.

706,739. Conductor for Wireless Telegraphy. Reginald A. Fessenden, Allegheny, Pa. Application filed May 29, 1901.

706,740. Wireless Signaling. Reginald A. Fessenden, Manteo, N. C. Application filed September 28, 1901.

706,741. Apparatus for Wireless Telegraphy. Reginald A. Fessenden, Manteo, N. C. Application filed November 5, 1901.

706,742. Wireless Telegraphy. Reginald A. Fessenden, Manteo, N. C. Application filed June 6, 1902.

706,743. Wireless Signaling. Reginald A. Fessenden, Manteo, N. C. Application filed June 26 1902.

706,744. Current-actuated Wave-responsive Device. Reginald A. Fessenden, Manteo, N. C. Original application filed June 6, 1902. Divided and this application filed July 1, 1902.

706,745. Signaling by Electromagnetic Waves. Reginald A. Fessenden, Manteo, N. C. Application filed July 1, 1902.

706,746. Signaling by Electromagnetic Waves. Reginald A. Fessenden, Manteo, N. C. Application filed July 1, 1902.

706,747. Apparatus for Signaling by Electromagnetic Waves. Reginald A. Fessenden, Manteo, N. C. Original application filed September 28, 1901. Divided and this application filed July 22, 1902.

706,759. Electrical Switch or Cut-off. Patrick Kennedy, Brooklyn, N. Y. Application filed December 4, 1901.

The circuit-closing device has a sheet of metallic gauze over the face of one of its terminals.

706,798. Electric Testing Apparatus. Penrose E. Chapman, St. Louis, Mo. Application filed December 4, 1901.

An incandescent lamp, a circuit for operating the lamp, a transformer in the lamp circuit, and means of taking current from any desired portion of the transformer are in circuit with a test-coil.

706,817. Electric Clock. Harleigh Gillette, Highland Park, Ill. Application filed June 24, 1899.

An electromagnet operates part of the mechanism.

706,856. Shade-holder for Incandescent Electric Lamps. Richard W. Schmelz, Brooklyn, N. Y., assignor of one-half to William V. Geis, New York, N. Y. Application filed February 5, 1902.

The shade-holder is formed of spring-wire.

706,870. Hanger for Transformers or the Like. James J. Wood, Fort Wayne, Ind. Application filed November 29, 1901.

The hanger is built to be attached to a cross-arm and has means for connecting it to the casing of the transformer.

706,923. Lamp. Charles E. Gervais, New York, N. Y., assignor to the Gervais Manufacturing Company, New York, N. Y. Application filed April 17, 1902.

The oil lamp is automatically lighted and extinguished by electricity.

706,924. Lamp. Charles E. Gervais, New York, N. Y., assignor to the Gervais Manufacturing Company, New York, N. Y. Application filed April 17, 1902.

An oil lamp in combination with a battery receptacle holding a battery for lighting the lamp is described.

706,927. Electrical Floor Key. Ernest C. Goodrich, Houghton, Mich., assignor to himself and Nicholas Britz, Houghton, Mich. Application filed April 21, 1902.

An electrical floor key, comprises a bottom plate provided with binding-posts insulated from each other, a top-plate provided with binding posts insulated from each other, a central link in electrical contact with the top binding posts and engaging the top plate, and snap-head contacts for temporarily connecting the binding-posts in the top plate with the binding-posts in the bottom plate.

706,974. Conduit for Electric Wires. Robert W. Lyle, Perth Amboy, N. J. Application filed April 10, 1902.

The conduit has a relatively short external groove in its side wall at an end of the section, one end of the groove being closed and the other end opening into the end of the section, and the side walls of the groove being undercut.

706,982. Galvanometer. Charles L. R. E. Menges, The Hague, Netherlands. Application filed December 23, 1897.

The galvanometer employs a magnet, a movable electrically acting device situated in the magnetic flux produced by the magnet, means for measuring the magnetic flux, and means for varying the magnetic flux and adjusting it to the required magnitude as indicated by the measuring means.

707,007. Multiple Telegraphy. Michael I. Pupin, New York, N. Y. Application filed February 23, 1894.

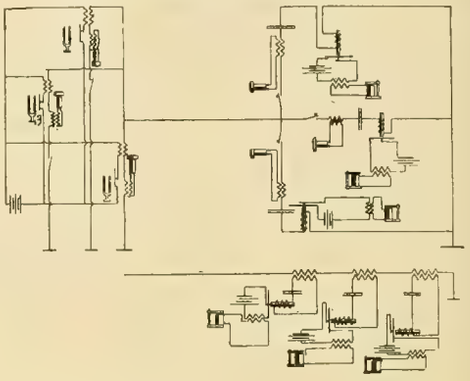
The inventor claims a method of distributing electrical energy which consists in throwing upon a common conductor a number of alternate currents of different frequencies and distributing the several energies of these currents each selectively to a separate electrical device. (See cut.)

707,008. Multiple Telegraphy. Michael I. Pupin, Yonkers, N. Y. Application filed December 29, 1897.

The system employs a set of electrical conductors consisting of selective parts connected to each other, each part containing a condenser and a self-induction coil, whereby it can be made resonant to an electromotive force of predetermined periodicity by properly proportioning its electro-magnetic constants, and means for impressing upon the system electromotive forces of different predetermined periodicities.

707,049. Terminal Box for Protected Electrical Circuits. Frank B. Cook, Chicago, Ill. Original application filed July 29, 1896. Divided and this application filed May 21, 1902.

A cable terminal and protector comprises a suitable box, a number of thermal protectors arranged at each side of the box, a pair of metal strips whereby the thermal protectors are each operative to establish connection to the ground, carbon lightning arresters arranged in conjunction with the thermal protectors, and binding posts arranged inside of the box and extending through its walls, the outer ends of the binding posts being connected with the thermal protectors and lightning arresters.



NO. 707,007.—MULTIPLE TELEGRAPH SYSTEM.

707,050. Electrical Protector Set. Frank B. Cook, Chicago, Ill. Original application filed July 29, 1896. Divided and this application filed May 21, 1902.

A self-contained protecting device for complete metallic circuits, comprises a base composed of insulation, a post rising from the base, a dome-shaped glass cover clamped upon the base by a nut screwed upon the post, and a number of protecting devices mounted upon the base and partially supported by the post.

707,051. System of Strong-current Protection. Frank B. Cook, Chicago, Ill. Original application filed July 29, 1896. Divided and this application filed May 21, 1902.

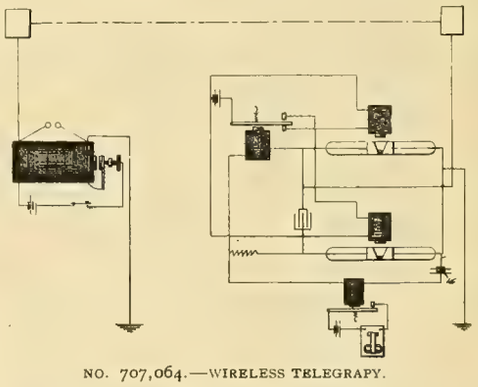
A system of protection for electrical circuits combines a line wire, a fuse hung on the wire, a pair of posts, a cylindric heat-coil removably mounted upon the posts, means for connecting the fuse, heat-coil and posts in series between the line wire and the instruments to be protected, an earth branch and carbon lightning arrester connected at a point between the fuse and the heat-coil, and a grounded conductor connected with the lightning arrester. (See cut.)

707,052. Regulation of Electric-lighting Systems. John L. Creveling, New York, N. Y. Application filed July 17, 1901.

A system of electrical distribution combines a generator, a mechanical governor, a regulator therefor, and electric means for compensating for the lag of the governor.

707,056. Automatic Selective System. Cornelius D. Ehret, Philadelphia, Pa., assignor to the American Wireless Telephone and Telegraph Company and the Consolidated Wireless Telegraph and Telephone Company. Application filed January 10, 1902.

See page 123.



NO. 707,064.—WIRELESS TELEGRAPY.

707,064. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Gustave P. Gehring, Philadelphia, Pa. Application filed June 1, 1901.

The inventor describes the system as employing a transmitting and a receiving apparatus, the receiving apparatus consisting of a series of coherers in the same main circuit and in parallel, and a decohering device for each coherer, the decohering devices being dependent upon the action of the coherers, one being operated when the coherers conduct and the other when one of the coherers has been decohered. (See cut.)

REISSUE.

12,019. Electrochemical Generator. Harry S. Amwake, Camden, N. J., assignor to Charles H. Graham and George D. Bouton, Philadelphia, Pa. Application filed July 16, 1902. Original No. 702,760, dated June 17, 1902.

The apparatus consists of a single-fluid cell, provided with a positive electrode and a negative fixed electrode, an electrolyte, and a current-conducting baffle-partition in the electrolyte, between the electrodes and normally insulated from them.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, AUGUST 30, 1902. No. 9

Electrical Equipment of Chicago Railroad Clearing Yards.

The amount of through freight that is handled daily by the steam-railroad lines entering Chicago reaches very large proportions. At present this freight is interchanged through the agency of belt lines and by switching directly between the roads. The large number of switch movements necessary, the increasing value of the real estate occupied as terminal yards, and other increasing factors of expense, such as the extension of track elevation, are features that suggested and finally resulted in the construction of an elaborate system of tracks where this work might be greatly simplified and expedited. This system of tracks was constructed by the Chicago Union Transfer Railway Company and forms a clearing yard in which miscellaneous freight may be received, classified and then distributed to the different roads for shipment.

The yards are located southwest of Chicago, just outside the city limits, and occupy a level tract 13,000 feet long and about 670 feet wide. The general plan of the tracks is indicated in the map (Fig. 3), shown on the next page. Each set of tracks is represented by a single line. The tracks extend in an east and west direction, and connection is made with the Chicago and Western Indiana railroad on the east and with the Chicago Terminal Transfer railroad and the Chicago Junction railway on the west, these roads being belt and switching lines.

The general features of the clearing yards consist of two sets of classification tracks, (B) and (B'), each 2,400 feet long, receiving tracks, (C) and (C'), 1,600 to 3,200 feet long, and overflow tracks, (D) and (D'). The total number of parallel tracks in a north and south direction at (B) or (B') is 49. To aid in the distribution of the cars into the classification tracks (B) and (B') and reduce switching expense to a minimum these tracks are built upon the sides of an artificial gravity mound, which has its highest point 22 feet above the level tracks, at the center of the yards. The grades on this mound vary from 1½ per cent. to one-half per cent. A general view of the east classification tracks, showing also the receiving tracks at each side, is given in Fig. 4. The view was taken from the signal and switch tower which spans the five tracks at the summit of the mound and from which the switches are operated. At the extreme left of the illustration is shown a portion of the stack and the power house which supplies the necessary power and light for the operation of this extensive system of tracks. Seventy-five-pound rails are used for the tracks, and there is a total of 105 miles of track now laid. It is estimated that between 5,000 and 8,000 cars can readily be switched and handled through this yard daily.

Fig. 1. Power House, Water Tank and Office Building.

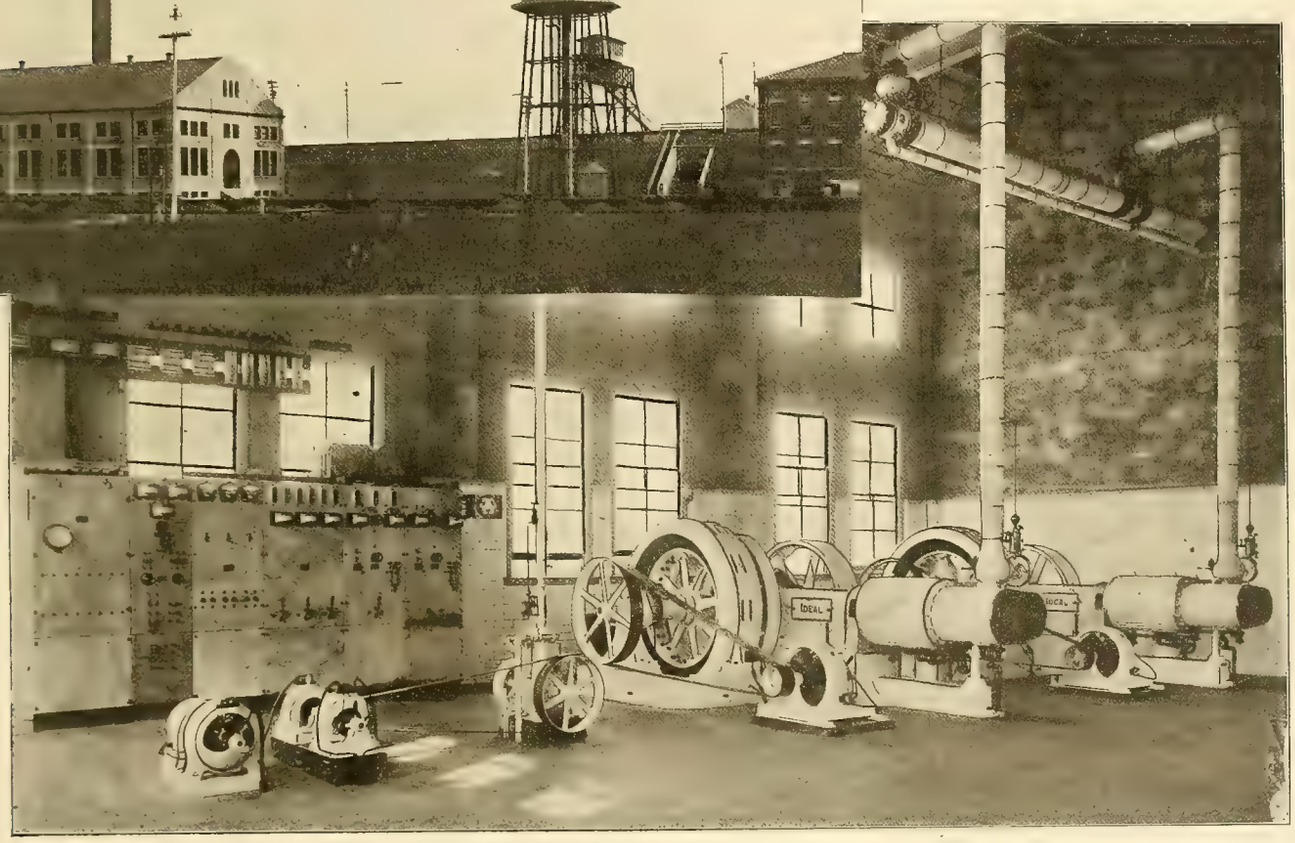


Fig. 2. Engines, Generators and Switchboard in Power House.

ELECTRICAL EQUIPMENT OF CHICAGO RAILROAD CLEARING YARDS.

Power House.

A general view of the power house, high water tank and office building, located north of the summit of the mound, as indicated in Fig. 3, is shown in Fig. 1. The picture also shows the signal tower and the subway under the mound, by means of which the south tracks are easily reached. The power house is a substantial, fireproof brick structure of pleasing construction, with concrete foundation. It is divided by a north and south wall into an engine room and boiler room, each 67 by 74 feet in size. The building has a steel truss roof and the walls have a high wainscoting of white-enamel brick, the walls above being plastered with cement. The basement under the engine room contains toilet rooms, shower baths, etc., for the employes. The engine room, besides being roomy, with high roof and well lighted, is very striking in appearance, as practically all the metal parts of all the machinery are painted with white enamel, the ends of cylinders and other portions that bear the direct heat of the steam being painted with aluminum bronze. The effect of this pure-white machinery, added to the white-enamel wainscoting, gives a most pleasing impression and one seldom experienced upon visiting an engine room. A fair idea of the engine room may be obtained from the views of the north and south sides of the room, shown respectively in Figs. 2 and 5.

The electrical generating equipment of the station, shown in Fig. 2, comprises two 150-kilowatt, three-phase, General Electric, alternating-current generators, direct-connected to 250-horsepower, tandem-compound, high-speed Ideal engines. The generators are of the rotating-field, 60-cycle type, and deliver a 2,300-volt current, the output per phase being 38 amperes. They are driven at 225 revolutions a minute by the engines, which run non-condensing and have cylinders 15 and 22 inches in diameter, with a 16-inch stroke. Belted to each generator is a nine-kilowatt exciter, delivering a 125-volt current at 900 revolutions a minute, the exciting current amounting to 72 amperes.

Electro-pneumatic Switch Operation.

Electricity is put to a variety of uses at the yards, including interior lighting, outdoor arc lighting, switch lighting, power purposes, and the operation of the switches. Probably the most interesting of these systems is the apparatus installed for operating the switches. In the entire yard there are 450 switches, and of these the 120 switches along the ladders of the classification tracks are operated by pneumatic cylinders, which are controlled electrically from the switch tower. The system was installed by the Union Switch and Signal Company and is similar in design to that of the standard machines of that type for interlocking work, except that the central or lock electromagnet is omitted. The cylinders work under 60 pounds air pressure. The controlling apparatus in the tower comprises a set of 10 push-button machines, each machine controlling the movements of 12 switches. These ma-

chines are set up in two banks of five each, the banks being arranged back to back and each bank controlling the 60 switches on one side of the mound. The five machines governing the east-track switches are shown in Fig. 6. Each machine is rectangular in shape and comprises two rows of push-buttons, called "normal" and "reversed," corresponding to the two positions of the levers of an interlocking machine. Each of the buttons is electrically connected with one of the two valve magnets of the switch cylinder.

Upon pushing a button in the upper or "normal" row the switch is made to assume its normal position, and, vice versa, pushing in the lower button opens the switch. Pressing in a "normal" button forces out the corresponding "reverse" button, and vice versa, the two buttons relating to each switch being joined at the back of the front board of the machine by a balance lever. The switch movement is of the direct-acting type, the switch points being connected direct to the piston rod of the air cylinder without the intervention of a lock movement, crank or other device. Fig. 7 shows one of the switch boxes in the foreground, a part of the mechanism being visible.

Above the push-buttons there is a row of indicators in electrical connection with the switches, and by means of insulated joints the track is divided into blocks embracing each turnout. One of the switch points in each set is also insulated from the main lead or ladder. Normally, or when the main lead is clear, the indicator shows white, but if the track in the vicinity of the switch or within fouling distance of the frog is occupied by a car the current is short-circuited, and a red target is moved across the aperture of the indicator. Thus, in operation, the appearance of the indicator informs the operator whether the switch has completed its throw or whether the neighboring track is occupied by a car. In switching cars the operator is provided with a schedule of the movements required to distribute the train, and in this way he is able to follow the course of the different cars, or "cuts," as they are called, by the successive appearance and disappearance of the indicator targets. These indicators are a prominent feature of the machine, since by their use rapidity of movement can be effected with certainty as to the positions of the cars.

Switch Lighting.

Of the 450 switches in the yard, 400 are lighted by electricity, this number including the switches which are electro-pneumatically controlled. The electric switch stands are placed adjacent to the hand-throw or interlocking gear controlling the track switches, as shown in Fig. 7. Each switch stand consists of a concrete foundation, extending into the ground to a depth of about three feet, resting upon which is a cast-iron terminal box that supports the switch stand, lens and electric lamp. The electric conductors are brought into these terminal boxes through iron conduit underneath the track.

A system of rubber-covered lead-encased cables connects the switch boxes situated at various points along the track and receives its current from a primary 2,300-volt alternating circuit which is placed on poles in the ordinary manner. Transformers (28 in number) are placed on the poles at various points, and the secondary wires, carrying 110 volts, are brought down through service boxes containing knife switches, each of which controls about 15 switch lights. The switch lamps are of eight candlepower each.

The entire system is operated from a switchboard in the power house, and is divided into four circuits of approximately 100 lights per circuit. Each circuit is furnished with a lamp indicator, or instrument, showing the number of lights burning at one time on each circuit. The entire installation is complete and in satisfactory operation. The cost of operation of the switch lights is said to be very slight, each lamp taking, approximately, 40 watts, while the total number of watts consumed per night does not exceed 160,000 watts.

The switch stand is made to meet the peculiar demands and the rough usage to which it is subjected for railway purposes. The concrete foundation prevents any vibration, and makes a permanent and substantial base upon which to set the stand. The stand is adaptable for any design of switch, either interlocking, single or double-throw, and can be operated by any movement of the rails, however slight. The electric lamp is supported by a tube attached to the terminal box, which is securely bolted to the foundation, thereby preventing vibration of any character, and prolonging the life of the lamp to its fullest time. The lantern containing the signal lenses is supported upon a tubular post, surrounding the electric conduit, and receives its motion from a lever at its base, securely slotted and keyed. This lever in turn is securely bolted to a tie rod of the switch, and is thus operated by the movement of the points. The switch stands and their equipment comprise a patented system, developed by the Arthur Frantzen Company, which made the installation.

The illustration (Fig. 7) shows one of the ladders on the east classification tracks, with a switch stand in the foreground, and the line of stands stretching off in the distance. When the photograph was taken the switch controlling the track that holds the locomotive shown at the right was closed, and consequently the red side of the lantern is turned toward the signal tower.

Power-house Switchboard.

The remainder of the electrical equipment of the yards may well be treated by returning to the power house and taking up a description of the switchboard. This board, which is shown in Fig. 2, is built of two-inch blue Vermont marble on an angle-iron frame. The four panels at the right are General Electric panels and are each 90 inches high and 30 inches wide. The equipment of each of the two generator panels comprises three fuse blocks, two pilot lamps, a voltmeter, a potential transformer, an ammeter, a synchronizing device, a three-phase ground detector, generator and exciter rheostats, a three-pole, single-throw generator switch and a double-pole, double-throw exciter switch.

An arc-lamp panel contains three ammeters, three short-circuiting switches and six tubular expulsion primary switches; also six tubular expulsion fuse blocks and three grounded arc arresters on the back of the panel. This panel controls three arc-lamp circuits through as many 35-lamp regulators located in the basement. The lamps are of the 2,000-candlepower series alternating-current type, with outer and inner globes. At present there are but 45 lamps installed and they are used mainly for lighting the gravity tracks, so that the work may be carried on at night. The lamps are arranged on alternate poles at intervals of 300 feet at the sides of the classification ladders, as shown (very faintly) in Fig. 7. The view given in Fig. 4 was taken before the lamps were placed, but shows the poles. These poles also carry the wiring for the incandescent-lamp switch stand. Shields are to be placed on the arc lamps, so that the rays will be thrown ahead on the classification tracks, but will be shaded from the tower men and brakemen riding cuts of cars. Some arc lamps are also placed about the grounds and near a hotel and group of houses, located a half mile north of the power house, and used by the employes.

The fourth panel is used as a feeder panel for incandescent lights and is provided with six fuse blocks, three ammeters and three double-pole, single-throw feeder switches. At present there are two circuits in use. Two lightning arresters are installed for each circuit on the back of the board.

The panel on the extreme left controls the electric switch-lamp stands and has already been mentioned.

Motor-generator Equipment.

The panel to the right of it is known as a motor-generator panel and controls two motor-generator outfits that are used to charge a small storage battery for the operation of the switch-control system. The motor-generators are in front of the switchboard, as shown in Fig. 2. One of the machines is of the General Electric make and consists of a two-kilowatt, 20-volt, direct-current generator, direct-connected to a four-pole, three-horsepower, 110-volt induction motor, the set having a speed of 1,800 revolutions a minute. The other set is a Wagner Electric Manufacturing Company's outfit, and consists of a four-horsepower, single-phase, alternating-current, 110-volt motor, directly driving a two-kilowatt,

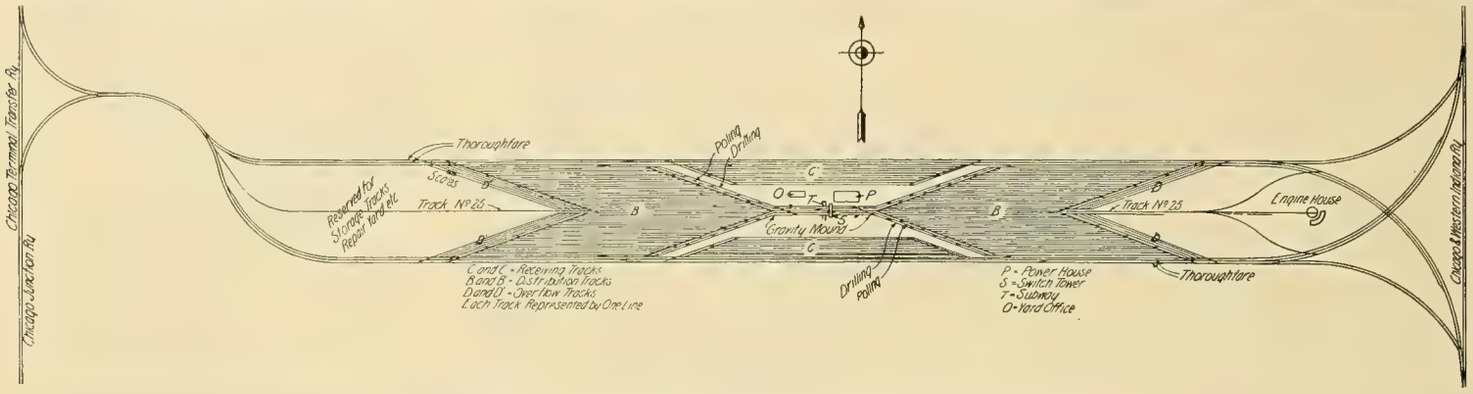


FIG. 3. CHICAGO RAILROAD CLEARING YARDS OF UNION TRANSFER RAILWAY COMPANY.

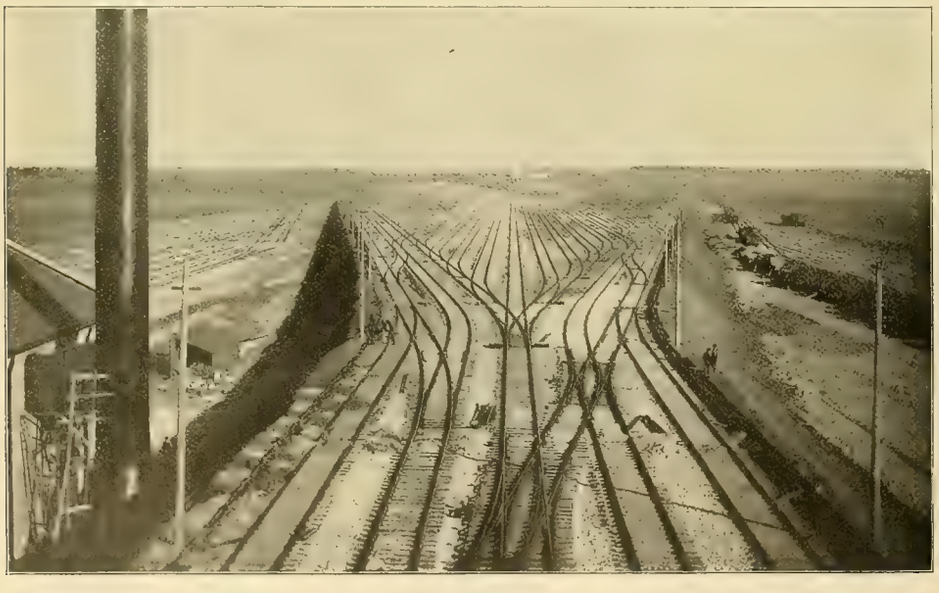


FIG. 4. CHICAGO RAILROAD CLEARING YARDS.—VIEW FROM SWITCH TOWER EASTWARD.

20-volt, direct current generator at 1,800 revolutions. A five by four-inch Junior Westinghouse engine is installed near the motor-generator for use as an auxiliary driving means, in case the large generators are not running.

The battery used for operating the switching system is installed in the basement in duplicate. It consists of 14 cells of Chloride accumulators, seven cells in each set. About 12 volts is usually required to operate the system. The panel controlling the motor-generators and batteries is so arranged that either motor-generator may be so connected as to charge either battery, or, if required, the machines may be connected so as to feed through the batteries directly on to the system. The equipment of the panel comprises two 75-ampere ammeters, one 50 and one 30-volt voltmeter, a circuit-breaker and the necessary rheostats and switches.

Fig 5. View in Engine Room, Power House.

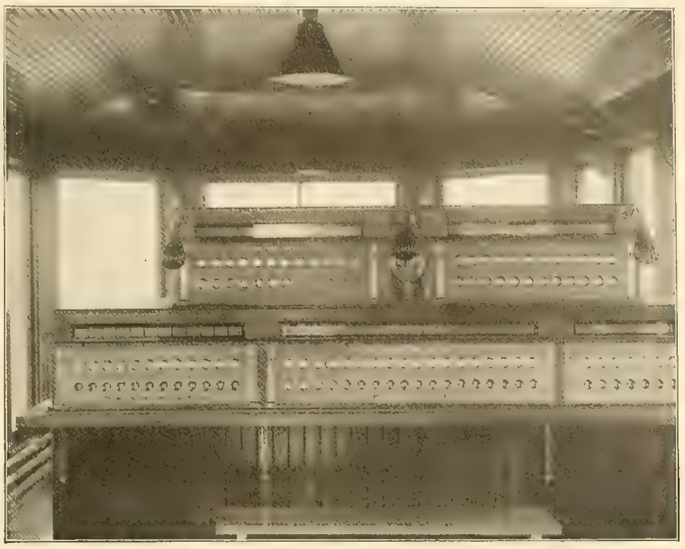


Fig 6. Push-button Machine in Switch Tower.

ELECTRICAL EQUIPMENT OF CHICAGO RAILROAD CLEARING YARDS.

Miscellaneous Machinery.

The machinery on the south side of the engine room, shown in Fig. 5, comprises two 1,000,000-gallon Knowlton steam pumps and three Rand-Corliss air compressors. The latter consist of two cross-compound machines of the respective capacities, in free air, of 800 and 1,196 cubic feet per minute, and a straight-line compressor, with a capacity of 950 cubic feet per minute. The compressed air is used for lifting water from the artesian wells, working the electro-pneumatic switch machines and for general purposes.

The boiler equipment comprises three 300-horsepower Babcock & Wilcox water-tube boilers. A pressure of 150 pounds is generally carried. Extra space is provided for future boilers. The auxiliaries include two boiler-feed pumps and a Baragwanath open feed-water heater. A glimpse of the boiler fronts is obtained through the engine-room door at the extreme left of Fig. 5.

Water is obtained from three 1,600-foot artesian wells. It is forced to the surface by compressed air and stored in a large reservoir, from which it is pumped to the large 100,000-gallon tank shown in Fig. 1. Water mains and hydrants are provided throughout the entire yards.

At the east end of the yards are located a nine-stall engine house and turntable and a coaling station, consisting of two 40-ton pockets. In the round-house are installed two engine lathes, a drill press, bolt cutter, shaper and milling machine, driven by a five-horsepower motor, and a planer directly geared to another five-horsepower motor. The coal-elevating machinery at the coaling station has a capacity of about 50 tons of coal an hour and is driven by a 10-horsepower electric motor.

A private telephone exchange is installed on the grounds with 10 telephones, located at various parts of the yards and buildings. The General Electric Company furnished the generators and electrical equipment, except as otherwise mentioned.

Western Union Telegraph Stock.

A sharp rise in the market price of Western Union stock has attracted attention. On July 29th the shares sold at 85, while on August 25th the closing price was 96¾, thus showing a gain of 11¾ points in less than a month. This increase is attributed by some to greater confidence in the earning capacity of the company under the energetic management of Colonel Clowry. Others see in it an indication of a possible consolidation with the Postal company. The old report of a possible combination with the American Telephone and Telegraph Company is also revived.

The Choctaw Construction Company of Lehigh, I. T., has been organized to build an electric power house for the Lehigh Traction Company.

Gas and Electric Lamp Renewals Compared.

The complete discussion on free lamp renewals at the last convention of the National Electric Light Association contained a paper by Francis W. Willcox of Harrison, N. J., which did not appear at the time as a part of the discussion. This paper calls attention to the growing practice of gas companies in taking up the supply and maintenance of Welsbach mantles in lighting service. This subject has an important bearing on the question of incandescent-lamp renewal and method of supply by electric-lighting stations, and on that account the following abstract of Mr. Willcox's remarks will be of interest:

Electric lighting has been largely built up on gas practice, and the custom of making the consumer supply his own lamps, where it exists to-day, is a direct inheritance from the practice followed in gas lighting of having the burners supplied by the consumer.

With the old simple tip burner, it made little difference in gas lighting, since the burner was a simple mechanical device, which, if kept clean, would not deteriorate, and could, therefore, be used indefinitely. It made no practical difference, therefore, whether the consumer supplied them or not. The quality of the gas and not the burner determined the character of lighting service.

With incandescent lamps, the case is quite different, the lamp being a complicated device in its operative results, requiring technical knowledge to select the best type and proper efficiency. It also steadily deteriorates in service, requiring replacement at fixed periods to maintain lighting results. In other words, we have here a case in which the burner (i. e., the lamp) is a feature having a large influence on results.

With the introduction of Welsbach lamps in gas lighting, we have a burner quite similar in character and in results to the incandescent lamp. It would be natural to expect, therefore, that the same necessities that have caused so many electric-lighting companies to provide for the supply of the lamps to their consumers, would cause gas companies to take up the supply and maintenance of Welsbach mantles.

In point of fact, we find this very practice becoming adopted by gas companies. The arguments and reasons given for the step are exactly similar to those found and advanced for free electric-lamp renewals, proven and established by practical experience with the Welsbach lamp in service. This result is, I think, quite positive and conclusive testimony in favor of free lamp renewals for electric-lighting companies.

There is this difference to be noted between Welsbach mantles and incandescent lamps: The Welsbach mantel is a delicate device and may be readily broken, with no evidence to show whether it failed of its own accord or was deliberately broken. It would, therefore, seem necessary to make some nominal charge for renewals to prevent fraud on the part of the consumer. This necessity does not exist with incandescent lamps, which can be readily broken only by destruction of bulb, thus giving evidence of forcible or deliberate breakage. Free electric-lamp renewals are, therefore, wholly practical as not liable to cause any loss from fraud.

FIG. 7. ELECTRICAL EQUIPMENT OF CHICAGO RAILROAD CLEARING YARDS.—MECHANISM FOR ELECTRO-PNEUMATIC SWITCH CONTROL.

It is rumored that the Canadian Pacific Railroad Company intends to establish electric car lines between the mountain resorts along its route through the Rockies. The third-rail system is to be used. The idea is to further the opportunities for traveling parties to see the Rocky Mountain country.

Seattle-Tacoma Interurban Electric Railway.

In a very short time electric cars will be in operation over what experts claim will be one of the most interesting high-speed electric railroads in this country—that of the Seattle-Tacoma Interurban Electric Railway Company's line between Seattle and Tacoma. This line is being built between the two named cities, largely over private right-of-ways, by Boston capital, and when completed will be one of the finest equipped lines in the country.

Starting in the heart of Seattle, the line runs

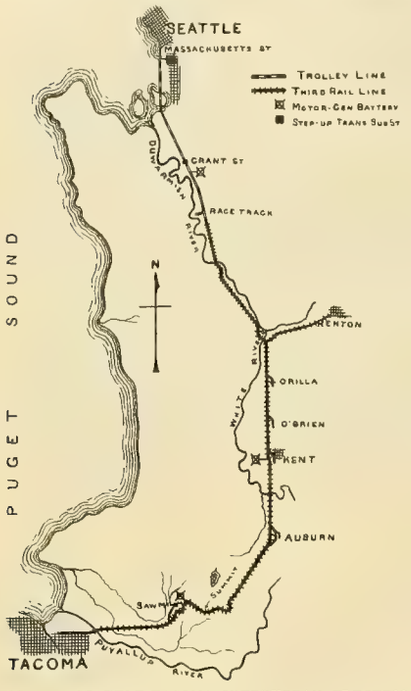


FIG. 1. SEATTLE-TACOMA INTERURBAN ELECTRIC RAILWAY.

through Georgetown, following the Duwarmish River to Renton through Orillia, O'Brien, Kent, Auburn, through the valley of the Stuck River, thence east across the Puyallup Indian Reservation to the heart of Tacoma. The route, with location of sub-stations, is indicated in the map, Fig. 1.

Very little hard work on the grade has been encountered, as a greater portion of the line is on water grade. The most difficult work was met at what is known as Hill section, from Auburn to Tacoma. Here a number of very heavy rock cuts

FIG. 2. SEATTLE-TACOMA INTERURBAN ELECTRIC RAILWAY.—ROCK TUNNEL NEAR TACOMA.

and fills were necessary, as was also a rock tunnel, which pierces the ridge at that point. A view of this tunnel, which is 12 miles from Tacoma, is shown in Fig. 2. The track shown is, of course, only temporary. A grade cut between Sawmill and Summit is shown in Fig. 3.

The third-rail transmission system will be used, except within the city limits of Seattle and Tacoma, where, for greater safety, the overhead system will be adopted. The rolling stock will comprise heavy combination smoking and baggage cars, 32 feet six inches in length, and 41 feet six inches over all. Each car will be equipped with automatic couplers, sand boxes and walk-over seats, and will be mounted on Brill trucks. There will also be similar cars without baggage or smoking compartments, to be operated as motor and trail cars. All cars will be controlled by the multiple-unit system, each motor car having four General Electric No. 66 motors mounted on its trucks, giving a rated capacity per car of 500 horsepower. This equipment is guaranteed to give a maximum speed of 60 miles per hour, with a 30-ton motor car hauling a 20-ton trailer. The company will also have in operation four-motor General Electric freight equipment cars, capable of handling a trailing load of 275 tons behind a 35-ton locomotive at about 12 miles per hour. The passenger gear ratio is 1.55 and that of the freight 3.95. Two of the motors of each freight equipment are connected permanently in series.

Power will be furnished the new road from the new Post Street power station of the Seattle Electric Company in Seattle. Power will be transmitted over a No. 0000 B. & S. two-phase circuit at 2,200 volts for one mile to the step-up transformer station, which will contain four 500-kilowatt water-cooled transformers. These will raise the potential to about 27,500 volts, which will feed the high-tension line with 60-cycle, three-phase current over three No. 1 B. & S. copper wire as far as Race Track. At this point the line will be changed to three No. 4 B. & S. copper wires which will continue to the sub-station at Sawmill. Transformers at the first

FIG. 3. SEATTLE-TACOMA INTERURBAN ELECTRIC RAILWAY.—GRADE CUT NEAR SUMMIT.

sub-station out of Seattle will be equipped with regulating dials, giving various secondary voltages with variations in the primary between 2,000 and 2,200. Each transformer is guaranteed to regulate within one per cent. at a power factor of 100 per cent., and within three per cent. at an 80 per cent. power factor.

The sub-stations are to be situated at Grant Street, Kent and Sawmill, about 3.5, 16.9 and 29.4 miles, respectively, from Seattle, and will serve as distributing points. At each of the stations there will be one complete 300-kilowatt motor-generator set, which will be fed by two 180-kilowatt, oil-cooled, step-down, three-phase, two-phase transformers. The machines consist of one eight-pole, 300-kilowatt, 450-revolution, 600-volt flat-characteristic direct-current railway generator, which will be direct-connected to a 16-pole, 450-horsepower, 2,200-volt, two-phase, induction motor. All of these machines have an overload capacity of 50 per cent. for two hours.

To supplement the motor-generators and to take up the fluctuation which the transformers will superimpose upon each sub-station, there will be three storage batteries, these being manufactured by the Electric Storage Battery Company of Philadelphia. At the Kent and Grant Street sub-stations there will be placed 288 of these cells, each battery having a capacity of 640 amperes discharge. At the Sawmill station there will also be 288 cells, but of type-G15, those at the Grant and Kent station being type-G17. The batteries will all be in type-G23 tanks, to allow for future growth. These batteries will be charged and discharged through differential boosters, each machine consisting of a six-pole, 35-kilowatt, 600-revolution, 50 to 110-volt generator direct-connected to a four-pole, 53-horsepower, 600-volt motor. The electrical machinery for the sub-stations will be furnished by the General Electric Company.

At the Seattle power station current will be furnished by two 1,600-kilowatt, Westinghouse 2,200-volt, 60-cycle alternators. This station, operated by the Seattle Electric Company, has a connection with the lines of the Snoqualmie Falls Power Company, which delivers the company power from the falls, 31 miles away, over a 30,000-volt, three-phase transmission line of aluminum wire.

The interurban transmission lines will be strung on red-cedar poles 40 to 45 feet long, placed from 110 to 120 feet apart. The feeders will be run on standard four-pin arms. All pins will be of eucalyptus. Insulators of the Locke type will be used, with porcelain petticoats and glass supports. All insulators are guaranteed to carry a working pressure of 60,000 volts.

As stated, the third-rail system will be used except within the city limits of both Seattle and Tacoma. The third rail will weigh 100 pounds to the yard. This will be supplemented by a 350,000-circular-mil cable within the cities' limits. The track will be laid with 70-pound steel rails, using Chase-Shawmut bonds. Stations will be maintained at every town now on the line of the road, and others will be established as the growth of traffic warrants. Although this point has not been definitely determined upon, it is probable that an hourly service will be given from seven o'clock until midnight. The speed capabilities of the equipment and the favorable right-of-way, as regards alignment and grade, will allow the above service.

It is understood that a rate of 60 cents each way, or $1 for the round trip, will be made, with corresponding rates to intermediate points. The Northern Pacific Railroad Company now charges $1 each way. The rates may be much lower, since the new road parallels the Northern Pacific almost the entire distance and will probably meet any cut made.

Street Illumination in San Francisco.

The Knights of Pythias convention which was held at San Francisco during the week ended August 16th was the occasion of an elaborate electrical illumination and display throughout the streets of the city. The accompanying illustration shows the fine night spectacle made by the Court of Honor on Market Street. Suspended in mid-air, some 150 feet from the street level, was a circular device in colored lamps, representing the head and shoulders of a knight in armor, and measuring 90 feet in circumference. Depending from all sides of the circle were white and colored lamps in festoons reaching to ornamental columns at the junction of Kearney, Sutter and Third Streets on Market Street.

From the Ferry and Depot Building, which was covered with electric lights, and for 2½ miles out

STREET ILLUMINATION IN SAN FRANCISCO.

on Market Street, were strings of colored lights and devices suspended from centers every 50 yards.

The City Hall, off Market Street, stood out boldly, and was one mass of electric lights, while very many of the principal buildings and places of business were beautifully illuminated and hung with flags of all nations. The vista, looking in either direction, was very fine. Market Street from the wharf runs up hill and affords an opportunity of street illumination possibilities seldom met with elsewhere.

From the picture a complete idea cannot be formed of the elaborateness of the illumination, on account of the loss of colored lights, which do not show in a photograph. It took some 50 men two weeks to

string the ropes of lights and devices. The Joshua Hendy Machine Company contracted to carry out the work, and it completed the construction in a very creditable manner.

The "Electric Cottage"—A Plan to Increase Central-station Business.

Many residents of the outlying districts of Chicago have been interested within the last few months by the appearance in their neighborhoods of the "Electric Cottage"—a tastefully designed little building, conspicuous at night by the light of electric lamps, which, upon inquiry, they found intended to call to their attention the multiform possibilities and advantages of the electric current offered for sale by the Commonwealth Electric Company. This clever idea in central-station advertising originated with John F. Gilchrist, contract agent for the Chicago Edison and Commonwealth Electric Companies; and its value has been amply demonstrated.

The "Electric Cottage," illustrated by the accompanying exterior and interior views, is a portable, rectangular, one-room affair, and has interior dimensions of 12 by 18 feet. The side walls are 12 feet high, and the roof is of the gable type. There are two windows on each of the longer sides and

THE ELECTRIC COTTAGE.

a bay window and door in front. The little building is strongly put together, though built in sections, which are held firmly in place by bolts. The sectional construction was adopted to facilitate the moving of the cottage from one place to another. The idea is to remain in one neighborhood just long enough to acquaint that particular section with the advantages to be gained by the use of electric light and power and to take any orders for the furnishing of current that may be secured. The cottage is then moved to a different locality and the operation repeated.

When the small edifice has been placed in a given locality, invitations are circulated to the people of the section to inspect it. One of these neatly engraved invitations reads as follows: "The Commonwealth Electric Company cordially invites yourself and friends to visit the Electric Cottage, which will be located, on and after August 16th, 1902, for a short period, at 6201 Kimbark Avenue, where it will be open from nine o'clock morning, until 10 o'clock evening." The cottage will remain in its present locality (Kimbark Avenue and Sixty-second Street) for a week or so yet.

Visitors are allowed to inspect and handle anything in the cottage, and are entertained to the best ability of the employes. The inside is fitted up

A PLEASANT CORNER IN THE ELECTRIC COTTAGE.

so as to be comfortable and inviting. Chairs and a settee are provided and the floor is covered with a fine rug. A roll-top desk is also installed, at which contracts for light can be signed, the cottage being used for business as well as advertisement.

The walls are covered with all kinds of electrical apparatus, which are operated for the benefit of any visitor. Different styles of lamps and lamp brackets, fans, cooking utensils, toilet articles, pendant switches and an electrically driven sewing machine are shown. Some 75 different electrical contrivances are to be seen. All of them can be operated on any ordinary light circuit.

Three-phase alternating current on a three-wire circuit is used. A box-like switchboard is built in one corner of the room, the switches all being covered by a door. The interior of the walls of the cottage is one network of wires, running to the different brackets and plugs. An electric chandelier is suspended from the middle of the room. It was built expressly for the cottage, as were also many other of the brackets and fixtures that are used.

Signs which hang on the walls are set in frames in which are embedded ground-glass incandescent lamps. One of the most conspicuous of these signs is as follows: "This cottage is intended to show some of the conveniences and labor-saving devices available where electric light is used. If you are not using electric light we shall be pleased to receive your application now." Another reads: "Do you read in bed?" This is attached to a new style of movable lamp bracket which can be hung on any convenient rod hook, or even the back of a chair. Still another bears this legend above the desk: "Applications for electric light received here." Others are:

"Are you using electric light in your home? A month's trial will convince you that it is superior to all other illuminants."

"Let us send you an electric fan complete ready to attach to any lamp socket."

"Are you using electric light? If not, let us 'enlighten' you on the subject."

These signs are arranged artistically on the four walls, and in their illuminated frames stand out clear and conspicuous.

Many other interesting features are seen in and around the cottage, which at night is an unusual and brilliant spectacle. The eaves are studded with 16-candlepower incandescent lamps and an arc lamp is suspended over the door. A double electric sign ("Electric Light") 18 feet in length, containing 92 four-candlepower lamps on a side, surmounts the ridge-pole of the roof.

On an average, 125 people visit the cottage a day, and the new business of the Commonwealth company since April, when the cottage was started out,

ELECTRIC COOKING OUTFIT IN ELECTRIC COTTAGE.

has exceeded expectations, although, of course, it is difficult to say just exactly what business belongs to the cottage and what does not.

A complete canvass will be made of the outlying districts of Chicago, and the cottage will be maintained so long as satisfactory results are obtained from it. The scheme belongs to the contracting department, and all solicitors use the cottage as a reporting office while it is in their district. A man remains with the cottage from nine in the morning until 10 at night, when a night watchman comes on who sleeps there, a folding bed of a clever form being provided. The night man assumes his rest with the knowledge that he is fully protected from burglars, since each window in the cottage is so wired that if it is raised the least distance during the night, all the lights will be instantly turned on. A nickel-in-the-slot telephone is also provided.

Besides being an advertisement bearing good results, the cottage is an instructive institution, since the general public, by visiting it, get much information of a valuable nature to all users of electricity, which is commonly unknown to them. In this way the company is a public benefactor at the same time that it furthers its own ends.

INTERIOR OF ELECTRIC COTTAGE.

The Washington, Baltimore and Annapolis Electric Railway Company recently bought three acres of land in East Hyattsville, Md., upon which, it is reported, it intends to construct a large power house. Electricity is to be generated to operate the following lines: The Washington, Baltimore and Annapolis; the City and Suburban railway, and the Columbia railway. The building for the proposed plant, it is estimated, will cost in the neighborhood of $350,000, and will have dimensions 133 by 203 feet. It is believed that the plant will also furnish current for manufacturing and lighting purposes.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Electrical Equipment of Chicago Railroad Clearing Yards. Illustrated 133, 134, 135
Western Union Telegraph Stock 135
Gas and Electric Lamp Renewals Compared 135
Seattle-Tacoma Interurban Electric Railway. Illustrated 136
Street Illumination in San Francisco. Illustrated 136, 137
The "Electric Cottage"—A Plan to Increase Central-station Business. Illustrated 137
Editorial 138
Third-rail System in the Baltimore and Ohio Tunnel. Illustrated 139
Telegraphic Communication with Alaska 139
Development of the Telephone Field 140
Telephone News from the Northwest 140
Indiana Telephone Items 140
Southern Telephone Developments 140
Telephone Progress in the Far West 140
Automatic Central Exchange for Chicago 140
Telephone Men 140
General Telephone News 140
Proposed Electric Pumping for Stock Wells. By A. J. Bowie, Jr. (Pacific Coast Electric Transmission Association) 141
St. Louis World's Fair Notes 141
Electrical Equipment for English Tunnel Railways 142
Detroit Street-railway Convention 142
Messenger Boys and Messenger Girls in Chicago 142
Remarkable Lightning Phenomena 142
Akouphone for Royalty 142
Aurora, Elgin and Chicago Electric Railway in Operation 142
Marconi-Postal Telegraph Rates 142
Large Railway Power Plant in Maryland 142, 143
Applications of Telpherage. Illustrated 143
Southern Colorado Street-railway Consolidation Proposed 143

DEPARTMENTS.

Correspondence 144, 145
New York Notes 144
New England News 144
Canadian Intelligence 144
Southern Developments 144, 145
Information from Indiana 145
On the Pacific Slope 145
Northwestern Notations 145
Among the Rockies 145
Personal 145, 146
Electric Lighting 146
Electric Railways 146
Power Transmission 146, 147
Societies and Schools 147
Publications 147
Miscellaneous 147
Trade News 147
Business 147
Illustrated Electrical Patent Record 148

CONVENTIONS AND EXPOSITIONS.

American Electrotherapeutic Association, Hotel Kaaterskill, Catskill Mountains, N. Y., September 2d, 3d and 4th.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Kansas Independent Telephone Association, Kansas City, Mo., September 11th and 12th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

COMPETITION has brought about some odd situations in the telephone business. The Bell companies have had much to say about the "natural monopoly" of telephone-exchange service, dwelling on the inconvenience and expense to which business men are put by the enforced use of two telephones. And yet, as a southern correspondent informs us, it was an Independent company that was installed and giving service in the Georgia town of Valdosta when the Bell company endeavored to get a foothold there. What is sauce for the goose is sauce for the gander, and the Independents, having taken up the sword, must expect reprisals; nevertheless, there seems to be a certain lack of harmony between the Bell companies in different sections of the country on the "two-telephone nuisance" theory.

AN interesting fact was brought to light at a session of the State Tax Board of Indiana last week. The assessments of telephone companies were under consideration, and a representative of the American Telephone and Telegraph Company, which had been assessed on a valuation of $828,000, asked for a reduction on the ground that the long-distance business of the company is not yet profitable. It seems that the taxing body had fallen into the curious error of considering the company as one doing a state business entirely, and on this mistake being pointed out and on the further statement in relation to the unprofitableness of the business, the board promised a fair decrease in the assessment. But can it be that, with their years of experience and the high rates charged, the Bell people are unable to make the long-distance telephone business profitable? Certainly the business of the American Telephone and Telegraph Company as a whole is far from being conducted on a losing basis.

AS WAS expected, the first chapter of the naval maneuvers, off the coast of New England, showed the value of ordinary electrical communication in coast defense (although the use of the telephone, for some unexplained reason, is said to have been something of a disappointment), and also demonstrated anew the usefulness of the electric searchlight, both on shipboard and on shore. But, if Admiral Higginson, of the victorious defensive squadron, is correctly reported, the one great lesson of the search problem which was worked to a finish in the New England maneuvers is the absolute need of wireless-telegraph service on the ships of the United States Navy. "Its value to me during the four days would have been incalculable," said the admiral. "I could have spoken my ships at sea, day or night, at any moment, by wireless telegraph, whereas, while all were in touch with me, they have been far beyond signaling distance, and, as it were, beyond my reach. While I have seen much during the last four days of value to me and to the navy, this one need of wireless telegraphs stands out so conspicuous in my mind as being the lesson of the last four days that it is all absorbing in its importance to my mind." This may be regarded as expert testimony, although, in conditions approaching a war footing, the wireless outfits might not have worked as well as the admiral anticipates. However, it is clear that space-telegraph sets must now be considered an essential part of all up-to-date warships.

Another possibility—and a very interesting one—of the use of space telegraphy in naval warfare is in communicating with submarine boats. As is well known, the submarines are "blind" below the surface of the water, and this fact constitutes the greatest drawback to their usefulness. If, when submerged, messages can be transmitted to this new type of torpedo boat from vessels on the surface or from shore stations, the value of the submergible boats will be greatly increased. Theoretically, it would seem that this accomplishment should be possibile, yet only actual experiment can determine whether a practicable method of communication can be developed. It is said that French naval officers have already had some success in transmitting wireless messages to the submarine Triton, and it is also intimated that the torpedo-boat experts of the British Navy are at work on the problem. In the meantime, one wonders if it would not be possible to turn to some use the submarine-signaling experiments of the late Elisha Gray and Arthur J. Mundy as the basis of a system of acoustic communication with the submarine boats through the water.

ELECTRICITY has been used in medicine as a stimulant, an irritant, an anodyne and an anæsthetic, and now, it seems there is a slight possibility of its employment as a soporific. In a recent issue of the Comptes Rendus of Paris S. Leduc describes a method of producing sleep and local anæsthesia by means of electric currents. Direct currents are used, with a small resistance in the circuit, and are best furnished by a storage battery. An interrupter, free from inductance, and giving 150 to 200 breaks per second, is inserted in the circuit. In the experiments heretofore made a moist electrode is placed on an animal's shaven head and another on the back near the tail. The electromotive force is rapidly increased till the animal shows generalized contractions, and respiration is stopped. The current is then reduced to about five milliamperes, with 12 to 30 volts. Respiration then sets in again and the animal sleeps a profound and tranquil sleep, which lasts as long as the current is continued. As soon as it stops the animal wakes up and jumps about with every sign of delight, and no evil consequences appear to result. If the current is not first brought to the point at which respiration stops, some agitation is displayed, such as seen in the administration of chloroform. A similar current applied to the root of a human nerve, such as the median of the wrist, gives rise to complete anæsthesia of the region innervated, accompanied by a prickling sensation which is not painful. There appears to be no record of electric sleep-producing experiments on the human subject, and the plan of stopping respiration temporarily as an incident of the process seems to be a heroic one. However, the investigation is an interesting one, and further researches may lead to results of practical value.

A COUPLE of months ago, discussing the question of the relation of electrical workers and gasfitters in installing piping for interior wiring, the Western Electrician said: "If the gasfitters are correct in principle, why cannot the carpenters step in and say the wiremen must not bore a hole in a joist?" At that time we thought we had assumed, for the purpose of illustration, a case of such extravagance that its absurdity would be patent to all. But we were not sufficiently acquainted with the convolutions of trade-union jealousies to exceed the fact, for only on Monday last a strike was called in the new Marshall Field retail building in Chicago growing out of a contention between the Brotherhood of Carpenters and Joiners and the Brotherhood of Electrical Workers as to which organization has the right to put up the molding covering electric wires in buildings. These unions appear to appeal to brotherliness and fellow-kindness by their very names, and yet they deliberately bring about a serious strike, from which many disinterested persons suffer, by such a trivial dispute between themselves. Surely, such a course is dictated by nothing but unenlightened selfishness. There is no dispute between the contractors and the men, and yet the work must be stopped owing to a miserable wrangle between the unions. Ordinary labor troubles are bad enough, but it is a thousand pities that such entirely unnecessary contentions as this should be allowed to interfere with needful industrial operations. To our thinking it is merely common-sense to allow the electrical workers to put up the molding to cover the wires they install; but, at any rate, these "brotherhoods," with their demands as to hours and wages granted, certainly owe it to all concerned to agree between themselves in these comparatively unimportant details, that the contractors, who hire them on their own terms, may not be delayed in work for the completion of which they are responsible to the owners.

Third-rail System in the Baltimore and Ohio Tunnel.

The City Council of Baltimore, Md., recently passed an ordinance requiring the Baltimore and Ohio Railroad Company to do away entirely with the use of steam locomotives and substitute electric locomotives in hauling freight trains through the Belt Line tunnel, which passes for nearly two miles under the main section of the city. As is well known to the engineering public, the Baltimore and Ohio company began to operate freight and passenger trains through this tunnel by electricity some seven years ago. However, the steam locomotives were allowed to remain on the trains and in hauling freight trains on the heavy grades they were often used to assist the electric motors. Finally the people complained that the steam locomotives threw out such quantities of smoke and cinders at the tunnel openings as to constitute a public nuisance, and the ordinance mentioned above was accordingly adopted. Contracts have been awarded, it is stated, by the Baltimore and Ohio company to the General Electric Company for two additional electric locomotives, which will be among the largest in the world. Each machine will weigh 150 tons and will be capable of drawing 1,500 tons of freight up the heavy grades of the tunnel. The motors will be designed to haul twice the load the steam locomotives pull through the tunnel.

When the tunnel was first equipped for electrical operation an overhead conducting system was erected, consisting of two Z-bars held in place by a covered plate and placed in such a manner as to form a box-like construction, by means of a series of overhead columns linked together by means of catenarys, to which the conductor was attached at comparatively short intervals. Inside of the tunnels, of which about one-half of the Belt Line consists, the construction was modified only by means of its support. In this overhead slot the conducting shoe carried on the locomotives was allowed to slide. This means of conveying current to the locomotive remained in use until last March, at which time the overhead system was abandoned and the third-rail system substituted in its place.

Some interesting details of the new equipment have recently been given out by W. D. Young, electrical engineer of the road, in an article published in the railroad company's publication, Book of the Royal Blue. The third rail is placed along the outside of the east and west-bound tracks. It is supported

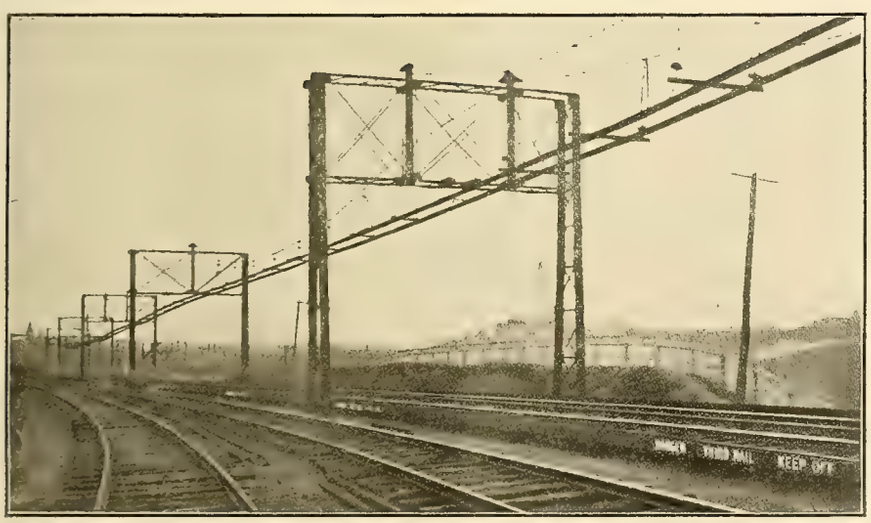


FIG. 1. THIRD-RAIL SYSTEM OF BALTIMORE AND OHIO RAILROAD.—VIEW SHOWING FORMER OVERHEAD WORK AND EXISTING THIRD RAIL.

by means of a guard and insulator stand, which is attached to ties at centers of approximately 12 feet. These guard and insulator stands form a support for planks placed on either side of the rail, acting as a guard to prevent employes coming in contact with it. The overhead and third-rail construction are both shown in Fig. 1.

Through the two passenger stations, Camden and Mount Royal, which are about a mile and a half apart at the ends of the tunnel passing under the city, it was necessary to modify this construction in such a way as to prevent all possibility of the traveling public coming in contact with the charged conductor. To accomplish this, there were several precautions taken. The third rail was laid through the station at the standard height, and on the insulators in the regular way, but it was completely covered over, the conducting shoe being allowed to make contact through a wooden covered slot, supported by iron members from the under side. This third-rail protection and an electric locomotive are shown in Fig. 2.

In addition to this, the rail was cut into sections, each of which was insulated from the one next adjoining, and controlled by the Murphy safety switch in such a way that the current would be on this section only when the locomotive was passing over that particular section. In the same way, all rails adjacent to crossings of foreign roads, special work and in the yard, the third rail was cut up in sections and protected by safety switches.

The question very naturally is asked by the casual observer: "Why would a system that has worked so well as the overhead unquestionably has, be replaced by another?" There are several very good reasons for this, among which may be enumerated the following:

The initial cost of the third rail was only about 25 per cent. of the overhead; it is easily adapted to any change that may be desired in the track from time to time; it is more easily repaired and has a very much lower percentage of depreciation.

Again, the question is often asked: "Is not this third-rail conductor dangerous, particularly when adapted to use on surface railroads?"

At first thought, it apparently is, but these objections are not found to be justified in actual practice, providing a reasonable amount of precaution and care is taken to warn the trespasser. The writer holds that, outside of stations, no one, employes excepted, has any right on the right-of-way of the large steam railroads of the present day, and through the polite little warnings given to the meddlesome employe, it is surprising to see how quickly and with what reverence this type of construction is regarded.

The third-rail construction is a most flexible one, but in certain cases it was found necessary to resort to special types of construction, hitherto unemployed, in order to handle such excessively heavy currents as are required through special work which had been constructed without any regard to electrical adaptability. It is a comparatively simple matter to handle currents as high as 500 amperes on a train to which may be attached at the sides several conducting shoes, for the purpose of giving a span, or reach, of the shoes in making crossings or passing special work; and, furthermore, to give the multiple contact in order to convey the current from the rail to the motors without sparking. In the case at hand, however, conditions were very different. The maximum reach that it is possible to obtain on the locomotives is, approximately, 28 feet. By this is meant the distance between the shoes, of which there are four, one on each corner of the locomotive.

In handling freight and passenger trains up the grade, which varies from eight-tenths to one and five-tenths per cent., it is not practicable to resort to the very common practice of shutting off the controller and allowing the train to drift over the crossings or special work. With the locomotives it is necessary that there should be one shoe making perfect contact with the rail at all times. To accomplish this it was necessary to construct a special shoe mechanism and to introduce in special work movable rails. The movable rails were placed in special work where it was neecssary to have a contact rail in such a position that the shoe might take current from same when the locomotive is passing and might be dropped to a low position to enable the steam locomotives passing in a diagonal direction or on an adjacent track without interference. These movable rails consist of a T-section, mounted on insulated blocks, all of which are raised into position or dropped by the operator at the interlocking tower.

In the design of the shoe it was necessary to construct one that would conduct at least 2,500 amperes without sparking. This may seem like a very simple problem, but to those who have had experience in this line, the difficulty will at once be appreciated. However, a shoe was designed which fulfills all these requirements in a most satisfactory manner. This shoe has eight distinct movements, all of which are made and fixed within certain ranges. They are: Up, down, out and in, the rocking of the shoe laterally, and the tilting in either direction, in order to take the inclines.

It may be of interest to show how much, within the past seven years, the demand on this electric service has increased, due to the increased number and weight of trains. In September, 1895, there were hauled by the electric locomotives, 333 freight trains; in May, 1902, 641 freight trains. Originally the passenger trains were not handled by the electric locomotives, but as a substitute coke-burning locomotives were used over the Philadelphia division so as to emit, while passing through the tunnels, as little smoke as possible. It was subsequently found, however, that the electric service was so satisfactory

FIG. 2. THIRD-RAIL SYSTEM IN THE BALTIMORE AND OHIO TUNNEL.—VIEW SHOWING SHOE OF ELECTRIC LOCOMOTIVE IN CONTACT WITH THIRD RAIL THROUGH SLOT.

that the passenger service since it was inaugurated has been continued.

On account of there being an up grade eastbound, freight and passenger trains are handled only in one direction, as power is not necessary for trains west bound. This is one of the reasons that often gives to the observer the idea that all freight and passenger trains are not being handled electrically.

Telegraphic Communication with Alaska.

Telegraphic connection has been established between the United States and points in Alaska. The routes of messages from different cities in the United States will be first to some point on Puget Sound. From there they will be sent via the lines of the Postal Telegraph-cable Company and the Canadian Pacific company to Vancouver, thence over the Dominion government's line to Dawson. From Dawson the route will be via an American line now operating to Eagle, thence to Valdes, via a line being built, and to be finished by September 1st. The Valdes-Eagle line will be 400 miles in length. This line is to have connections with Fort Gibbons, which will be the next point in the proposed route. From there to St. Michaels a message will travel via lines now in operation. The last and probably the most important stretch in this long route is from St. Michaels to Nome. This distance will be covered by wireless telegraphy. When the system is completed it will be possible to send a message from Washington, D. C., to Nome, Alaska, and receive an answer the same day. Part of this route will be in operation in the early fall, but the completed connection will not be in working order before March 1st next.

A party of government experts has been working until recently on the Skagway-Juneau cable and some interesting information comes from them. According to their report, the government seems to have been deceived concerning the condition of the cable. It was understood that the cable, although in bad shape, was still capable of repair. This, the experts say, is an impossibility. In fact, the idea of repair has been entirely abandoned, and work on the cable stopped. The cable, which was laid last fall, has been capable of use, it is said, only a few weeks since that time. It was swung so loosely that it sank to the bottom in coils. Numerous kinks occurred, and so many breaks were found in the insulation that it was decided to give up the proposed attempt at repair. The line is 100 miles long and covers a route over which the government will now attempt the use of a wireless-telegraph system, mention of which was made recently in the Western Electrician.

Mankato, Minn., is in the field for electric-lighting machinery.

DEVELOPMENT OF THE TELEPHONE FIELD.

Telephone News from the Northwest.

The Winnebago County Telephone Company has been formed at Oshkosh, Wis., and proposes to proceed with the construction of a local city exchange, whether the City Council will grant a franchise or not. This it can do, under the state law, which requires it to submit to reasonable police regulations. The company has therefore filed a plat of work projected, and has asked the council to indicate where it shall proceed and how.

The telephone taxes in South Dakota aggregate $4,261.87, of which the state's portion is $615.80. There is but one county in the state which has no telephone lines within its borders.

A new line is being constructed between Lesterville and Tabor, S. D.

The county telephone system was put to good use recently in the neighborhood of Woonsocket, S. D., when a fire broke out and destroyed 160 acres of wheat. About 100 neighbors were summoned by telephone, and, after a desperate fight, the fire was put out.

The Warren (Minn.) Telephone Company has changed from the automatic system to the manual system.

The Southwestern Minnesota Telephone Company is installing a local exchange at Minneota, Minn.

Funds are being raised to secure the construction of a telephone line from Gentilly, Minn., to Crookston.

The Consolidated Telephone and Telegraph Company has filed a trust mortgage at Duluth, Minn., to raise funds for construction work, in the amount of $50,000.

The Mesaba Telephone Company of Duluth, Minn., has raised $75,000 by a trust mortgage, running to the Old Colony Trust Company.

The Buffalo Lake (Minn.) Telephone Company has completed a modern exchange. It is full-metallic throughout, and is equipped with Stromberg-Carlson instruments.

The Northern Telephone Company has begun work on the construction of a circuit from Fort Dodge, Iowa, to Storm Lake.

The Chicago and Northwestern Railway Company is understood to be experimenting with telephones for use in operating its block system in the neighborhood of Cedar Rapids, Iowa. A thorough test of the plan will be made, and, if found to be desirable, telephones will be established in each block station.

The Consolidated Telephone and Telegraph Company has been granted admission to Hastings, Minn.

The Lone Tree Telephone Company of Lone Tree, Iowa, has been incorporated with $5,000 capital stock.

The Bell Telephone Company at Anamosa, Iowa, advertises to furnish free with each business connection at $2 a month, a residence connection. New subscribers are furnished free service for several months. It is needless to state that there is a competing telephone company in Anamosa.

The Yankton Telephone Company has been formed at Yankton, S. D., and will proceed to construct a local exchange without delay.

The Fremont Telephone Company has been incorporated at Fremont, Neb., with a capital stock of $200,000, of which $25,000 must be paid up before the construction of the plant begins.

Ora Green of Traer, Iowa, has brought suit against the Cedar Valley Telephone Company for damages for the delivery of the wrong message. A telephone message was sent to him about some stock, and a messenger delivered the message verbally to the effect that his father was dying. He and his wife rushed to the home of his father, to find him perfectly well. Green thinks the nervous strain damaged him permanently. The case will come up at the October term of court.

The striking employes of the Iowa Telephone Company at Des Moines feel that the action of the company at different towns in the state is to ward off similar trouble. Hours have been shortened at Boone to nine hours a day. At Ottumwa there has been an increase of wages.

The council of Des Moines has passed a fiery resolution to have the case against the Iowa Telephone Company pushed in the courts to oust it from the streets.

R.

Indiana Telephone Items.

The Cumberland Telephone Company, which has been doing business in Evansville for the last 25 years, must quit business within 90 days. The crisis was precipitated at a meeting of the City Council on the 18th inst., in the passage of an ordinance to that effect. The franchise of the Cumberland company, according to the opinion of the city attorney, expired July 22d last. The Board of Works will ask for new bids, and if the Cumberland company offers the best bid, it will be accepted, and a new contract entered into. Other companies will be asked to bid, and it is believed that should some other than the Cumberland company receive the franchise the Cumberland company will test the matter in the courts. This action of the council is said to be indicative of the failure of Mayor Coverts' municipal telephone scheme.

The State Tax Board is giving its final session up to representatives of telephone companies, who are appearing in droves, hopeful of convincing the board that it has assessed this class of property too high. The board fixed the valuation and then notified the companies to appear and show cause, if any, why the valuations should not stand. The United Telephone Company, which operates lines in Hartford City, Montpelier, Marion and several other cities, was represented by Hugh Dougherty, who made a strong plea for a lower assessment. It was shown that within the last year the United company absorbed the Indiana Telephone Company and the Marion Telephone Company, and it was directed that these two companies be taken off the duplicate. The board assessed the United company on a valuation of $321,000. Mr. Dougherty, in asking that that amount be reduced to $154,000, said that, in his opinion, the method provided by law for arriving at the value of telephone property, was not a fair one. The board takes the stock at a fair cash value, adds to that the indebtedness, and then deducts the assessment on real estate and personal property made in counties through which the company operates. It was shown by Mr. Dougherty that real estate owned by the company is assessed at about 45 per cent. of what the company paid for it, and he insisted that it was unfair to assess real estate at such a low figure and then make corporations pay on a cash valuation.

Charles Martindale, representing the American Telephone and Telegraph Company, whose assessment had been raised from $440,000 to $828,000, brought out the fact that the board was of the impression that the company did a local business. This is not the case, he said. Its business was interstate, and is not yet profitable. He was promised an equitable decrease.

In answer to a question from Governor Durbin as to what the future had in store for the telephone business in Indiana, Mr. Marvin of the Frankfort company said he believed that men who had put money in the business were beginning to realize the real situation. "I do not believe the use of telephones will diminish, but companies will have to make a larger charge for the service. It is evident that within 20 years a company will have to rebuild its plant two or three times, and this cannot be done on such a low rate."

The board has fixed the assessment on 134 companies, operating 88,641 miles, and the rate is from [illegible] to $10,000 per mile. The present week the board will pass on all appeals from the primary assessment, and then its work for the year will be completed.

F.

Southern Telephone Developments.

The Board of Trade of Valdosta, Ga., has decided to appoint a committee to endeavor to prevent the establishment of a second telephone system in the city unless the company shall absorb the old company. The new concern is the Bell company. W. A. Bisbee of Savannah is principal owner of the Independent company.

The Tennessee District Telephone Company of Memphis has been granted a charter, with a capital of $100,000. E. Howard, J. Compton and others are interested.

The St. Matthews (S. C.) Telephone Company has obtained its charter. The capital is placed at $1,500. L. M. Able is secretary and treasurer.

The Strowger telephone interests of Augusta, Ga., are remodeling their exchange, which will be occupied in September. New switchboards and other improvements will be installed.

F. C. Toepleman, general superintendent of the Henderson (N. C.) Telephone Company, has compiled a directory of the toll stations and exchanges of the principal Independent companies of Eastern North Carolina.

N. D. Smith of Pittsburg, Pa., will be manager of the Home Telephone Company of Jackson, Tenn. This company will operate in opposition to the Cumberland company. Its lines will be underground, and everything will be of the latest improved type.

A new telephone line is being built between Oakridge and Kernersville, N. C.

The Home Telephone Company of Talladega, Ga., has been sold to the Bell company, which states that the local exchange will be rebuilt. G. A. Mattison, owner of the Home plant, made the deal on account of other business demanding his time.

The Bell company will locate a long-distance office in Rocky Mount, N. C.

L.

Telephone Progress in the Far West.

The Rocky Mountain Bell Telephone Company will extend its De Lamar line to Jordan Valley, Idaho.

The largest barb-wire telephone system in the country will be made by the consolidation of all the systems running into Dayton, Huntsville and Waitsburg, Wash. A central exchange will be built at Waitsburg.

The Sunset Telephone Company is introducing a system of reduced rates in competition to the new Pomona (Cal.) Valley Telephone Company. The price of individual telephones, formerly $4 per month, is now reduced to $2.50 for business houses and $2 for residences. The 10-party-line service, which was $1.50, will now be reduced to $1 per month.

The Telluride Power Company has been granted a 25-year franchise to build and maintain a telephone system in Salt Lake County, Utah. The company must furnish the county telephones at a rate 40 per cent. less than the public one.

A telephone line will be built to the summit of North Baldy Mountain, one of the Sierra Madre range, from Los Angeles, Cal.

Judge L. L. Bone has asked the city of San Diego, Cal., for a telephone and telegraph franchise for a period of 50 years. The petition states that the holders of the franchise will expend $15,000 within the first six months, $15,000 more in nine months, $15,000 more in 12 months and $30,000 within 18 months, or a total of $75,000. The company will charge $54 per year for business and $27 for residence telephones. It is thought that Mr. Bone is asking for the franchise in the name of the Home Telephone Company of Los Angeles, Cal.

A. W. C.

Automatic Central Exchange for Chicago.

The Illinois Telephone and Telegraph Company, Chicago, has secured a five-year lease on a four-story building located on Fifth Avenue (175-181) in which it purposes to install a central exchange for its automatic telephone system. The lease does not take effect until January 1, 1903, and hence work on the installation in the exchange cannot proceed until then. The switchboard, which is being built by the Automatic Electric Company of Chicago, is nearly completed. The tunnels being constructed for the Illinois company through the business portion of the city are nearing completion, those under the Chicago River (two in number) having been finished. Each building using the system will be connected with the street tunnel by a subway extending from its basement. It is asserted that the initial capacity of the automatic exchange in Chicago will be 25,000 instruments. The telephones are to be delivered by April 1st next, by which time the switchboard may be ready for operation.

TELEPHONE MEN.

Kempster B. Miller and W. W. Dean of the engineering staff of the Kellogg Switchboard and Supply Company, Chicago, are enjoying a hunting expedition in Colorado.

A communication from Mr. and Mrs. Charles J. Glidden and Dr. F. L. D. Rust states that they reached Baden July 24th, having covered 800 miles of their European automobile tour. They started at London, crossed the channel to Dieppe, from whence they passed across the northern section of France to Metz, down the valleys of the Saar and Moselle to Coblenz, up the Rhine to Bingen, and to Heidelberg and Baden. They found excellent roads as far as Bingen, but the German roads are so hard and rough that they will not go through as much of that country as they intended, but will take a longer trip through Switzerland, northern Italy and France.

GENERAL TELEPHONE NEWS.

The Cleburne and Bono (Texas) Telephone Company has been incorporated with a capital of $10,000 by J. H. Mimas, T. J. Honea and J. B. Landers.

It is reported that on August 24th successful trials were made with the "wireless telephone" between Lassnitz and Kolberg, in Germany, a distance of 105 miles.

The City Council of Albuquerque, N. M., has granted a franchise to the Mutual Automatic Telephone Company to construct and operate a telephone system at that place.

The meeting of the Kansas Independent Telephone Association that was scheduled to be held in Topeka, Kan., in August, has been postponed and will now be held at Kansas City, Mo., on September 11th and 12th, upon the invitation of the Kansas City Home Telephone Company. Independent telephone men throughout Western Missouri have been invited to attend the meeting, and indications point to a well-attended and successful convention.

The Brockton (Mass.) aldermen have refused to extend the time in which the Massachusetts Telephone and Telegraph Company (the Independent company) may get its Brockton exchange in running order. As granted, the franchise allowed 15 months for the necessary work, but it was extended one year, until August 18, 1902. The company asked for one year more on the ground that the construction work had been delayed by changes in management, but no one appeared before the aldermen, in behalf of the company, and the petition was refused. The company forfeited $4,000 by not fulfilling the terms of its franchise. The company has done no work in Brockton during the last year. There is much criticism of the Bell service in that city.

Proposed Electric Pumping for Stock Wells.[1]

By A. J. Bowie, Jr.

The field for electric power has grown wonderfully in the last few years, and yet its possibilities and limitations are scarcely known. Everywhere it has been supplanting other means of power, forging ahead of all competition for general use. One of the uses to which it might be successfully applied is in a plant proposed by the writer for the operation of the stock wells owned by the Kern County Land Company. These stock wells are of from six to 7¼-inch casing and of depths varying from 50 to 150 feet. The distances from the surface of the ground to water, as measured after three successive dry years, were from 10 to 30 feet in all but about four of the wells, where the depth of water was from 45 to 70 feet.

The present installation at these wells consists of single-acting, deep-well lift pumps, from three inches to four inches in diameter, with a maximum stroke of 18 inches. The pump is put down the well and wooden plunger rods connect the same to a walking beam, which is driven by animal power. A few of the pumps are provided with stuffing boxes in order to force water into tanks; but the majority of them have no stuffing boxes at all, as they deliver the water direct into the watering troughs. The average capacity of these troughs is about 300 gallons each. Most of them are of galvanized iron. At each well there are from two to eight troughs. A mule is used to furnish the motive power, and a man or woman watches him and sees that everything goes well. In some of the places one attendant and mule can look out for several wells. Some of the wells have to be pumped continuously, however, so as to supply sufficient water for the stock. In all except the Poso Ranch, which includes all the pumps north of Rosedale, any or all of the pumps are liable to be used at any time. On Poso Ranch, however, of the 75 pumps, there are never more than 30 in operation at any one time.

The power-transmitting apparatus consists of a large gear with internal teeth, mounted on a vertical pivot or shaft. This gear is driven by a projecting pole to which the mule is hitched. A pinion meshes with this gear, and drives through bevel gears a horizontal shaft, on the other end of which is mounted a flywheel and crank. The crank is provided with different holes for the crank pin, so as to alter the length of stroke. Wooden rods connect the crank pin with the walking beam, which is also of wood. The average mule will pump from 20 to 25 gallons per minute with this rig in the wells of 30-feet lift. You have to keep after him all the time to keep him up to the 25-gallon rate, and 20 gallons is about a safe figure. Sometimes, when there is a great demand for water, it is necessary to keep pumping the wells continuously, night and day. Most of the time there is no other water near these wells, and the supply which is pumped is depended on for drinking water for the cattle. It is, of course, absolutely essential that the cattle should not be without drinking water for any considerable period of time, especially in the hot summer days. Should one pump break down, so that it would take some time to fix it, the cattle are driven into another field, where they can obtain water from another pump.

The maximum amount of water consumed by cattle on the hottest days is 25 gallons per head per day. The greatest number of cattle ever watered from one well is 1,200, corresponding to a total maximum demand of 30,000 gallons per day, or 21 gallons per minute, continuous pumping. Some of the pumps, however, supply only a comparatively small number of cattle, and are run only a small part of the time; others are often not run for long periods, depending for their operation on the way the cattle are moved into the different fields. The principal items of expense for the present operation of the wells are the pay of the pump attendants, feed for the mules and depreciation of machinery. The wages of that class of labor are naturally small, and feed is not high.

Such are the present conditions, and at first glance it would seem almost impossible for electricity to compete with present methods, owing to the great distances and the small amount of power used.

Three methods of power operation might be applied:

1. Air lift.
2. Gasoline engines.
3. Electric operation.

The first system was suggested by Mr. L. A. Hicks for the operation of the 53 pumps on the north of Poso Ranch. The plan was very ingenious in its conception and in the details which were worked out. He distributed compressed air from one central air station.

As for a comparison of the different systems, compressed air would be the simplest of all in its operation, but the first cost would be higher than either of the other systems. Gasoline engines would be the cheapest to install, but the most expensive to operate; besides, gasoline engines have a habit of getting out of order, and would require men of a comparatively great amount of skill, and hence, well paid, to keep them in repair.

Electric operation was between the other two systems in first cost, being also very simple and cheap to run. Most of the country was open and level, and hence naturally suited for a pole line.

The system proposed was as follows: The present 10,000-volt line ending near Rosedale was to be extended to Wasco, with 25-foot redwood poles. At Wasco and at four other places were to be located transformer sub-stations stepping down to 3,300 volts.

Transformers of ample capacity for more than full load were to be installed. In addition, one 25-kilowatt transformer was to be kept on hand in event of losing any of the other transformers. The transformer sub-stations were to be of wood, except at Wasco, where a brick generating station, with one 90-kilowatt, 3,300-volt, 60-cycle, three-phase generator, one 100-horsepower engine and one 100-horsepower boiler were to be installed.

Current was to distributed at 3,300 volts, single-phase, to the different pump stations, where it was to be stepped down to 110 volts. The distribution pole line was to be 22-foot redwood poles. The two 3,300-volt wires were to run on a cross-arm, and the telephone wires below on the pole.

No. 10 B. & S. hard-drawn copper wire was to be used for the extension of the 10,000-volt wires to Wasco. The wire for distribution at 3,300 volts was to be No. 8 and No. 10 B. & S. hard-drawn copper, and No. 8 and No. 10 B. W. G., E. B. B., galvanized-iron wire, by far the greater part of the wire used being of iron. This and the small size of the poles cut down the expense of pole line very materially.

Line cut-outs were to be provided for every branch, besides having several in the main line. Lightning arresters were to be used at most of the stations. The telephone line was of two No. 12 E. B. B. galvanized-iron wires, and a complete telephone system was to be provided. The equipment of each pumping station was to be as follows: One one-kilowatt transformer, one three-quarter-horsepower, single-phase motor, one switch and fuse block, one automatic single-pole switch, operated by float, for operating motor, one telephone, one centrifugal pump to deliver 30 gallons per minute against a 40-foot lift. At each station was to be a small pump house. Where the water was sufficiently near the surface these pump houses were to be built above ground; but when the water was too far below the ground, a pit about 10 feet deep was to be dug and the pump placed in the bottom and belted to the motor above. There would be a foot valve on the bottom of the suction pipe, so that the pump would always be primed. The discharge would go into an earth reservoir. The capacity of these reservoirs was to be from 15,000 to 40,000 gallons, so as to have at all times at least a day's supply of water on hand, should any break occur in the line. Float valves would be put in the pipes connecting the reservoirs with the watering troughs. The automatic motor switch would be operated by the water in the reservoir. The reservoir would be fenced around the top to prevent cattle from entering. A low-water alarm was to be put on the telephone circuit, which would ring up at regular intervals the number of the station at which there was any such trouble. The oiling devices for pump and motor would be of such a nature that they could run for days without attention.

In the stations where the water was very deep, where it would not pay to sink a pit, the pumps at present in use would be connected to a suitable power head and driven by double-reduction belting and gearing.

While these pumps give a higher efficiency than small centrifugal pumps, where the lift is over 20 feet, still the power heads alone will cost from three to five times as much as centrifugal pumps suitable for this work; they also require much more attention.

Being unable to get a small runner suitable for a centrifugal pump, of high enough efficiency, the highest efficiency obtained from the small runners tried being 28 per cent., the writer designed a runner which gave 36 per cent. efficiency, a relative efficiency of about 25 per cent. better than the runner experimented with. This made it possible to use three-quarter-horsepower motors instead of one horsepower, and similarly made a very large saving throughout the entire plant.

The plant was to be operated by power from the Power Development Company's lines. Should any interruption of service occur, due to a break in the line, it could always be fixed up within a day. However, should any accident happen to the Power Development Company's plant, causing it to shut down, then it would be absolutely necessary to have a reserve station. With this in view, the Wasco power station would be put in. It might never be used, but if there ever was need for its use, it would be absolutely indispensable. It would deliver power to the pumps fed from the transformers at Wasco direct at 3,300 volts. The step-down transformers would be used to step up to 10,000 volts, and distribute back to the other sub-stations.

Four men would be ample for the continuous operation of the entire plant. They would be expected to visit each station in operation at least once in every two days.

The cost of installing the electric plant complete would be $60,000. This includes the 120 miles of pole line and 120 pumping plants. Each station was to have a motor, except on Poso Ranch, where 35 motors would be provided, the motors being moved around as required.

Figuring on interest on investment and taxes at seven per cent., repairs, renewals and depreciation of pole line 10 per cent., repairs, renewals and depreciation of remainder of plant at suitable figures, the cost of operation, including the fixed expenses of the electric plant, would be of such a size that the plant would pay for itself in saving over present cost of operation within five years, and excluding depreciation and repairs, which would not cause much outlay for the first few years, the plant would pay for itself within four years. In making this estimate, the present plant has been credited back simply as junk, as it would be impossible to realize but very little on it. The cost of each station, pump, motor, etc., complete, excluding the reservoir, would be about the same as the cost of each station of the present plant, being almost half the total cost of the installation. It can readily be seen what a very large saving this would have made had an electric plant been originally installed.

With all pumps in operation at one time, the maximum drop in the line voltage would not exceed 15 per cent. As the pumps would be operated, it is doubtful whether this would ever exceed 10 per cent. in actual practice, averaging perhaps five per cent. The cost of wire is so small that ample margin has thus been allowed for any increase needed. Single-phase is preferable to any other method of power distribution in such a case on account of simplicity. While there is little other demand for power in the district traversed, electricity renders possible a very simple and cheap means of obtaining power throughout the entire district, and use for it will undoubtedly grow, even though on a small scale, where the lines are at hand.

It is doubtful whether any other system could be as efficient or reliable under the circumstances as an electric system.

1. Paper read before the Pacific Coast Electric Transmission Association at San Francisco, June 18, 1902.

St. Louis World's Fair Notes.

The Transportation Building will be 1,300 feet long and 525 feet wide, covering an area of over 15 acres. The building will contain about four miles of standard-gauge railroad track, with an exhibit space of 270,000 square feet in addition.

One of the standing committees of the Exposition Company is on electricity and electrical appliances. It is constituted as follows: J. E. Smith, chairman; Joseph Ramsey, Jr., vice-chairman; Clark H. Sampson, Charles A. Stix, August Gehner, A. A. Allen and S. M. Dodd.

The Administration Building is to be equipped with a complete telephone service, the committee on grounds and buildings having closed contracts with the Bell and Kinloch companies to install in the building a central telephone station, one in each of two rooms in the west wing of the building. These lines will serve the entire site, including the offices of the contractors, as well as the administration buildings.

Some electrical contracts have been let recently by the St. Louis World's Fair officials. A contract for the laying of an electric conduit of 60 ducts has been secured by Jacob Althaus, and calls for the completion of the work by October 1, 1902. The remuneration is $4,768. The Western Electric Company received a contract for a 30-horsepower motor, which is to be used to operate a large centrifugal pump in the sewer system of the fair.

The first carload of porcelain electrical appliances shipped to the World's Fair site by the Commercial Electrical Supply Company arrived last month. The car contained boxes of knobs, cut-outs, branch blocks, cleats and other electrical fastenings. This is the first of 11 carloads which will be needed to equip the lighting lines of the exposition. To show the amount of supplies that will be needed, Chief Electrical Engineer Rustin states that 1,492,250 wiring knobs will be required.

The following extracts from the rules governing the eagerly anticipated aeronautic contests are of particular interest to readers of the Western Electrician:

A first prize of $2,500 and a second prize of $1,000 are offered for the airship motors, other than the exact machine winning the grand prize, having the least weight and the greatest efficiency in proportion to their power. There are no limitations as to the kind or type, but the motor must have a minimum capacity of one brake horsepower, and shall not exceed a maximum of 100 brake horsepower. The weight of the motor is to include all appurtenances (tanks, water, etc.) and fuel, or its equivalent, for a run of one hour. It must be so constructed that it can be attached to an apparatus for making a brake test. The first test will cover one hour's run to determine power and the second test a continuous run of ten hours for ascertaining the reliability and durability of the apparatus.

One prize of $3,000 for a successful attempt to drive an airship motor by energy transmitted through space, either in the form of electric radiation or in some other form of electrical energy, to an actual amount of one-tenth of a horsepower at the point of reception, and at a distance of at least one thousand feet. The test must be made on the exposition grounds by experts satisfactory to the jury.

The consolidation of the Rockford (Ill.) and Belvidere Railway Company and the Rockford Railway, Light and Power Company took place on August 11th at Rockford, Ill. The roads have been controlled by the same interests for some time, and the above consolidation was only a legal move. The principal stockholders are John Farson and R. N. Baylies of Chicago.

Electrical Equipment for English Tunnel Railways.

At a recent meeting in London, England, of the Metropolitan Railway Company, Chairman J. J. Mellor of Manchester devoted a considerable portion of his report to the electrical equipment that was being installed on the railway. He said that substantial progress had been made with the work. Contracts were let in March last to the British Westinghouse Electric and Manufacturing Company for the supply of the complete plant and machinery for the power station at Neasden and for the sub-station plant and machinery, the whole of which is now being constructed. Plans and specifications have been prepared for the erection of the power-station building, and tenders have been advertised for and received, and a contract is now being settled for this work, which will proceed simultaneously with the construction of the electric plant and machinery, so that the whole may be completed in the autumn of next year. A design for new rolling stock, on the corridor principle, has been approved by the board, and a contract for the construction of the trains and motors to be used on that portion of the railway which will be electrically equipped will shortly be let. The reduction recently made in passenger fares has also been a much-needed step in the right direction, so far as the recovery of traffic is concerned.

Another important road which is being changed from steam to electric traction is the Mersey railway, which connects Liverpool and Birkenhead and passes under the River Mersey. The tunnel is double-tracked and the route of the railway is about 4½ miles long, the total length of track, including sidings, being about 12 miles. Its situation is unique, joining two such important business cities between which the only competition in the transportation of passengers and freight is given by ferry boats on the river, and the traffic on the line is large. The number of passengers carried amounted to between seven and eight millions per year, even with the old steam-locomotive system.

The railway is standard gauge, laid in accordance with heavy steam-railway practice, the rails being of the ordinary English "bull-head" type, weighing 86 pounds per yard. The line is to be fitted with the third-rail system, the conductor rail to be laid alongside, and just outside of the running track. The running rails will not be used as the return electrical conductor, but a fourth rail is to be placed between them solely for this purpose. This will entirely prevent any destruction of the track rails or buried pipes in the vicinity by electrolytic action. The third and fourth rails will be similar in size and in arrangement. They are to be of T-section, 60 feet in length and to weigh 100 pounds per yard. They will be effectively bonded and carried on stoneware insulators spaced at intervals of seven or eight feet apart.

The last of the main generators and engines intended to be installed in the power plant of the Mersey railway are about to be shipped from the Westinghouse works at East Pittsburg. These generators are of the railway type (1,200 kilowatts, 650 volts, 90 revolutions per minute) and are to be direct-connected to vertical cross-compound Westinghouse-Corliss engines of 1,500 horsepower each. The power-house lighting and the electric lighting of all the seven stations, sidings, etc., will be supplied from a separate generating plant, comprising two compound-wound generators, each having a capacity of 200 kilowatts, at 650 volts, direct-connected to Westinghouse compound engines and running at a speed of 250 revolutions per minute. The power-generating plant will have an aggregate output of about 6,600 horsepower—6,000 horsepower for the railway proper, and 600 horsepower for lighting.

The Westinghouse electro-pneumatic system of train control is to be used, and the cars will be equipped with Westinghouse high-speed air brakes. The rolling stock will consist of 60 cars, each about 60 feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor cars, equipped with four 100-horsepower motors each. It is expected that the trains will run on a three-minute service.

Detroit Street-railway Convention.

Announcement is made by Secretary T. C. Penington of the transportation rates and arrangements made for the delegates and visitors who will attend the twenty-first annual meeting of the American Street Railway Association at Detroit, Mich., on October 8th, 9th and 10th. The passenger associations have granted excursion fare from all points (except in Michigan from points on the Michigan Central railroad and the Lake Shore and Michigan Southern railroad, from which the rate of fare is two cents a mile). It is necessary that 100 or more persons purchase tickets, and they must get properly executed certificates from agents when purchasing tickets. Those holding certificates properly signed by the railroad officials and countersigned by the secretary of the association may obtain tickets for the return journey at one-third fare. The certificates are not transferable, and return tickets must be purchased within three days after adjournment of the meeting.

Thursday, October 9th, has been set apart as exhibitors' day. No session of the association will be held on that day, so that all may have time to examine the exhibits. The headquarters of the association will be at the Cadillac Hotel. Other first-class hotels in Detroit are the Russell, Wayne, St. Clair, Normandy, Griswold and Metropole. The annual dinner will be held at the Cadillac, Friday evening, October 10th, when the officers-elect will be installed. The local committee in Detroit is making every effort to provide an enjoyable time, and the officers of the association expect a very profitable and pleasant convention.

Messenger Boys and Messenger Girls in Chicago.

On August 20th all the messenger boys employed by the Illinois District Telegraph Company again went on a strike. This company settled a previous strike with the boys on July 23d, and at that time the demands of the boys, which were principally for shorter hours and pay by the day instead of by the message, were conceded. The present strike, the boys affirm, is on account of the company's failing to live up to its agreement. The officials of the company say that any such information given out by the boys is false and that they have done their best to keep the boys contented. They insist that the boys have not lived up to the agreement signed by their committee on July 23d.

As a great deal of important business depends upon the delivery of telegrams, something had to be done. A scheme of delivery was adopted which at first, it was thought, would bring the strikers to terms. Girls were employed by the company and the messages delivered in that way. At first all went well, but finally the girls, on account of the taunts of the youngsters, gave up their work. On August 25th men of all stations in life were delivering the messages, and finally the officers of the company had to take a hand in the service, as some important messages could not be delivered in time otherwise.

The boys say they will not deliver another message unless the company will give them what their agreement of July 23d calls for. The company, on the other hand, says it will employ any means of delivering its messages so long as it can avoid the use of the boys. A few girls are still working for the company, but the situation promises no little trouble before a settlement is reached.

Remarkable Lightning Phenomena.

Remarkable electrical phenomena occurred recently in the city of Butte, Mont., and the village of Troy, Ill. At Butte the sky, during a rainstorm, was overcast with a sheet of flame, which remained over an hour, according to a newspaper account. Nearly everything became more or less charged with electricity, and one man who entered a refrigerating car to remove some meat was instantly killed on touching it. Many others received shocks by coming in contact with telephone wires even several hours after the electrical display had ceased. It is said that the display was the most remarkable ever seen in the Rocky Mountains.

At Troy, Ill., the phenomenon was of an entirely different nature. During a severe electric storm a cross-shaped fissure was formed in the earth—again accepting the newspaper narrators as truthful—one arm of which is said to be 40 feet long and six inches wide, the other 20 feet long and of the same width. Where the two arms intersect, there is a hole two feet in diameter said to be over 150 feet in depth. Though no one saw an unusual bolt of lightning, the theory is advanced that lightning entered the ground at the intersection of the arms of the cross.

Turning to more authenticated phenomena, it is interesting to observe that during June and July more than 500 buildings in Chicago were struck by lightning, over 400 cases being recorded in July alone. In one storm—that of July 17th—127 strokes were reported. These figures are taken from the record of adjusted insurance losses and represent only lightning losses serious enough to cause a claim to be made. The average loss was $76. One was as high as $12,000, although no other was over $1,000. Omitting the $12,000 damage, the average loss was $36.

Akouphone for Royalty.

M. R. Hutchison's akouphone—a micro-telephonic instrument designed to intensify sounds, so that the partially deaf may hear—is just attracting attention in England, although known in the United States for several years. A dispatch from Manchester, sent earlier in the month, says that Mr. Hutchison delivered an address on the subject before the British Association. In the course of his address it developed that he is treating Queen Alexandra and the Duke of Cambridge for partial deafness. The most convincing demonstration of the value of the new apparatus, according to a newspaper account, was the fact that it enabled a dozen children born deaf to hear for the first time in their lives. Mr. Hutchison has received an offer from London capitalists for the European rights in the invention.

Aurora, Elgin and Chicago Electric Railway in Operation.

The Aurora, Elgin and Chicago Railway Company opened its line to the public between Chicago and Aurora, Ill., for the first time on the morning of August 25th. There has been much comment in relation to the high rate of speed which is to be maintained on this line, and its opening was watched with interest. At present the cars run between the Fifty-second Street end of the Garfield Park branch of the Metropolitan Elevated road, and Aurora, Ill. The Elgin (Ill.) portion of the new system is not yet finished, but is expected to be in operation by December 1st.

The equipment of the road is of the best. Eighty-pound rails were used in its construction and the bed is built with high-speed possibilities in view. Grades have been reduced as much as possible and grade crossings avoided. The third-rail system is employed. Alternating current of high voltage is generated for power at the central station in Batavia, and is distributed to six sub-stations, where it is transformed down and changed to direct current, which is used on the line. A maximum train will consist of a motor car and four coaches. The motor cars are equipped with four 125-horsepower motors of the highest speed gearing ever built by the General Electric Company. There is thus 500 horsepower in motors on each motor car.

A high rate of speed was not attempted on the first day's running of the trains and will not be for some time, the company wishing to assure itself that the entire system is in perfect order. The first train run over the road, left Chicago August 25th at 6:15 a. m. and reached Aurora, Ill., in one hour and 15 minutes. The distance is about 45 miles. The above time includes stops. Trains leave either end of the line 30 minutes apart and this service will be maintained until further notice. The officials of the company say that extremely high rates of speed will not be attempted for passenger service, although a schedule running time of 60 miles an hour, including stops, is looked for by them.

The road parallels the Chicago and Northwestern railroad in the service between the cities of Chicago and Aurora, and a rate war may ensue. At present the electric line charges 90 cents for the round trip, while the steam road charges $1.25 each way. The present route to Aurora is via Wheaton, which makes the trip somewhat longer than it would otherwise be. The right-of-way is private, and in places where danger from the third rail might be apprehended the track is fenced in by a six-foot woven-wire fence.

Marconi-Postal Telegraph Rates.

In a circular recently issued to the various offices of the Postal Telegraph-cable Company authority is granted for the receipt of messages for delivery to passengers on outgoing and incoming Atlantic liners fitted with the Marconi wireless-telegraph apparatus. This is made possible through an arrangement with the Marconi company, that company agreeing to transmit the Postal messages through the medium of its station at Sagaponack, L. I., to any vessel fitted with the Marconi apparatus. (This contract was noted recently in the Western Electrician.) A message of 10 words, address and signature excluded, will cost the sender $2 in addition to the regular rate to Sagaponack. All messages must be prepaid. If, for any reason, the message does not reach its destination, the amount received for transmission, less land-line tolls to Sagaponack, will be refunded.

Notification of the arrival of vessels can also be furnished those desiring such service, about five hours prior to the vessel being sighted at Fire Island. The charge for this service will be $1.50 for each report to New York, Brooklyn, N. Y., Jersey City or Hoboken, N. J. To other points the tolls on a 10-word message to Sagaponack, L. I., will be added to the $1.50 charge.

The vessels entering New York at present equipped with the Marconi apparatus are the Cunard Line steamers Lucania, Campania, Etruria and Umbria, the American liner Philadelphia, the Atlantic Transport liners Minnehaha, Minneapolis and Minnetonka, the North German Lloyd steamers Kaiser Wilhelm der Grosse and Kronprinz Wilhelm, and the French liner La Savoie.

Large Railway Power Plant in Maryland.

The Washington, Baltimore and Annapolis Electric Railway Company recently bought three acres of land in East Hyattsville, Md., upon which, it is reported, it intends to construct a large power house. Electricity is to be generated to operate the following railway lines: The Washington, Baltimore and Annapolis; the City and Suburban railway, and the Columbia railway. The building for the proposed plant, it is estimated, will cost in the neighborhood of $350,000, and will be 133 by 203 feet in size. It is believed that the plant will also furnish current for manufacturing and lighting purposes. The plant will also furnish power for the Chesapeake

Beach railway, which is to discontinue the use of steam. Construction work will be commenced the first week in September. The electrical equipment for the plant will be furnished by the Westinghouse Electric and Manufacturing Company and the engines by the Hamilton-Corliss Engine Company.

Applications of Telpherage.

Telpherage may be defined as the electrical transportation of light or divisible material to a distance. The method of applying it is an engineering problem and depends upon local conditions. It may be overhead, upon the surface or underground, but the overhead system is commonly used, principally on account of the advantage of depositing material at an elevation. Telpherage has been principally developed in this country by the United Telpherage Company of New York city, which has perfected a line of appliances suitable for a great variety of installations.

In constructing the system the track is made of cable, especially drawn, either of standard wire or lock-coil type, which latter has a strength approximating 95 per cent. that of the solid bar, or else solid rail, either of flat, girder or bulb type.

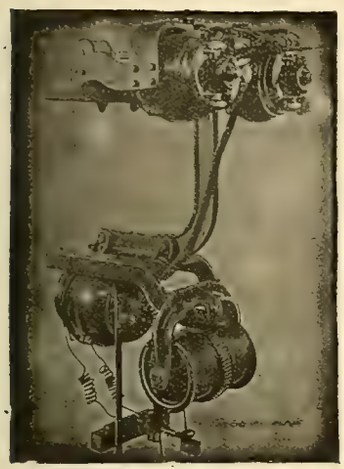


Fig. 1. Side-bearing Telpher and Hoist.

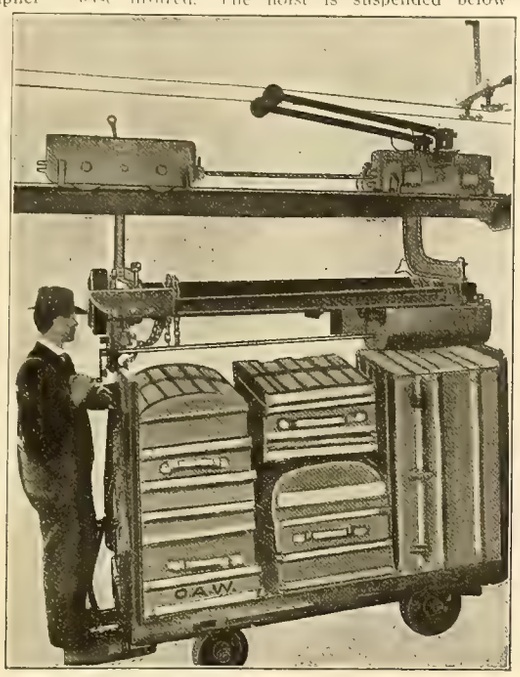


Fig. 4. Handling Trunks and Baggage.

APPLICATIONS OF TELPHERAGE.

The cable tracks are supported every hundred feet, provided it is convenient to erect poles or structures. Where there are deep ravines or between upper stories of factories, the span is made to correspond with the distance, and can be made of any reasonable length. In addition to the track cable, upon which the telpher runs, there is also what is known as the suspension cable, from which the track cable is suspended by means of hangers.

The supports are either simple poles with a bracket, or what is known as the "A" construction or ordinary cross-bents. The weights conveyed thus far by telpherage vary from 125 to 10,000 pounds, and the cost varies accordingly.

Running parallel to the track rail, either above or at the side, and depending upon the amount of head room, are stretched one or more trolley wires; one wire, if the track be used as a return. If, however, it is desired not to use the track as a return, or to use alternating current, two trolley wires are employed.

According to the construction, telphers are divided into three distinct classes, center-bearing, side-bearing and alternate-bearing. The center-bearing has two motors, one on each side of the track; the side bearing has both motors on the same side, and the alternate has one motor upon one side of the track and the other motor upon the other side, but not upon the same shaft. All the weight, in the side-bearing telpher is utilized for traction, and the load is suspended beneath the driving wheels. The frames of the telphers are made in one casting, and the driving wheels are of steel, this having been determined to be the best material.

The motors are waterproof and dustproof and are compound-wound for automatic work. When a telpherman goes with the telpher the series winding is employed. There is also used a special series coil to give greater torque when starting. The telpher be placed above the track, thereby keeping the motors from injury, while there is also no danger of their coming in contact with the carriers or being otherwise injured. The hoist is suspended below the telpher, as shown in Fig. 1, or sometimes from a trailer drawn by the telpher.

Either hand brakes or solenoid brakes are used, both of which are arranged to apply pressure to the wheels or to grip the track.

It is often advisable, where a large amount of material is to be carried, especially over one track, to use trailers. These consist generally of a two-wheeled truck, below which is suspended a bucket or other suitable form of carrier, or even the hoist, as the case may require.

In automatic lines it is necessary to provide appliances whereby it is impossible for an unskilled operator to injure the telpher. In order, therefore, to provide for contingencies, a "dead section" is placed at each end of the line, the middle of the line being generally left alive. Upon closing a spring switch, the dead section is energized so long as the operator keeps his hand on the switch, which is generally only a few seconds, during which time the telpher passes to that portion of the line which is always alive. When it reaches the other end, it comes upon the dead section, and then either slows down of its own accord, or else a mechanical or solenoid brake is applied. The telpher then passes under the reversing arrangement, and it is therefore reversed, either with no current in the line or else with a high resistance.

The surves are of solid rail and likewise the trolley track, where there is a curve, especially when it has a short radius. Wherever it is necessary to pass around a curve, take turnouts or crossovers, a resistance is inserted in the trolley circuit, so that the telpher automatically reduces its speed while it is traversing the curve or turnout or approaching a crossover switch. As soon as it reaches the other side of the curve it receives full voltage, and continues at its normal speed. In regular service the speed varies from 300 or 800 feet per minute, up to 20 miles per hour, or even more, when required. The slower speeds are used when the lines are short and where there are many curves, particularly for factory and foundry work.

It has been shown by test that the actual power consumed at six miles per hour for 1,000 pounds on a level is only 0.16 horsepower. The maintenance of telpherage lines has been shown to be exceedingly small. The flexibility is also an important feature. In one plant, about to be installed, the proposed capacity is 250 tons per hour, over a distance of one-half mile, the material being distributed over an area of about an acre.

The applications of telpherage are very numerous, and some typical applications are shown in the accompanying illustrations. Fig. 2 shows a cross-country, double-track telpher line, illustrating the "A" supports, the suspension cables and hangers. The grade at this point is five per cent. In Fig. 3 is shown a telpher conveying saws in a waterproof carrier between high buildings. In both of these installations center-bearing telphers are used. The use of a telpher and trailer for handling trunks and baggage at railway stations is illustrated in Fig. 4.

In general, the manufacturer claims that wherever material is to be carried to a distance, there is no power so flexible, so economical in first cost of installation, costing so little for power or the expense of maintenance, and with such great capacity as telpherage.

Fig. 2. Double-track Cross-country Line.

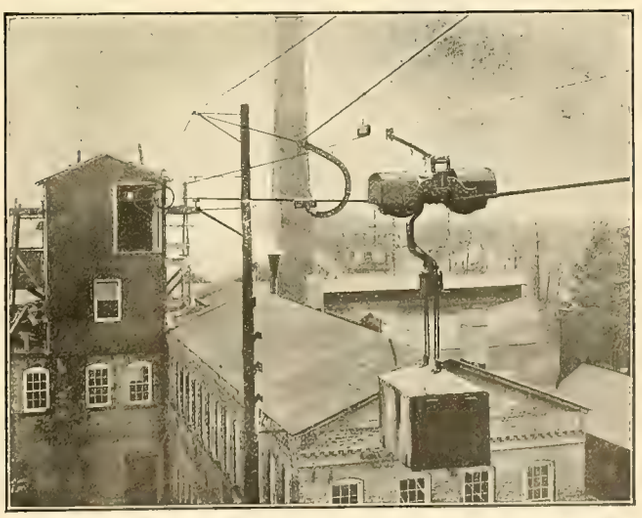


Fig. 3. Factory Installation.

APPLICATIONS OF TELPHERAGE.

Southern Colorado Street Railway Consolidation Proposed.

It is reported that a big street-railway merger is projected in Southern Colorado cities, the report having for its foundation the recent incorporation of the Colorado Springs and Interurban Railway Company. The company's capital stock is placed at $1,500,000, and the incorporators are W. S. Stratton, A. B. Sharp, William Lloyd, John McBane and Henry McAllister, Jr. The company received practically unlimited grants of power.

The first object of the company is reported to be the acquirement, by purchase, of the lines of the Colorado Springs Rapid Transit Railway Company and the Colorado Springs Suburban Railway Company, which will then be connected with new lines to be constructed in the towns of the Cripple Creek district to Pueblo, and through Cheyenne Canyon and the Garden of the Gods. The company is also authorized to purchase street railways now in operation in El Paso, Teller and Pueblo Counties. It can also acquire franchises and rights-of-way over any route selected by the directors. The motive power for the between-town lines will be electricity. The company has also the right to build telegraph and telephone lines and power plants for supplying electricity to mines. The dividends of the new company, which are payable quarterly or semi-annually, are limited to six per cent., all surplus to be invested in improvements.

The Gallipolis (Ohio) Electric Light Company has been incorporated with $10,000 capital by C. A. Clendenin and J. W. Clendenin.

CORRESPONDENCE.

New York Notes.

New York, August 23.—The Board of Health has informed the Rapid Transit Commission that the sanitary condition of the subway under construction by the commission must be improved. The contractors working on the rapid-transit tunnel are said to be entirely too careless of the inconveniences they leave for the public and of the sanitary conditions that they cause by their work. Lawsuits have been brought, in some instances, against individual contractors, on account of the unnecessary nuisances that are maintained by them. The Rapid Transit Commission, immediately on receipt of the above complaint, sent word to Chief Engineer Parsons, who will undoubtedly look after the matter.

The street-railway companies of Manhattan are to be the defendants in suits brought by the city to recover an amount in the neighborhood of $1,250,000. This sum, it is said, the city has expended in paving in and about the tracks of the various companies' roads. The money is due, according to the city officials, under Chapter 252 of the General Railroad Law of 1894, which states that the companies shall keep in repair the streets between their tracks and two feet outside of them. Under the law the city is authorized to make all repairs if a company refuses or neglects to do so.

President Cantor of the Borough of Manhattan has sent in his quarterly report to Mayor Low. In the report he states that provision has been made for a uniform system of illuminated street signs to be placed on the corners of all the principal streets, including Broadway, Madison Avenue, Twenty-third Street (East and West), and along the Boulevard. At his request, the Board of Estimate and Apportionment has authorized the expenditure of $40,000 for this purpose, and 2,126 such street signs will be erected, most of them to be illuminated from within, upon the principal thoroughfares of the city. There will be also 683 signs on electric-light poles at prominent corners and 1,443 signs placed on the lamp-posts in equally prominent positions. President Haffen of The Bronx has also issued his quarterly report, in which he states that the necessary steps have been taken for the burial of all overhead telephone and telegraph wires that are now strung over the streets of The Bronx.

Notice has been sent out to the stockholders of the Interborough Rapid Transit Company to the effect that a meeting will be held on August 26th, at the company's office in New York city, to vote on an increase of the capital stock of the company from $25,000,000 to $35,000,000. The par value of the shares is to be the same as before, $100.

On August 19th a short but severe electric storm broke over the city shortly before six o'clock in the evening. Considerable damage was done to the telephone service of the city. A fire-alarm box was struck by the lightning and an alarm sent in to which three companies responded.

The trolley-road extension from Hempstead through Elmont to Queens, all on Long Island, is rapidly approaching completion. The Long Island Electric Railway Company has extended its line from Queens to the city line, where the Hempstead company will connect on the Hempstead turnpike. About 600 feet of road has been laid daily.

On August 19th one of the heavy open street cars of the Union Railway Company of The Bronx left the tracks on Jerome Park Avenue near the crossing of Mosholu Parkway and turned completely over in a ditch. Eight people were seriously injured and one fatally. The car was going down an incline at the rate of 30 miles an hour when the accident occurred. The track at this particular spot has a bank on one side and a deep ditch on the other. Rain, which had fallen shortly before the trip of the car, had washed sand and gravel down over the rails, and it is believed this was the cause of the accident.

An electric carriage call has been installed in the Metropolitan Opera House driveway. The mechanism consists of an electric signboard which is placed above the driveway. When a carriage is wanted an usher presses its number on a switchboard, and the number is flashed up in large and bright characters on the signboard. These numbers are so large that they can be seen for blocks. This form of calling a carriage does away with all the old-time confusion.

An incorporation of Brooklyn has filed papers under the name of the Electro-Sterilizing Company. The capital is placed at $100,000. W. R. Chipman and A. S. Castner of Brooklyn are among the directors.

New England News.

Boston, Mass., August 22.—During the last year the Worcester (Mass.) Electric Light Company has declared dividends amounting to 18 per cent., including an extra dividend of 10 per cent. and the people of that city are asking why the company cannot reduce the price of municipal lighting from 30 to 25 cents per night per light of 1,600 candlepower. The company's capital stock amounts to $600,000. The last bid for the stock was $250 per share, but it did not bring out any.

The Massachusetts railroad commissioners have issued a certificate stating that the Cape Cod Street Railway Company has complied with all the requirements of the law, and the secretary of state will probably soon grant a charter.

The Exeter Manufacturing Company will establish its own electric-lighting plant at its Exeter (N. H.) plant this fall.

The Sigourney Tool Company is to rebuild its manufacturing plant at Hartford, Conn. The new building will be lighted and the machinery will be operated by electricity.

Owing to increasing business, the Norton Electrical Instrument Company is to build a new factory in Manchester, Conn., on a lot adjoining the building it now occupies.

Sargent, Conant & Co. of Boston have obtained the contract for the entire mechanical and electrical equipment of the Philadelphia plant of the Crompton & Knowles Loom Works of Worcester, Mass. The plant will be run by electric power.

The Brockton, Stoughton and Boston Street Railway Company has been organized. It proposes to build an electric railway between Avon and Milton, Mass., via Stoughton. The capital is $30,000 and the following are directors: George Monk, H. W. Britton, A. M. Bridgman, Horace E. Britton, George E. Wentworth, Horace C. Witt and Jerome F. Murphy. H. W. Britton is treasurer and A. M. Bridgman is clerk.

The Plymouth, Carver and Wareham Street Railway Company has been incorporated. It will build an electric railway between Tremont and Plymouth, Mass., via Carver, the principal cranberry-growing town in this country. The company expects to carry freight, and will get most of the cranberries shipped from Carver, which are now sent by teams to Tremont, the nearest railroad point. The company also proposes to build a road between Tremont and Amherst, via Rochester, Mass. The incorporators are Henry F. Griffith, Eugene E. Shaw, James A. Vaughan and Theodore T. Vaughan of Carver, and Charles C. Doten, James B. Collingwood and Henry O. Whiting of Plymouth. The capital is $45,000, all of which has been paid in, the town of Carver having subscribed for one-third of it. Power for the road will be obtained from the Plymouth electric station.

Judge Kingsbury of the Middlesex County (Mass.) District Court has filed his finding in the inquest into the cause of the death of John H. Harris, the motorman killed in the Marlboro (Mass.) accident on June 28th. The judge criticises the railway company for having an obscure and complicated timetable, as did the State Railroad Commission, as mentioned in last week's letter.

The Seekonk (Mass.) selectmen have granted a location in that town to the Bristol County Electric Street Railway Company. This company and the Norton and Taunton Street Railway Company have been contesting for this location. The latter company has now changed its petition so that it covers a different location, and the Seekonk selectmen will probably grant it a franchise.

The Williamstown (Mass.) selectmen have granted the Hoosac Valley Street Railway Company's petition for a franchise permitting the company to build an electric railway from Williamstown Station to the Vermont line.

The Concord, Maynard and Hudson Street Railway Company has petitioned the Stow (Mass.) selectmen for a franchise allowing the construction of an electric railway between Clark's Corner and West Acton, a portion of the proposed line between Lowell and Worcester, Mass.

It is stated that the Clinton Gas and Electric Light Company is arranging to run wires to Lancaster, Mass., in order to furnish that town with electric lights. The company will string its wires on the poles along the line of the Worcester Consolidated Street Railway Company, the two companies to own the poles jointly.

In the Superior Court, August 20th, Chief Justice Mason sent down his decision in the case of E. F. Baker versus the Boston Elevated Railway Company. The suit was a test case to determine whether the plaintiff could recover for the noise of the elevated railway, the decision holding that where property is damaged by the construction of the railway, the plaintiff has a right to recover for damages caused by the noise. If this decision is sustained by the full bench of the Supreme Court, it will materially increase the damages which the railway company will have to pay in other suits, provided the plaintiffs win their cases. Baker was awarded $2,000 by the decision, one-half of which was for the damage caused by the noise occasioned by the operation of the railway, and the decision added that the damage from noise was $100 more than if the railway were located wholly in that part of the street of which the fee is not owned by the petitioner. The plaintiff was also allowed interest from September 10, 1901, the day upon which he filed his petition. In the decision, Judge Mason says: "The court finds that the petitioner's estate has been damaged more than it has been benefited or improved in value by reason of the location, construction, maintenance and operation of the respondent's elevated railway, not including any damage resulting from the impairment of the facilities of public travel or any annoyance or discomfort to any in the use of such facilities, to the extent of $2,000." This decision affects other like suits, the damages in which will aggregate some $6,000,000.

The Massachusetts railroad commissioners have authorized the leasing of the Haverhill and Plaistow Street Railway Company's property to the Exeter, Hampton and Amesbury Street Railway Company, the latter being a New Hampshire corporation.

At an adjourned meeting, August 20th, the stockholders of the Edison Electric Illuminating Company of Boston voted to increase the capital stock from $7,850,400 to $8,635,500 and to increase the number of shares from 78,504 to 86,355. This is a little less than half the increase authorized by the Massachusetts gas and electric-light commissioners. The directors offer the 7,851 shares of new stock to the stockholders at $200 per share, at the rate of one share of new for 10 shares of old stock.

The Massachusetts railroad commissioners have granted the Worcester and Southbridge Street Railway Company's petition for authority to issue additional stock amounting to $300,000, the proceeds to be used in paying floating indebtedness incurred in constructing and equipping its electric railway. B.

Canadian Intelligence.

Ottawa, Ont., August 23.—The town electric-lighting plant of Fort William, Ont., has been found insufficient to provide the necessary light and power for the purposes of the town. A proposition is now under consideration to develop the Ecarte Rapids power. T. Pringle & Sons of Montreal estimate the cost of developing 2,000 horsepower there at $207,000.

Pig lead is now being regularly shipped from the smelter at Trail, B. C. This is the first pig lead produced on a commercial scale by electricity, and it is believed that this process will as completely replace the old fire methods in lead refining as in copper refining.

The Ontario government has authorized the construction of a cofferdam at Dufferin Islands, on the Niagara River, by the Ontario Power Company, to be used in diverting water through the park to the company's outlet below the Falls. Although the company's application has been opposed by the Canadian Niagara Power Company, which was first in the field, and has built a magnificent power tunnel, the government has decided to grant the Ontario Power Company's application, in order to stimulate competition in that district.

The expansion and development in all electric lines of business is one of the most extraordinary and encouraging phases of the trade of the city of Montreal. For instance, the Northern Electric and Manufacturing Company, which employs over 400 hands, has been forced to build an extension and increase its staff by an additional hundred men. All the companies in the city supplying electricity state that they have increased their customers by at least 15 per cent. over last year. The new electric power station of the Montreal Light, Heat and Power Company is about completed, and is already supplying current. This is said to be the most up-to-date power house on the continent, and has four of the largest transformers in the world.

The Shawinigan Water and Power Company has made a proposition to the Dominion government for lighting the channel from Montreal to Quebec. The idea is to convert the channel into a canal, practically, either bank of the river to be outlined with electric lights and the channel proper buoyed. This is probably the most comprehensive plan of channel lighting that has ever been proposed. The Shawinigan company has the necessary power already developed half way between Montreal and Quebec, and all that would be required would be the electrical installation. The details of the scheme have been laid before the government, and it is said that the general sentiment was in favor of the adoption of such a plan, but it is thought that the deepening operations in the St. Lawrence at that point will first be concluded. W.

Southern Developments.

Charlotte, N. C., August 22.—The Coweta Power Company, with $150,000 capital and the privilege of increasing to $1,000,000, has applied for a charter at Columbus, Ga. The company proposes to develop large waterpower on the Chattahoochee River, furnish light and power, and also to erect and operate manufacturing plants if desired. George J. Baldwin is one of the incorporators.

The Catawba Power Company is constructing near Fort Mill, S. C., what will be one of the largest dams in the South when completed. The estimated cost will be $1,000,000. The company expects to develop 4,800 horsepower. Two cotton mills have already contracted for power with which to run their machinery.

The Richmond (Va.) Engineering Company, James O. Spear, Jr., of Baltimore manager, has bought out the Smith-Courtney Company, electrical contractors, and will fill all contracts of the latter company. The contracts thus secured by the Engineering company aggregate about $10,000.

F. J. Butler, Greenville, Miss., has been awarded the contract for a $36,000 electric power house at Jackson, Miss., by the capitol commissioners.

It is announced, on what is claimed to be good authority, that George Gould and associates have purchased the Bay Shore Terminal Company and the Chesapeake Transit Company of Norfolk, Va.

The city of St. Louis has started a movement to build its own lighting plants at its two public institutions. The two plants will cost about $45,000.

The town of St. Francisville, La., has voted $10,000 water and electric-light bonds.

A. H. Cox, representing the Atlanta (Ga.) Elec-

tric Company, has made a proposal to the city to furnish electric power for lights, at $30 per horsepower per year, the city to own its own wires, poles, etc.

The city of Chattanooga, Tenn., will shortly advertise for bids for city lighting, the present contract expiring next month It is said, however, that a new company will enter the field as a seeker of the contract.

W. D. Mayfield and others of Columbia, S. C., have applied for a commission for the Broad River Manufacturing Company to develop waterpower on Broad River, and use the same for cotton-manufacturing purposes. The capital will be $100,000. L.

Information from Indiana.

Indianapolis, August 25.—The Richmond and Ohio Traction Company has filed articles of incorporation. The company proposes to construct and operate 30 miles of electric railway in the state. The officers are: President, C. E. Hooven; vice-president, J. C. Hooven, and secretary and treasurer, W. C. Shepard. They are Hamilton (Ohio) men.

Interest has been revived in the proposed electric road from Cincinnati to Louisville along the Indiana shore of the Ohio River. Two surveys will be made and it is said that the Westinghouse people are interested.

The directors of the Winona Assembly have voted to construct an electric railroad between Warsaw and Winona.

The Ohio and Indiana Traction Company has obtained nearly all of the necessary right-of-way, and will now push the road between Muncie and Portland to completion. A gravel pit has been purchased for $10,000. The Muncie and Portland Traction Company, recently organized and supposed to be a part of the Union Traction Company's system, is proposing to build a line over almost identically the same route, and the competition promises to be spirited.

The Fort Wayne and Southwestern Traction Company which, a week ago, began the operation of its line from Fort Wayne to Wabash, is now able to handle freight. Freight houses are being built at Fort Wayne and Wabash. The company has made important reductions in package-freight rates, and with its new equipment will be able to handle all classes of freight offered.

There was a stormy session of the Logansport council on the 21st inst., when a franchise was granted to F. C. Boyd, which gives him a monopoly of the streets and requires all interurban lines to enter the city over his lines at a 2½-cent rate per round trip. The minority of the council and the citizens generally were opposed to the grant and gave such vehement expressions as to occasion the meeting to adjourn. Mass meetings are being held and the situation is one of excitement. The people are demanding that the interurban roads be allowed to enter the city over independent lines.

The Interurban Motor Company was incorporated during the week with a capital of $5,000, and has already started regular trips with new automobiles between Garrett, Auburn and Waterloo. The company expects to take the place of the long-talked-of electric line between these points.

The citizens of Evansville are congratulating themselves upon the reorganization of the Evansville Electric Light Company, because they are now for the first time permitted to use electric lights and fans in residences. F.

On the Pacific Slope.

San Francisco, August 21.—Articles of incorporation of the Cloverdale Light and Power Company have been filed at Santa Rosa, Cal. The capital stock of the company is $100,000, of which $36,000 has been paid in. The directors are A. Sbarboro, P. C. Rossi and A. L. Sbarboro of San Francisco, and W. P. Brush and T. E. Humbert of Cloverdale. The principal place of business of the company will be at Asti, Cal., but the company will also have an office in San Francisco. The corporation is now building a dam and power house on Sulphur Creek for the purpose of generating electricity for light and power to supply Cloverdale, Asti, Geyserville and the wineries of the Italian-Swiss colony in that vicinity. The principal stockholders of the company are also large stockholders in the Italian-Swiss colony.

The Northern California Power Company has awarded a contract to the Western Electric and Manufacturing Company for two 2,000-horsepower, three-phase generators, to be installed in the new power house of the company, to be erected on Cow Creek, Shasta County.

The Little Creek Power Company has been organized at San Bernardino, Cal., with an authorized capital stock of $300,000. The directors of the company are H. P. Hayes of Riverside, S. B. Wright of Colton and C. L. Allison, John L. Campbell and W. H. Miller of San Bernardino. This company is organized for the purpose of supplying electric light and power to Riverside, Cal.

The plans for the construction of a new auxiliary power house for the Washington Water Power Company of Spokane, Wash., are now in the hands of the contractors, Johnson & Son of Spokane.

The Judson Iron Works, Emeryville, Cal., have just completed a shipment of 100 tons of structural iron to the Fanning Islands in the South Pacific. This iron is to be used in the construction of a cable station for the new transpacific cable owned by the British government. The Pacific Construction Company of San Francisco has the contract for the construction of the cable house.

The Board of Public Works of Seattle, Wash., has granted permission to the Seattle Electric Company to lay underground conduits in the business section of Seattle. In all about four miles of conduit and Edison tubing will be laid. It is estimated that the undertaking will cost in the neighborhood of $300,000. The work will be in charge of Mark Lowd, an expert sent to Seattle by Stone & Webster of Boston. It is the intention of the company to place enough ducts underground to carry the service wires for at least 40 years.

The battery to be used in the Georgetown transformer station of the Puget Sound Electric Company of Seattle, Wash., is now being installed. The battery will be used chiefly for the interurban-railway service of the company. The work is being done under the supervision of A. Adams, the company's electrical engineer.

Several weeks ago the city trustees of Alameda, Cal., invited bids for furnishing electric current to the Park Street power house, owned by the city. On August 4th the Suburban Electric Company, lessee of the Standard Electric Company, submitted a bid, offering to furnish electric current at the rate of 2¼ cents per kilowatt-hour. It now costs the city a little over four cents per thousand watts to generate its own power. When the matter was brought before the board of trustees it was referred to the judiciary committee to draw up a contract, and it is understood that the bid of the Suburban Electric Company will undoubtedly be accepted.

The Kern River Power Company of Los Angeles, Cal., let contracts last week for five, 2,000-kilowatt, three-phase generators, to the Wagner-Bullock Electric Company. The generators will be manufactured in the company's works at Cincinnati. The transformers used will be manufactured by the General Electric Company, and the exciters by the Westinghouse Electric and Manufacturing Company. The power plant of the Kern River Power Company will be located on Kern River, near Kernville, Cal., and the power will be transmitted 110 miles to Los Angeles, Cal., where it will be used by the electric railroads controlled by the Huntington-Hellman syndicate.

The San Joaquin Power Company has been incorporated at Los Angeles, Cal., with an authorized capital stock of $800,000. The directors are Otto Weiss, E. A. Beck and others.

The breaking down of a 1,000-horsepower generator in the Edison Company's power station at Los Angeles, Cal., and the burning out of a transformer in the company's station at Pomona left that town without light and power for three days.

The Condon Water and Power Company of Goldhill, Ore., has been incorporated with a capital stock of $100,000. C. R. Day, W. F. Hunter and F. S. Smith are the incorporators.

The City Council of Vancouver, Wash., has decided to loan J. R. Harvey the sum of $15,000, to be used in putting in the new electric-lighting plant. Mr. Harvey recently bought the old plant of the city, paying for it the sum of $11,000.

W. C. Watson, representing a company of San Francisco capitalists, is in Tonopah, Nevada, looking over the ground for the purpose of erecting an electric-light plant.

Northwestern Notations.

Minneapolis, Minn., August 23.—J. W. Steed has been granted a franchise at Anoka, Minn., for an electric-lighting plant.

Clintonville, Wis., has awarded contracts to Langstadt & Meyer of Appleton, Wis., for a municipal lighting plant.

The electric-light plant at Luverne, Minn., was recently damaged considerably by an electric storm which burned out the transformer, fuses, connections and meter boxes all through town.

The city of Sleepy Eye, Minn., will have to secure a new dynamo, as the present one is unequal to the demand which will be made upon it the coming winter.

There has been talk at Winona, Minn., of a second lighting company. The City Council, however, is taking steps to establish a municipal plant in connection with the waterworks station. The estimated cost of such a plant is $40,000.

The Light and Traction Company of Oskaloosa, Iowa, has secured sites for power houses and car barns for the new car line, and the contracts have been let for their erection.

An electric interurban line is projected from Marshalltown to Charles City, Iowa. The company which is now constructing a line between Clinton and Davenport, is interested in this project.

The Duluth-Superior Traction Company will make improvements to its system in Duluth, Minn., and Superior, Wis., to cost at least $225,000.

The parties who have just been granted a franchise for an electric street-car line in Fargo, N. D., and Moorhead, Minn., have made application at Grand Forks, N. D., for a similar franchise. They propose to connect with East Grand Forks, Minn., just across the river, and will construct a line at first covering about 8½ miles. R.

Among the Rockies.

Salt Lake City, August 22.—Logan, Utah, has voted $65,000 in bonds for a municipal electric-light plant.

The Caldwell (Idaho) Power Company has let a contract for the construction of a power plant in that town, by which 100 horsepower will be generated.

The Highland Valley Power Company of Idaho has started the construction of its 240-foot dam across the Boise River. Work on the dam is greatly aided by the unusually low stage of the water in the river.

Baker City, Ore., is advertising for street-lighting bids. Lamps must be in place by October 1st.

The City Council of Salt Lake City has granted franchises to the Salt Lake and Suburban Railway Company for a street railway from a point near the business center, south to the city limits. The new company must pay the city one per cent. of its gross earnings every year. The term of the franchise is 20 years.

The new plant of the Telluride Power Company, to be located in Provo Canyon, has been started. Six miles of flume will at once be built, to convey water to the proposed 8,000-horsepower plant. The flume will be six by eight feet and will require 2,000,000 feet of lumber. The entire plant, when completed, will cost $500,000.

Engineer Hayward of the Utah Light and Power Company of Salt Lake City has been inspecting the waters of the Big Cottonwood Canyon, with the prospect of building a large power plant for the Great Western Mining Company, which has mines in the canyon. It is understood that the plant will be built in the coming spring.

The Denver (Colo.) Tramway Company has asked for franchises to extend its lines 19 miles.

A. W. C.

PERSONAL.

A. B. Coryell, well known to southern electrical men, has been appointed general manager of the Huntsville (Ala.) Railway, Light and Power Company.

In a recent advertisement the Wireless Telephone Company of America states that Nathan Stubblefield and Professor A. Frederick Collins are now working together for the sole benefit of that company.

H. S. Johnson, who one year ago succeeded George B. Kerper as general manager of the People's Railway Company in Dayton, Ohio, has resigned, to accept a position in Buffalo, N. Y.

C. O. Baker, Jr., of Baker & Co., platinum refiners of Newark, N. J., has been appointed a member of the board of directors of the National State Bank of Newark, one of the strongest financial institutions of New Jersey.

M. Rocheford, the inventor of one of the systems of wireless telegraphy now being tested by the United States Navy Department, recently arrived in Washington from France. He brought some additional apparatus which he is to submit for test purposes.

On Mr. Marconi's recent visit to Russia on the Italian boat Carlo Alberto he was visited by the czar, who inspected the wireless-telegraph equipment installed on the boat and commended the work of the inventor. Before leaving Russia the czar decorated Mr. Marconi with the Order of St. Anne.

Belvidere Brooks, general superintendent of the eastern division of the Western Union Telegraph Company, has also been appointed general superintendent of the southern division of the same company, in place of James Merrihew, who has resigned. Mr. Brooks takes up his new duties September 1st.

C. E. Page, for many years Cincinnati manager for the Western Union Telegraph Company, has succeeded Thomas Roche as superintendent of the eastern district of the same company. Mr. Roche has held this position since the consolidation of the American Union and Western Union companies, in April, 1881.

George F. McCulloch, president and general manager of the Union Traction Company of Indiana, Anderson, Ind., accompanied by his wife, left for Europe on August 21st. Mrs. McCulloch has been ill in a Baltimore (Md.) hospital most of the summer. After their return they will reside in Indianapolis, Ind.

Mr. Ralph D. Smith, general manager of the Hoosick Falls (N. Y.) Electric Company, is spending his vacation in the West, principally in Waukegan, Ill. Mr. Smith reports that the demand for light and power is increasing in his home town and that it has been necessary to install much new machinery to meet it.

Daniel M. Lamb died at the Boston City Hospital, Boston, Mass., August 17th, after an illness lasting about four weeks. He was a well-known inventor. When taken sick he was working on a magnetic battery, designed to produce light, heat and motive power. He was born in New Jersey in 1824, but had lived in Boston for 17 years. He left one daughter.

William R. Gaston, chairman of the board of directors of the Boston Elevated Railway Company,

is seeking the Massachusetts Democratic gubernatorial nomination, for this fall's campaign. His opponents in the party argue that his connection with the big railway corporation will greatly interfere with his election, if nominated. His father was governor of the state in 1875.

ELECTRIC LIGHTING.

The council of Troy, Ill., has passed an ordinance authorizing a $3,500 bond issue, to improve the electric-light plant.

The Lampasas (Texas) Light and Power Company has been incorporated with $10,000 capital stock by B. F. Barnes, F. J. Harris and G. D. Stokes.

Eagle River, Wis., has granted D. E. Riordan a franchise extending 15 years, giving him the right to construct and operate an electric-light plant in the village.

The National Light, Heat and Power Company at Pierre, S. D., has been incorporated with $5,000,000 capital stock. W. T. Croslen and J. W. Boyd are the incorporators.

H. Clay Tunis is furthering the plans for the construction of a 5,000-horsepower electric plant in the vicinity of the Tunis Lumber Company's planing and saw mills at Berkley, Va.

The Merchants' Protective Association has organized an electric-light company with a capital of $75,000 to afford competition in commercial and city lighting in Mankato, Minn.

A resolution has been passed by the Logan (Utah) City Council to offer for sale the $65,000 of city bonds recently voted by the people to put in a municipal electric-lighting plant.

The Clyde (N. Y.) Electric and Power Company has gone out of business. This action is partially due to the successful competition of the Wayne County (N. Y.) Electric Company.

The Pioneer Electric Lighting, Heating and Power Company of Marseilles, Ill., has been granted a license to incorporate, with $25,000 capital stock. The incorporators are J. E. Bond, J. A. Kelso and R. F. Knott.

The new power house of the Wheeling Traction Company is to be built in Brilliant, Ohio, and will cost $175,000. Plans have been prepared for the new power house. General Manager Flynn may be addressed.

The Shadyside Electric Company (Pittsburg, Pa.) has asked for a charter granting the right to organize a company for the purpose of furnishing light, heat and power to the East End. H. W. Rowe is interested.

The Richmond (N. Y.) Light Company has been incorporated with a capital of $3,000,000. Electricity is to be furnished for light, heat and power purposes. Among the directors are A. Corliss and J. Bannan of Brooklyn, N. Y.

The Coshocton Light and Heating Company has been incorporated at East Orange, N. J., with $250,000 capital stock. The incorporators are W. A. Himebaugh, J. D. Severns and T. L. Montgomery of Coshocton, Ohio.

A company composed of Waxahachie (Texas) business men will purchase the electric-light plant at Hillsboro, Texas. The new company has a capital stock of $50,000, M. B. Templeton, W. C. Ross and U. T. Buckner being interested.

The village council of Plainview (Minn.) has granted a 12-year franchise to a local company to install and conduct an electric-light plant. The company has purchased the discarded plant at Durand, Wis., and expects to have the town lighted by October 1st.

The work of remodeling the plant of the Fond du Lac (Wis.) Street Railway and Light Company into one that will adequately meet the needs of the city, is progressing as rapidly as the necessary machinery can be secured and placed in position. President Grover can be addressed.

The plant and property of the Dallas (Texas) Electric Company has been sold at a United States receiver's sale for $300,000 to representatives of the old Dallas Electric Light and Power Company. The purchasers are Boston capitalists. The property is worth upward of $1,000,000.

The Jamestown (N. Y.) Electric Light and Power Company has been sold at mortgage sale to William Whitney of Boston for $10,000. Mr. Whitney represents the bondholders. What will be done with the plant is not known. The mortgage amounted to $46,000 and accrued interest.

The proposition made by the Crystal Falls (Mich.) Board of Public Works to C. A. Weeks & Co. of Chicago, that it take the contract to install a complete electric-lighting and water-power plant for the sum of $15,000, and which was accpeted by that firm, has been approved by the City Council.

The People's Light and Power Company has been incorporated with a capital of $100,000 in Norfolk, Va., and has asked the City Council for a 30-year franchise to operate an electric-lighting and power plant in the city. This concern comes into the field with the purpose of opposing the consolidated companies in the city operated by the Williams syndicate of Richmond, Va. This is the second company formed within a year with the above-mentioned purpose in view. The first company was absorbed by the syndicate some time ago. John G. Tilton, city attorney, is president of the new company.

The Houghton County Street Railway Company and the Peninsular Electric Light and Power Company of Houghton, Mich., have combined to form the Houghton County Electric Light Company. The new company was incorporated with a capital stock of $1,300,000, the greater part of which is held by Lawrence A. Ford of Beverly, Mass. The company will have its head office in Boston, Mass.

It is reported that a Chicago-Cincinnati syndicate has purchased the plant of the Belleville (Ill.) Gas, Electric Light and Coke Company. The price paid for the property is said to have been $300,000, which is twice the par value of the stock. The purchasers assume all the liabilities of the old company. Representatives of the syndicate have given out the information that the new company intends to connect Belleville and East St. Louis by an electric power and light line. The two towns are 15 miles apart. The Chicago men interested are W. N. Horner and H. M. Byllesby. Cincinnati is represented by Rudolph Kleibelt & Co.; Belleville by Turner & Header, and East St. Louis by Stephens, Turner & Foreman.

From July 20th to August 18th central-station companies from the following-named cities joined the National Electric Light Association: Akron and Leipsic, Ohio; Bellevue, Danville, Lynchburg and Waynesboro, Pa.; Canon City, Colo.; Dixon, Ill.; Ionia, Mich.; Kenosha and Rhinelander, Wis.; Lyons, Niagara Falls, Potsdam and Richfield Springs, N. Y.; Pocatello, Idaho, and Stockton, Cal. From now to January 1st all companies can join the association by paying the annual dues only, without any entrance fee, and the remarkable increase of membership since the Cincinnati meeting shows that this rule is appreciated. A list of active members of the association on August 1st has been issued in pamphlet form. The names are conveniently arranged in alphabetical order, both as to states and cities.

ELECTRIC RAILWAYS.

The British government is preparing to send Colonel H. A. Yorke to the United States in September to report on the working of American railways, both steam and electric.

A fast run was recently made by an electric car belonging to the Lake Shore Electric Railway Company, on a straight stretch of track, 17.4 miles in length, lying between Toledo, Ohio, and Munroe, Mich. The distance was covered, it is said, in 17 minutes.

The Amsterdam United States consul, F. D. Hill, makes a statement that the Amsterdam council has voted a loan of $3,778,800 for the building of a plant to furnish electricity for power and light, and for changing the car service to electric traction. The machinery for the plant will be furnished by German and Dutch manufacturers.

Eastern capitalists, through John O. Zabel of Monroe County, Mich., are considering a proposition to build and operate an electric railway connecting Ann Arbor, Milan, Dundee and Monroe, in Michigan, and Toledo, in Ohio. The survey work is all finished excepting in one township, through which right-of-way is for the time denied.

It is reported that a company will be formed of Denver and eastern capitalists to build a network of electric railways in the northern part of New Mexico, making Las Vegas a center. The company proposes to tap the different steam railroads within a radius of 100 miles with the new interurban roads, doing a freight as well as passenger business.

As a result of a systematic "crusade" against the Chicago Consolidated Traction Company, the citizens of Austin, Ill., from now on, will ride from that suburb into the center of Chicago for one five-cent fare, instead of two, as was heretofore the case. The suburbanites have been struggling to secure this grant from the company for the last six months.

It is reported that a combination of American traction millionaires, which includes the Widener-Elkins-Dolan-Brady-Flower people, has been for some time working on a tentative scheme for organizing the foreign rapid-transit field, but that it will not do so until the psychological moment arrives. That will be when the combination has secured from a foreign government franchises or concessions valuable enough to insure a profit in the undertaking.

At a recent meeting of the directors of the Chicago Union Traction Company it was voted to have built 75 new large-sized modern cars, and it is probable 100 more will be ordered in a short time. General improvements in tracks and roadbeds were ordered to keep pace with the local improvement work done by the city. On the whole, a comprehensive betterment of the physical condition of the property was decided on, to be carried on as fast as possible.

Regular through service between Cleveland and Toledo, Ohio, via the Lake Shore Electric Railway Company's line, was recently established. A two-hour service will be maintained during the day, commencing at five o'clock in the morning and lasting until 6:30 p. m. The through running time will at first be about six hours, but later on this, it is said, will be cut to less than five hours. Eventually, it is expected to run cars from Cleveland through to Detroit, the arrangement from Toledo to Detroit being now under consideration.

POWER TRANSMISSION.

The Washington Power Company of Spokane, Wash., will furnish power for the Lewiston (Idaho) water system at 1½ cents per kilowatt-hour.

The Reading (Pa.) Power Company has been incorporated with a capital of $1,000,000. Among those interested are R. N. Carson and H. C. Moore of Philadelphia.

The Beechel Electric Power and Irrigation Company of Cuero, Texas, has increased its capacity by adding four new turbines to the waterpower. A steam plant has also been added.

The Whittier (Cal.) Gas, Fuel and Electric Power Company has been incorporated with a capital of $50,000 by J. C. Hiatt, A. M. Louden, J. H. Spires, W. T. Hallingsworth and W. M. Hiatt.

A large power-transmission scheme is projected in Victoria (Australia). It is that of working the extensive mines of the Walhalla district by an electric plant, to be located at Mormon Town, on the Thomson River. This river, having an excellent fall and permanent water supply, is well adapted for such a development.

It is reported that the Standard Electric Company, San Francisco, Cal., is negotiating for the purchase of the following companies: Central Light and Power Company, capitalized at $700,000; Equitable Gas Company, capitalized at $5,000,000, and the Mutual Electric Company, capitalized at $500,000. The Standard Electric Company has just completed a power line into San Francisco, via San Jose, from Tuolumne County, where its plant is located. This company is also incorporated in San Jose.

G. L. Beech and W. W. Fairbanks have closed a deal with Waters, Rogers and Christian, representing New York and Chicago capitalists, for the transfer to them of their rights in the waterpower at the Horseshoe Falls on Caney Fork River, about 13 miles from McMinnville, Tenn. The purchasers will at once organize a corporation to utilize this large waterpower, which is estimated at 20,000 horsepower, and will transmit electricity to Nashville and intermediate points, to be utilized for lighting, heating, etc.

The foundation work on a new power plant to be the property of the Virginia Passenger and Power Company, has been commenced. The plant is located in Dunwiddie County, Va., on the Nottoway River. The plant will cost in the neighborhood of $100,000, and it will have the advantage of an immense waterpower furnished by a bed of water, 40 feet wide, six feet deep, with a fall of several feet. The plant will be able to furnish electricity for all the light and power needed in Petersburg and the surrounding country.

A recent cable dispatch from Paris stated that a prominent electrical concern of that city which is closely connected with the General Electric Company of New York is now securing all the waterpower available in the department of the Alpes Maritimes, with the object of supplying light and power to towns on the southeastern coast of France. The company also hopes to supply power for the electric locomotives which the Paris-Lyons-Mediterranean railway proposes to test on the Cannes-Monaco railway during the winter.

The new electrical power plant which is to be located in South Boise, Idaho, 1¾ miles from the business center, will have a capacity of 400 to 700 horsepower and cost about $40,000. The equipment comprises two double Leffel turbines, each connected to two lighting and power generators of the Fort Wayne and Westinghouse types. A Lombard governor will be used for controlling the water. The building is about 40 by 70 feet in size. With a reduction in the price of lighting, it is conservatively estimated that the increase in consumption will be about 40 per cent. At present about four miles of pole line is completed. Several carloads of poles have been ordered, and the company hopes soon to have 10 miles of work finished.

A large power company has been formed in England under the name of the South Wales Power Distribution Company, to operate in the mining districts of Wales and the surrounding manufacturing country. Power will be transmitted to the mines and factories on transmission lines at 12,000 volts and will be transformed down to suit requirements. The company's plant will be built on the Taff River at Pontypridd in Wales. It will have five direct-connected units of 2,250 kilowatts' capacity each. The dynamos will be built by Ganz & Co. of Budapest, the engines by Williams & Robinson. The boilers are of the Niclausse type (water-tube), of which there will be 24 in all. The present plant of 12,000 horsepower will be increased to 75,000 horsepower, if the need develops.

SOCIETIES AND SCHOOLS.

Technology Chambers, the new dormitory of the Massachusetts Institute of Technology, Boston, Mass., is practically completed and will be ready for occupancy within a month. This building is along the line of President Pritchett's plan to strengthen the social side of student life at the Institute.

A new mechanical and electrical-engineering building has just been completed for the Leland Stanford University at Palo Alto, Cal. About $50,000 worth of machinery has been purchased and will be installed at once. The old mechanical-engineering building is being turned into machine shops for the use of all departments of engineering, and machinery to the amount of $100,000 is to be installed in it.

The Engineer and Iron Trades Advertiser of Glasgow is authority for the following: "Manchester is the site selected for the next 'World's Fair.' It is proposed to open in May, 1903. As planned, the exhibits will consist of the world's work up to date in the way of machinery, textiles, scientific research, photography, electricity, education, agriculture, aerial navigation, and the fine arts. The exhibition will be distinctly international in character."

Two new buildings are being erected for the School of Technology at Stetson University, DeLand, Fla., and will be finished in time for the fall opening of school. One of these is Science Hall, a three-story brick building, 200 by 80 feet, containing offices, lecture and class-rooms, laboratories and workshops for the various departments of the engineering school. The other is a power house, containing the necessary apparatus for furnishing electric power to the shops and laboratories in Science Hall. All machines in the shops will be run by motors, thereby doing away with shafting.

PUBLICATIONS.

The excellent presidential address of Henry L. Doherty, delivered at the convention of the National Electric Light Association, held in Cincinnati, last May, has been issued in pamphlet form by the association, which has an office at 136 Liberty Street, New York.

MISCELLANEOUS.

The capitol commissioners at Jackson, Miss., have awarded the contract for the electrical power house to F. J. Butler of Greenville, Miss., for $36,020.

There were 1,565 patents taken out in 1900 for electrical inventions in Germany. For telegraphs and telephones the patents numbered 283; for primary batteries and accumulators, 208; thermopiles, cables and distributing system, 368; motors and distribution accessories, 199; meters, etc., 149; lighting, 250; auxiliary apparatus, 58; heating and cooking, 50.

An American living in Brazil reports the discovery of a substitute for rubber. He says that he has found a tree growing near Para and for thousands of miles along the Amazon, called the balata, the sap of which will produce a gum which will rival rubber in the world's markets. The natives were entirely ignorant of the tree's possessing any especial features.

A recent United States consular report gives the following statement of the production of copper and platinum in British Columbia in 1901: The copper production was 27,603,746 pounds of fine copper, valued at $4,446,674, an increase of 17,606,666 pounds and of $2,831,674 in value over that of the previous year. Platinum in an amount worth $457 was produced from the Similkameen district.

William T. Benallack, electrical inspector for the Michigan Inspection Bureau, has been going over the wiring and other work of the municipal and the Negaunee and Ishpeming Street Railway and Electric Company's plants. He found the work up to standard and says that the general conditions over the entire state of Michigan are improving, and better than he had anticipated finding.

The instructions of the Treasury Department of February 19th last, establishing a rate for allowance of drawback on aerial and underground telephone cables, have been extended, as far as applicable, to cover electric cables used in the transmission of power, sound, or for lighting purposes, manufactured by the General Electric Company of Schenectady, N. Y., in the manufacture of which no other than imported lead has been used.

In the construction of a municipal electric generating plant for Geneva, Ill., the engineers found themselves confronted with a great difficulty in the constantly varying water level of the River Rhone. In order to overcome this inconstancy of the water supply, a two-story station was constructed, with two sets of turbines, built one above the other. The plant uses 18 of these turbines. Its total capacity is 18,000 horsepower.

It is said that a company is to be organized in Baltimore, Md., to manufacture a fuel of which the basis is ordinary street dirt. Dr. Jacob Melling, a chemist, is the reputed inventor of the process. It is said that the efficiency of the new fuel would be mainly due to the chemical compounds used in its manufacture and carried by the dirt or earth. According to the story, the residuum after combustion may be used again and again in repeated manufacture.

Charles Nordmann, in recent experiments, made on Mont Blanc, at a point 9,570 feet above sea level and with the best apparatus available, obtained data from which he says he can positively state that the sun emits no electromagnetic waves which can be propagated along a wire to operate a coherer. At least he says it is impossible to cause any action upon a coherer by waves from the sun. He believes that, if the sun does give off such waves, the earth's atmosphere absorbs them.

A neat bit of electrical wiring was recently accomplished by F. M. McKee, electrician in the shops of the Chicago and Alton Railway Company at Bloomington, Ill. Mr. McKee, by a system of trolleys and cables, so wired a traveling crane that the operator could remain on the ground and still have as perfect control of the crane as if he were in the cab. The cause for the change was due to the height of the crane cab or box above the workmen. This was so great that speech was of little value, signs being made to the crane operator whenever the crane was needed. Now the operator is where he can see the needs for the crane and carry them out most expeditiously.

TRADE NEWS.

John A. Walker, vice-president, treasurer and general manager of the Joseph Dixon Crucible Company, Jersey City, N. J., has returned from a five weeks' business trip in Europe.

R. H. Leavitt of Capron, Ill., dealer in poles and cross-arms, finds that his trade is extending to foreign countries. He has just received an order for cross-arms and pins from Nuremberg, Germany.

The Jessop Steel Company of England is building a large steel plant at Washington, Pa., in which electrical power distribution will be employed. The company has recently purchased a considerable amount of direct-current apparatus from the Westinghouse Electric and Manufacturing Company.

William J. Martin of the mechanical department of the George A. Fuller Company, 137 Broadway, New York city, wishes to receive catalogues of every description for office files, reference and ordering. This concern is the largest in the world as a builder and operator of real estate, and its necessities of all kinds are very great.

Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until September 3d, on the installation of a conduit and electric-wiring system in the Hygienic Laboratory, United States Marine Hospital Service, Washington, D. C. Plans and specifications for the above work may be obtained at the office of the supervising architect, at his discretion.

American electrical apparatus is making remarkable progress in European markets. The Société Anonyme Westinghouse has found it necessary on account of the great number of orders to make extensive additions to its plant, which has been in operation for only five years. This plant is located at Havre, France, and supplies the territory included in Holland, Belgium, Italy, Switzerland, Spain, France, and their colonies and protectorates.

Edward R. Taylor, manufacturing chemist of Penn Yan, N. Y., is the patentee of an electric furnace, described in the Western Electrician of August 16th. He states that he has made 3,000,000 pounds of bisulphide of carbon in his furnace, and adds that nothing can exceed the ease and satisfaction of its operation, the furnace operating continuously for months at a time without cooling off or giving a particle of trouble. Mr. Taylor described his furnace at the recent convention of the American Electrochemical Society. The product of the furnace is marketed by the Taylor Chemical Company, Penn Yan, of which Mr. Taylor is president.

It is stated that the General Electric Company has instituted suit against the United States Incandescent Lamp Company of St. Louis, Mo., of which Hugh Ferguson is president, and J. M. Davey, secretary, asking an accounting for profits derived from the use of the Malignani patent (No. 03) for a process of exhausting incandescent lamps, and also asking a perpetual injunction against the United States company upon the further use of the patent. The statement has been made that this important move on the part of the General Electric Company against users of what is known as the chemical exhaust process forecasts a new and vigorous campaign on the part of the complainant company against lamp manufacturers who would to-day be practically unable to make a modern incandescent lamp without the use of this process.

The Chinese-American Commercial Company was recently incorporated in San Francisco by P. E. Bowles, Henry F. Fortmann, Rudolph Spreckels, Ho Yow, Chinese consul-general at San Francisco, and several other well-known capitalists. The company is capitalized at $1,000,000, and purposes to develop business and trade between the two nations. It will establish commercial museums for the exhibition of American manufactures and products all over China, and will do the same in the United States for Chinese products. The company will be alive to all contracts which may be let in China for railroads, shipbuilding, mining, electrical plants, telephone systems and the like. The market will be opened and developed likewise for machinery, lumber and implements of all kinds. The principal offices of the company in the United States will be in San Francisco, Chicago and New York.

BUSINESS.

The Scientific Exchange of Chicago reports that through its agency George D. Duncan, an electrical and mechanical engineer, has just been appointed superintendent of the Home Electric Light and Steam Heating Company of Tyrone, Pa., with G. H. Gneiss as assistant superintendent. Both gentlemen left Chicago last week to take up their work.

The Pittsburg Gage and Supply Company of Pittsburg is furnishing two 125-horsepower boilers to the Cadiz Electric Light and Power Company of Cadiz, Ohio, besides giving its power plant a general overhauling. The Pittsburg company is also furnishing the Sleepy Eye Milling Company of Sleepy Eye, Minn., with a complete oil-filtering system.

The Mica Insulator Company of New York city and Schenectady, N. Y., announces that it is making an addition to its plant which will increase its output 50 per cent., and enable it to fill all orders very promptly. The company was led to take this step in order to meet the increasing demands of the trade for its well-known specialties, Micanite goods, Empire goods, and M. I. C. compound.

To meet the demand for a lamp in which the end candlepower is of the first importance, such as in sign work, the Electric Appliance Company of Chicago is now supplying what it calls its multiple-burning sign lamp. The lamps are furnished in 4.6 and eight-candlepower for 45 to 130 volts, with any standard base fitted. All bases are porcelain insulated and are attached with a waterproof cement.

The Western Electrical Supply Company of St. Louis reports that it has been unusually successful with Browning small motors and generators, for which it is general sales agent. These machines are made in sizes from one-fortieth to 10 horsepower and one-eighth to 8½ kilowatts. The workmanship and material in these machines is of the best, and they are sold under the strongest guarantee. This apparatus is especially designed to be used where a high-grade, strong and compact motor is necessary, and is adapted for all small power works, manufacturers, jewelers, hotels, clubs, restaurants, or small lighting plants.

The Standard Pole and Tie Company of 44 Broad Street, New York city, announces that it has recently opened another cross-arm mill in the South. The company has a large stock of standard arms already milled and its facilities for turning out arms according to special specifications are excellent. All arms are carefully inspected before shipment is made and even the smallest defect is deemed sufficient reason why the arm should not be shipped. Among the company's regular customers for cross-arms are the General Electric Company, Central New York Telephone and Telegraph Company, Empire State Telephone and Telegraph Company, Hudson River Telephone Company, and Diamond Electric Company of Philadelphia.

The Chicago and Alton Railway Company has established an employment bureau, the purpose of which is to recruit employes from among the people living along the line of the Alton road. The head of the bureau meets citizens living in towns upon and adjacent to the line, for the purpose of getting in touch with young men of good habits and high character who would like to become employes. Students in telegraph offices, clerks in various departments, operators, brakemen, firemen, etc., are recruited from persons whose record is kept by the bureau, the selections being made from those who are best suited and qualified after having passed mental and physical examinations which have been made a part of the requirements for employment by the Chicago and Alton Railway Company

The Triumph Electric Company of Cincinnati, Ohio, says that it is extremely busy, in fact, more so than it has ever been. The following is a partial list of its recent and most important orders: The Krell-French Piano Company, Newcastle, Ind., one 200-kilowatt generator and 56 motors, aggregating 520 horsepower; Wooster University, Wooster, Ohio, two 100-kilowatt and one 50-kilowatt generators; Kanawha Valley Traction Company, Charleston, W. Va., two 125-kilowatt generators; Nordberg Manufacturing Company, Milwaukee, Wis., one 100-kilowatt and a 60-kilowatt belted generator; the Globe Wernicke Company, Cincinnati, two 200-kilowatt belted generators and 27 motors, aggregating 910 horsepower, in motors; Water Works and Electric Light Company, Norwood, Ohio, two 100-kilowatt generators; Gardner Electric Light and Power Company, Gardner, Mass., one 50-kilowatt generator; James H. Curran Elevator Company, Cincinnati, 21 elevator motors; W. P. Callahan & Co., Dayton, Ohio, 15 lighting machines, of 7½ to 10 kilowatts capacity; Buckeye Iron and Brass Works, Dayton, Ohio, 12 machines of 7½ to 12½ kilowatts capacity; Charter Oak Stove and Range Company, St. Louis, Mo., one 100-kilowatt generator, seven motors, aggregating 125 horsepower.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 19, 1902.

707,075. Combined Overhead and Underground Electric Railway. Daniel S. Bergin, Chicago, Ill. Application filed February 10, 1902.

The system combines an overhead collector, a conduit having outgoing and return conductors therein, removable underground contact members for separately engaging the underground conductors, and a conductor running from the positive member of the underground contact to an engaging member on top of the car. There are also provided means for connecting the overhead collector with the engaging member, and means for permanently connecting the overhead collector with a motor, the terminal of which is electrically connected to the negative member of the contact element. The terminal is also connected with the track-rails, and with a switch for cutting out the latter.

707,099. Incandescent Electric Lamp. Edgar S. Gardner, Boston, Mass., assignor to the Bernstein Electric Manufacturing Company, Portland, Maine. Application filed July 22, 1901.

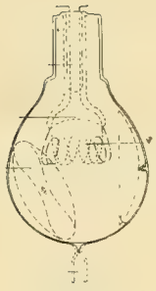
An improved incandescent lamp makes use of a reflector inserted into the bulb before the neck is sealed and secured to the inside of the bulb and opposite the filament. (See cut.)

707,150. System of Electrical Distribution. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 6, 1902.

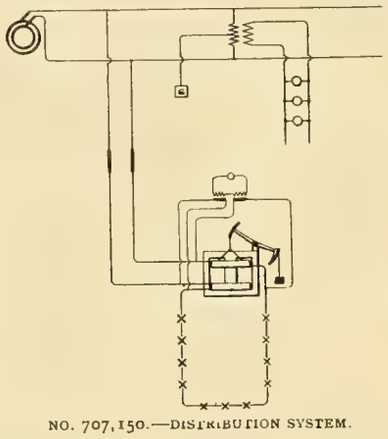
The system combines constant-potential mains, leads extending therefrom, a reactive coil having windings in series with the leads, and translating devices connected in circuit between the windings. (See cut.)

707,180. Selector for Railway Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, Buffalo, N. Y. Application filed November 10, 1900.

The selector combines with an operating circuit a counterweight lever, signal levers and magnets in number corresponding to and in operation actuating the signals, mechanism for engaging the counterweight lever with any one of the signal levers actuated by the magnets, and means for closing any one of the magnets in the motor circuit.



NO. 707,099.—INCANDESCENT LAMP.



NO. 707,150.—DISTRIBUTION SYSTEM.

707,181. Railway Switching and Signal Interlocking Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, Buffalo, N. Y. Application filed November 10, 1900.

The apparatus combines an electric switch and a lever bar actuating the same pivoted to the switch, and a bar pivoted to the lever bar. Means provided for engaging the bars and for throwing them in and out of engagement consist of a solenoid and an armature actuated thereby. (See cut.)

707,182. Railway Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, Buffalo, N. Y. Application filed November 10, 1900.

A semaphore signal electrically operated is described.

707,194. Electric Rheostat or Heater. Henry P. Ball, Brooklyn, N. Y., assignor to H. Ward Leonard, Bronxville, N. Y. Application filed November 2, 1896.

The rheostat is made up of a metallic support comprising two plates having irregular outer surfaces and grooved inner surfaces, a layer of insulating material in the grooves, and a separate resistance step in each groove. The edge of one plate projects beyond that of the other to expose the ends of the resistances.

707,222. Automatic Line Catch for Trolley Wires. George R. Floyd, Cincinnati, Ohio. Application filed December 31, 1901.

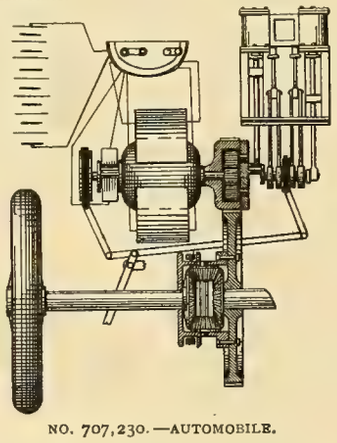
The inventor describes an automatic safety device consisting of a supplemental wire or rod, connected to the trolley wire at opposite sides of and beyond a point of probable breakage by suitable holding-ears, the wire having a limited longitudinal movement in the ears.

707,226. Electric Block System for Railway Trains. James T. Hambay, New York, N. Y. Application filed March 15, 1902.

An electric block-signal system is made up of a normally open signal circuit completed through contacts on the locomotive whenever and so long as the latter is on the block. It has branch circuit connections including a safety signal and a caution or danger signal, both of which are on the locomotive and in convenient proximity to the engineer. Means are also provided for controlling the system from a conveniently located tower.

707,230. Automobile. John C. Henry, Denver, Colo.; Susie A. Henry, executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Application filed April 1, 1901.

An electrically driven automobile is described. (See cut.)



NO. 707,230.—AUTOMOBILE.

707,244. Resistance for Rheostats, Electric Heaters, etc. Harry W. Leonard, Bronxville, N. Y. Application filed August 26, 1901.

The resistance comprises a metallic electrical conductor in the form of a ribbon arranged edgewise under tension around an insulating surface capable of withstanding heat. (See cut.)

707,266. Wave-detecting Device. Harry Shoemaker and Greenleaf W. Pickard, Philadelphia, Pa., assignors to the American Wireless Telephone and Telegraph Company. Application filed June 2, 1902.

The device comprises carbon terminals bridged by metallic needles.

707,299. Machine for molding Incandescent-lamp Sockets. Charles A. Chase, Chicago, Ill. Application filed March 20, 1902.

The machine combines a mold-shell with two dies which approach each other within the shell, one of the dies being duplex and containing parts. One of the parts reciprocates and rotates while the other reciprocates but does not rotate.

707,300. Controller for Electric Motors. William H. Chapman, Portland, Maine. Application filed March 12, 1902.

The controller combines with the armature a pair of differential rheostats, each terminal of each rheostat being connected with one armature terminal, and a rheostat-arm for each rheostat with means for operating the arms in unison with each other.

707,305. Electric Signal for Elevators. Lewis K. Curlett, Chicago, Ill., assignor of one-half to William D. Allen, Chicago, Ill. Application filed November 7, 1901.

The mechanism is composed of an electrically operated signal carried by the car, and car-actuated contact devices to operate the signal when the floor of the car is flush with a floor of the building.

707,306. Method of Electro-depositing Metal on Lace. John A. Daly, Washington, D. C. Application filed October 15, 1901.

The method consists in preparing the surface of the flexible article to be coated with an electrical conductor, then binding the article to an open-work metallic base by coils of wire having metallic connection with the base, and immersing the whole in a plating tank for a primary deposit, afterwards removing the wire and base and completing the deposit in the usual manner.

707,312. Automatic Circuit-closer for Telegraph Keys. John E. Folsom, Mitchell, Ill. Application filed August 29, 1901.

The circuit-closer combines with a telegraph key, binding posts mounted upon and extending from the key lever, a circuit-closing lever pivotally connected to the binding posts, and a spring in position to operate the circuit-closing lever. A set-screw in the forward end of the circuit-closing lever makes the contact and closes the circuit, and a button carried on the rear end of the circuit-closing lever is in position to be engaged by the operator when he operates the keys.

707,338. Trolley. Perry E. Loree, Dayton, Ohio. Application filed March 31, 1902.

A trolley wheel and pole for an electric car is described.

707,339. Trolley Lubricator. Perry E. Loree, Dayton, Ohio. Application filed May 31, 1902.

A lubricator for trolley wheels is described.

707,363. Galvanic Battery. Eason L. Slocum, Pawtucket, R. I. Application filed July 1, 1901. Renewed July 23, 1902.

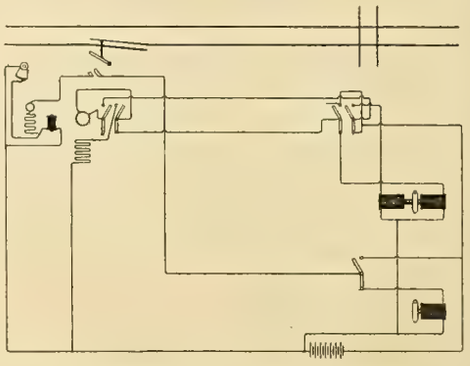
The battery employs a carbon or negative element made in four divisions, each division having in cross-section the form of a letter W forming ribs on both the outside and inside of the carbon, and zinc elements held in the spaces between the divisions.

707,372. Electrochemical Generator. Harry S. Amwake, Camden, N. J., assignor to Charles H. Graham and George D. Bouton, Philadelphia, Pa. Application filed June 13, 1902.

A fluid cell containing electrodes, an electrolyte and current baffles is described.

707,383. Electric Arc Lamp. Clifton L. Bundy, Philadelphia, Pa., assignor to himself and Albert H. Manwaring, Philadelphia, Pa. Application filed February 12, 1902.

The lamp combines magnets supported at one end by connections entering their cores, and means for varying the voltage of the arc, the means serving to vary the distance between the cores of the magnets at the free ends of the same.



NO. 707,181.—RAILWAY SIGNALING APPARATUS.

707,389. Synchronous Alternating-current Motor. Alexander Churchward, Fort Wayne, Ind. Application filed October 1, 1898. Renewed May 1, 1901.

The invention combines with a synchronous motor, a fly-wheel driven by it through the medium of a yielding connection.

707,390. Synchronous Alternating-current Motor. Alexander Churchward, Fort Wayne, Ind. Application filed January 11, 1899. Renewed February 21, 1901.

A synchronous motor is combined with a fly-wheel driven thereby, free to turn on its driving shaft, and a yielding frictional connection between the fly-wheel and the motor.

707,429. Insulator for Electric Wires. Theodore F. King, Nashville, Tenn. Application filed September 21, 1901.

The insulator has an opening, or slot, extending from its upper end downward, a lateral slot extending outwardly upon opposite sides of the insulator, the lateral slot terminating in a vertical orifice, or bed, for the wire, extending upwardly and downwardly upon opposite sides of the lateral slot.

707,433. Shade Support. Ernest A. Livet, London, England, assignor to the Hiram Maxim Lamp Company, Limited, London, England. Application filed March 19, 1901.

A shade support for an incandescent lamp is described.

707,438. Medical Electrode. George G. Marshall, Wallingford, Vt. Application filed May 2, 1902.

The electrode comprises a cap of non-conducting material and has a tapering opening or passage. A metallic conductor is held in the cap and engages the walls of the passage at the widest portion thereof.

NO. 707,244.—RESISTANCE FOR RHEOSTATS.

707,441. Telephone Receiver. Lemuel Mellett, Somerville, Mass., assignor to the American Otophone Company, Boston, Mass. Application filed July 5, 1901.

The receiver employs a magnetic diaphragm free at its edges, a magnet co-operating with the diaphragm on one side thereof and springs acting in opposition to each other on the diaphragm.

707,505. Electrical Switch. Leonard L. Elden, Boston, Mass., assignor of one-half to Sears B. Condit, Jr., Somerville, Mass. Application filed April 15, 1901.

The switch controls contacts for a line circuit and for a polyphase system. A single rotary hand-lever transfers the line circuit by a single straight-ahead movement from any one phase of the polyphase system to any other thereof.

707,508. Electric Roller for Massage and Therapeutical Purposes. John W. Gibbs, New York, N. Y. Application filed April 17, 1899.

An electric massage roller is described.

707,516. Plug Receptacle. Charles J. Klein, New York, N. Y., assignor to the C-K Manufacturing Company, New York, N. Y., and Jersey City, N. J. Application filed April 5, 1902.

The receptacle is provided with a face plate having a plug opening therein; and closure means for the plug opening embodying a pivoted, tensionally actuated member arranged to be swung inwardly of the receptacle upon the insertion of the plug.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, SEPTEMBER 6, 1902. No. 10

Progress on Power Plant No. 2 at Niagara Falls, N. Y.

By Orrin E. Dunlap.

Within a few weeks the Niagara Falls Power Company will be supplying electric power from power house and wheel-pit No. 2. This power house is 560 feet long, while its width is 70 feet. Architecturally, it is a far more beautiful structure than power house No. 1. The roof of the original building has an unbroken front, while the roof of power house No. 2 is broken by a gable that relieves the flatness, and midway in the middle of the length of the roof there are other gables that have a beautifying effect, greatly increasing the attractiveness of the new building. Every part of the building is fireproof, and the stone used is identical with that of the first station. The window casings are of steel, as are also the door casings. Metal laths are used, and hollow brick are employed in the partitions. The roofing and slating of the structure are nearly completed. The building of the superstructure is nearly finished. Mosier & Sumers of Buffalo have this contract, and they have yet to finish the center gable and the storehouse portion at the south end.

The National Contracting Company, which had the contract for the wheel-pit work has completed its contract, and the work of clearing away the construction plant is under way. Walter McCulloh, resident engineer of the National Contracting Company, is looking after this work; and of the plant, which was valued at $130,000, all but from $10,000 to $15,000 worth has been disposed of to various buyers. The completion of this contract leaves the work in the hands of the Niagara Falls Power Company and the contractors on the installation.

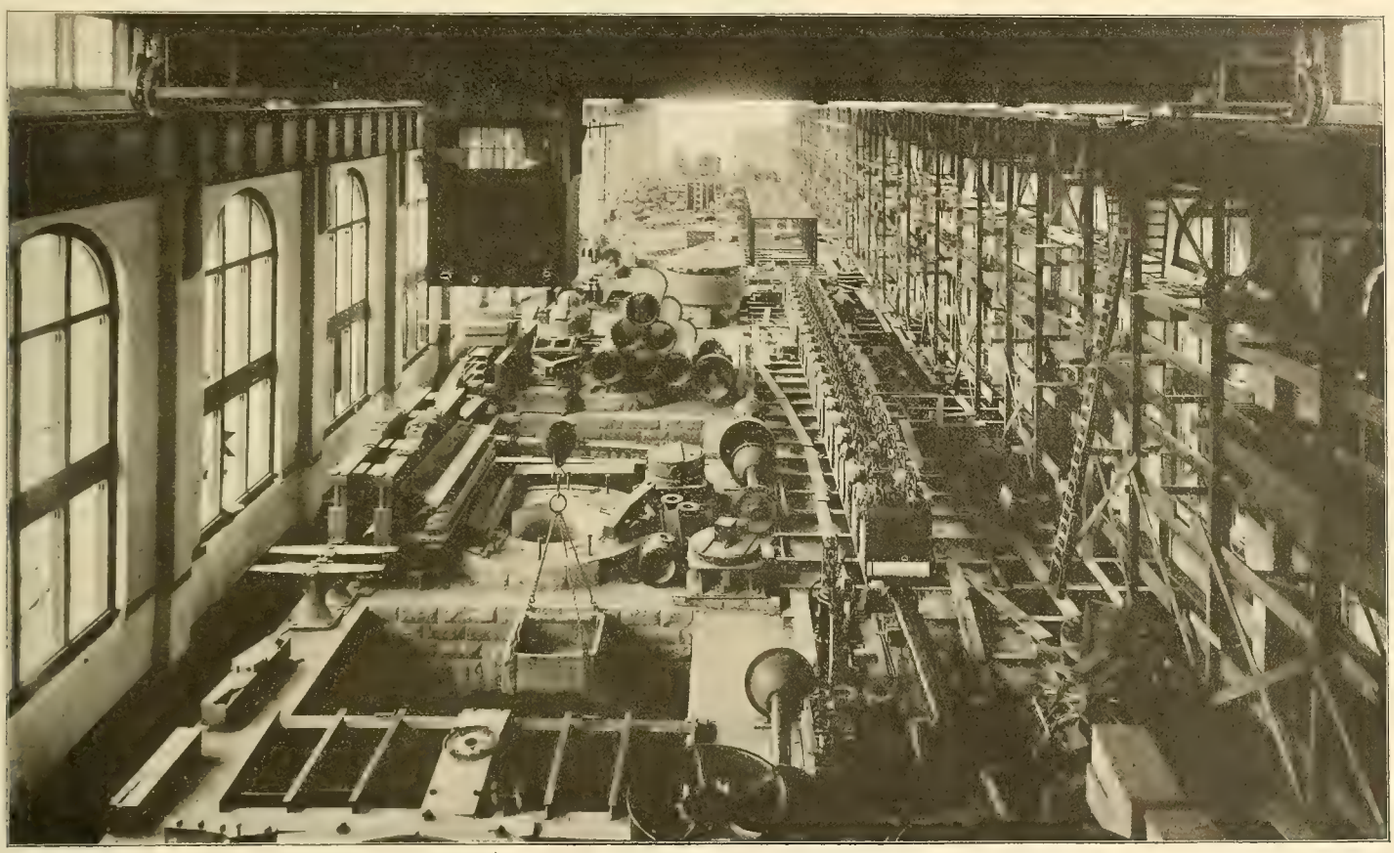
The covered forebay at the west side of the building is well advanced, and water has been let into it. This forebay is 40 feet wide, and extends nearly the entire length of the building. The racks of power house No. 1 are uncovered, but the racks of power house No. 2 are protected by this forebay structure. In the inlet canal a dredge, with scows and a tug, are at work removing the big cofferdam that was built to aid in the work.

The interior of the building presents a striking and busy scene. All about parts of the turbines, generators, switchboards and other apparatus to be installed await the moment when they shall be needed to fit in the places they are designed to occupy in this remarkable plant to develop 55,000 horsepower additional of the force of the Niagara. The I. P. Morris Company of Philadelphia has many men at work in the wheel-pit erecting the turbines and shafts. In power house No. 1 the wheels are numbered one to 10, inclusive, and in power house No. 2 the first wheel will be known as No. 11. Already wheels Nos. 11, 12 and 13 are set, and the shaft of No. 11 is in place. The turbines that are being installed were designed by Escher, Wyss & Co. of Zurich, Switzerland, and built by the I. P. Morris Company. The governors were also designed by Escher, Wyss & Co. and are being built by A. Falkenau of Philadelphia.

The General Electric Company has commenced the erection of the first generator. The six generators first to be installed will be very similar to those now in operation in power house No. 1. They will be of the external-field type, and have the nickel-steel revolving magnet ring, but the iron bridge over the machine will be omitted, a fact made possible by placing the collector rings at the bottom instead of at the top of the dynamo shaft. The regulation of the machines in station No. 2 will be closer than of those in station No. 1.

Last winter the immense quantities of ice in the river in front of the inlet canal gave considerable trouble, owing to the shallowness of the channel. A dredge is now at work out in the river in front of the canal deepening the channel in order that there may be a greater flow of water into the inlet. The 10 turbines now in operation in wheel-pit No. 1 serve to create a pretty stiff current in the inlet canal, which will be greatly increased in speed by the operation of the 11 wheels to be placed in the new wheel-pit. This pit is 463 feet eight inches long, 18½ feet wide and 178½ feet deep. The wheels will work under a head of 145 feet and will be of the Francis or inward-discharge type.

The work on the new development has been in progress over a year, but only in the way of cleaning up and clearing away the construction plant is there any intimation of a cessation of the great activity that has been about the spot all these months. On all sides there are quantities of material, sections of big penstocks, and other things which will have their part in the complete work. To a degree, the laborers have given place to the coming of the skilled hands from the several great contracting companies, and the careful work is now in progress. At the south end of the transformer station an addition is being built. It will correspond in style, material, etc., to the present structure. William A. Brackenridge, resident engineer of the Niagara Falls Power Company, is in charge of all the work, and under his skill and experience the progress is pleasing. The expectation is that power from the first wheel and generator will be available about October 1st.



PROGRESS ON POWER PLANT NO. 2 AT NIAGARA FALLS.—INTERIOR OF THE NEW POWER HOUSE.

Hydro-electric Irrigation in Hawaii.

The Pioneer Mill Company of Lahaina, Maui, the latter one of the Hawaiian Islands, is building a pumping station embodying interesting features. Waterpower is to be utilized by tunneling into the side of a mountain at a sufficient elevation. One million gallons a day is flowing from the tunnel made, and the power of this flow will be used to turn a large turbine direct-connected to a General Electric generator. The current will be carried over five miles of line to the central station, where it will drive a motor direct-connected to a lift pump of large capacity. The pole line, turbine and electrical machinery are in place, and the company is now awaiting the delivery of the pump, which is building in the United States. The company intends to pipe the water from the turbine, which will be located some distance above the lower levels, to the sugar-cane fields on its level for irrigation purposes, the lower levels being cared for by the lift pump.

The Italian government has appointed a committee to investigate the feasibility of building an electric railway between Naples and Rome. The proposed line is to be double track throughout and operated on the third-rail system. The distance between the two cities, which is about 110 miles, is to be covered, including stops, in less than two hours.

Census Report on Electrical Apparatus and Supplies.

An extensive report on the manufacture of electrical apparatus and supplies of the United States during the year 1900 has been issued by the Census Bureau. S. N. D. North, chief statistician for manufactures, in transmitting the report to Director William R. Merriam says:

"This is the first report made at any census on the subject of electrical apparatus and supplies. The industry is of comparatively recent origin, and some idea of its rapid development may be had from a statement of the value of products reported at the censuses of 1880, 1890, and 1900, which were $2,655,036, $19,114,714, and $91,348,889, respectively. Great, however, as has been this advance in value of products, no figures can convey an adequate idea of the many and constantly increasing uses to which electricity is put by means of the apparatus which is here so exhaustively described."

"The reports show a capital of $83,130,943 invested in the manufacture of electrical apparatus and supplies. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations. The value of the products is returned at $91,348,889, to produce which involved an outlay of $4,563,112 for salaries of officials, clerks, etc.; $20,190,344 for wages; $6,788,314 for miscellaneous expenses, including rent, taxes, etc.; and $48,916,440 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is in any sense indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the shop or factory."

The report itself was prepared under Mr. North's direction by Thomas Commerford Martin of New York city. Some of Mr. Martin's statistics and deductions are given in the following paragraphs, which are based on the report:

It is interesting and important to note that the proportion of the electrical product reaching the public directly treated in this report is by no means large. So far as telegraphy is concerned, there is to-day practically no private or individual work. In telephony the public has a better opportunity to buy the apparatus directly and employ it for varied purposes, and a considerable percentage of the telephones now made go into hotels, offices, mills, yards, etc., superseding speaking tubes and irrespective of connection with central exchanges. In electric lighting, it would appear that the apparatus produced is absorbed in about equal proportions by the central-station companies and by isolated plants installed simply to supply some large building or factory. In electric-railway work the distance between the manufacturer and his ultimate patron is even more remote, for nobody dreams of possessing his own trolley car, as he would a buggy or bicycle. At the same time, there are notable exceptions to this rule, for in respect to such articles as fan motors, or electric heating and cooking apparatus, the customer is left usually to make a selection for himself, and to buy the appliances in the open market. In the aggregate, the consumption of current by these devices is appreciable, and there are indications that electric current supply companies are becoming more logical, limiting their efforts entirely to that portion of their system which lies on the generating side of the meter, and leaving to the consumer the selection and purchase of everything on the registering side of the meter.

While certain leading lines of American manufacture are subject to limitations imposed by the demand for or competition of foreign goods, it can be said that the electrical industries are not subject to any check of this kind. On the contrary, there has grown up a steady export trade, which would be very much larger but for the fact that the American apparatus sent abroad having at once proved popular and attractive, the patent rights for its manufacture in Europe have been purchased, or arrangements made for drawings and patterns. Hence, American electrical factories are now located all over Europe, under one name or another, in Paris, Berlin, Havre, London, Antwerp, and other cities, and their product embodies American ideas, or capital, or direction, or labor, sometimes all four. These factories employ thousands of men, and it is only fair to point out that the increase in the export of American electrical manufactures would be enormous but for this natural and inevitable restriction. The export of electrical apparatus in the census year 1900, amounting to $5,000,000, might easily have been five times as much but for the facts just noted. On the other hand, the electrical importations have been checked by corresponding conditions in the United States, though in much lesser degree, and are confined to but one or two specialties.

It would appear from the records of patents issued by the United States in the more specific electrical classes that during the four and a half years from 1896 to June 30, 1900, no fewer than 6,796 patents were issued, evidencing a great rise in the activity with which electrical inventors were still prosecuting their endeavors in these newer fields of discovery and application.

The amount of money spent each year by each member of the community for the necessities of life and its luxuries affords a measure of the extent to which the various arts and industries rank in importance in promoting the comfort and welfare of the public. It would seem, from the foregoing investigation as well as from the statistics that follow, that the average annual expenditure on electricity in the United States for each individual of a population not far from 75,000,000 was $7. Of this amount about $1.25 per head would represent the demand for electric apparatus and supplies; the income of the electric traction companies would reach not less than $3 per head; while that from electric lighting would reach about $1.50. The returns available would also indicate that not less than 75 cents per head would represent the expenditure on telephone service, and 50 cents per head the outlay for telegraph, fire alarms, and kindred work. These values, which are conservatively put, are, however, rapidly increasing.

Table 1 presents the comparative statistics of the industry for the censuses of 1880, 1890 and 1900.

TABLE 1.—ELECTRICAL APPARATUS AND SUPPLIES. COMPARATIVE SUMMARY, 1880, 1890 AND 1900, WITH PER CENT. OF INCREASE FOR EACH DECADE.

	Date of Census.		
	1900.	1890.	1880.
Number of establishments	580	189	[1] 76
Capital	$83,130,943	$18,997,337	$1,509,758
Salaried officials, clerks, etc., number	4,987	[2] 683	[3]
Salaries	$4,563,112	[2] $849,138	[3]
Wage-earners, average number	40,890	8,802	1,271
Total wages	$20,190,344	$4,517,050	$683,164
Men, 16 years and over	34,150	7,289	1,132
Wages	$18,369,228	$4,082,847	[3]
Women, 16 years and over	6,158	1,469	72
Wages	$1,701,110	$426,660	[3]
Children, under 16 years	582	44	67
Wages	$120,006	$7,543	[3]
Miscellaneous expenses	$6,788,314	$1,154,462	[4]
Cost of materials used	$48,916,440	$8,819,498	$1,116,470
Value of products, including custom work and repairing	$91,348,889	$19,114,714	$2,655,036

1. Includes 36 establishments reported as "electrical apparatus and supplies," and 40 reported as "telegraph and telephone apparatus."
2. Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table.
3. Not reported separately.
4. Not reported.

In 1900 there were 580 establishments, with a capital invested of $83,130,943, and with a total output, including custom work and repairing, of $91,348,889. In the course of the investigation the returns of 712 establishments were considered, all of which embraced some product of an electrical nature, bringing the value of such product up to an apparent total of $104,738,719. The supplementary concerns thus noted have not, however, been included, nor their output, as there would be serious difficulty in apportioning to electricity the part of capital, labor, charges, etc., that might be fairly due that item as compared with other items of output from the same factory. It is indeed essential to point out that of the material used in electrical manufacturing establishments, very little is purchased in "raw" or crude form. The returns show that materials valued at no less than $46,272,533 were purchased in partially manufactured form.

Nineteen states are separately enumerated in the general returns, New York leading the list with 134 establishments, Illinois coming second with 82, and Ohio and Pennsylvania closely contesting third place with 64 and 63, while Massachusetts has no fewer than 54. On the other hand, in gross value of output Pennsylvania heads the list with $20,967,587, as compared with $17,697,352 for New York, $11,641,177 for Illinois, and $8,259,612 for Massachusetts. New Jersey has also an excellent standing as a producer of electrical apparatus, with 35 establishments showing a value of $7,380,139, or more than Ohio, with $7,036,103.

The general figures do not reveal any tendency to excessive capitalization, for the capital of $83,130,943 is actively employed in producing a yearly product greater than itself in the census period by $8,000,000. This may be explained in part by the fact that the largest producing company had reduced its capital by about one-half not long prior to the census year, but has since restored to the present stockholders the amount thus mulcted, on account of the reparation of losses and the steady earning of a profitable income. It has been asserted in economic circles that electrical development has done its share in the creation of "securities" and "values" as a result of the combination and consolidation tendencies of the time, but the statistics of electrical manufacturing would appear to be quite clear from such criticism.

DYNAMOS.

Mr. Martin's report states, apparently, that during the year ended June 30, 1900, there were manufactured in the United States 10,527 dynamos having an aggregate capacity in horsepower of 770,832 and a value of $10,472,576. Ohio led in number of machines, but not in size of the units. For the principal producing states the figures of the manufacture of dynamos for the census year are as follows:

State.	Number.	Horsepower.	Value.
Connecticut	408	13,182	$ 263,590
Illinois	1,102	59,696	868,640
Indiana	521	22,827	355,759
Massachusetts	711	53,930	757,486
New Jersey	1,147	37,090	612,459
New York	1,220	269,708	3,280,871
Ohio	3,292	38,096	771,164
Pennsylvania	1,236	255,285	3,126,453
Wisconsin	433	9,950	247,000

Some of the figures not given above, but contained in the census report, are rather remarkable, as, for instance, that in the state of Michigan only 20 dynamos were manufactured in 1900 and in Missouri only 25.

In 1900 the average size of the dynamo produced had risen to nearly 75 horsepower. The reports summarized include 1,345 alternating-current generators of a total of 342,231 horsepower, valued at $4,174,651; so that the output of direct or continuous-current apparatus would represent 9,182 machines of 428,601 horsepower, valued at $6,297,925. Hence it would appear that while the average size of the alternating-current machine was 254 horsepower, that of the direct-current, considered alone, was but 47 horsepower.

During the year 1900 the total number of dynamotors, motor-generators and boosters produced was 649, aggregating 14,397¼ horsepower and having a value of $379,747.

TRANSFORMERS.

In 1890 transformers were of very small capacity, and able to furnish current to only a few lights. But the production in the census year of 1900 was 36,513 transformers of 407,451 horsepower, or about 11 horsepower each, equal to at least 135 lamps. The average size is now about five times greater than in 1890. The total value of the transformers produced was $2,962,871. The four states which lead in this manufacture are Massachusetts, with 23,799 transformers of 120,190 horsepower, valued at $951,-

SECTIONS OF THE BIG PENSTOCKS FOR POWER HOUSE NO. 2 AT NIAGARA FALLS. (SEE PAGE 149.)

014; Pennsylvania, with 2,362 transformers of 115,900 horsepower, valued at $783,653; New York, with 436 transformers of 103,366 horsepower, valued at $723,008; Missouri, with 3,775 transformers of 37,000 horsepower, valued at $270,000.

Switchboards and Switches.

During the year there were 6,422 switchboards for light and power, produced at a value of $1,846,624, the manufacture being divided among 17 states. The two largest producers were New York, with 2,506 boards, valued at $1,055,288, and Pennsylvania, with 3,354 boards, valued at $353,043.

The production of switchboards for light and power is but one branch of a very large industry comprising the production of similar apparatus for telegraphic, telephonic and electric-railway work.

POWER HOUSE NO. 2 AT NIAGARA FALLS. (SEE PAGE 149.)

The range of size in switchboards, particularly for light and power, is extremely wide, running upward from the small panel-boards of a sub-station or a small office building to those which receive the current from the largest dynamos in central stations, some of which have become so extensive and complicated as to be built three or four stories high, with stairways, and even with electric elevators passing from floor to floor to facilitate swift manipulation.

The number of switches produced was 1,723,387, valued at $1,129,891. Connecticut leads, with 1,415,000 switches, valued at $382,810; Pennsylvania is next with 203,458 switches, valued at $254,340, and Massachusetts and New York follow, with the respective figures of 20,000 switches, valued at $237,762, and 7,435 switches, valued at $191,027.

Motors.

The aggregate value of all classes of motors manufactured in the United States during 1900 was $19,505,504. The number of direct and alternating-current motors turned out was 35,604, of 515,705 horsepower, and valued at $7,551,480. Of this figure there were 29,615 direct and 5,989 alternating machines of 378,329 and 137,376 horsepower, respectively. For railways there were produced 15,284 motors of 666,669 horsepower and valued at $7,568,841; for automobiles 3,017 motors of 8,220 horsepower and valued at $192,030; for fans 97,577 motors of 12,766 horsepower and valued at $1,055,369; for electric elevators 385 motors of 6,730 horsepower and valued at $2,523,901; for miscellaneous uses 7,913 motors of 11,392 horsepower and valued at $613,883.

There are 21 states included in the statistics, and the data of the six leading states may be summarized as follows:

Illinois.

Direct and Alternating-current Motors.—Number, 1,688; horsepower, 1,780; value, $167,638.
Automobile Motors.—Number, 1,440; horsepower, 2,870; value, $156,823.
Fan Motors.—Number, 15,046; horsepower, 755; value, $130,281.
Electric Elevator Motors.—Number, 153; horsepower, 1,500; value, $40,000; establishments reporting value only, $466,359; total value, $506,359.
Miscellaneous.—Number, 480; horsepower, 450; value, $9,600.
Aggregate Value.—$970,701.

Massachusetts.

Direct and Alternating-current Motors.—Number, 6,293; horsepower, 23,754; value, $410,176.
Railway Motors.—Number, 4,078; horsepower, 94,791; value, $1,095,069.
Automobile Motors.—Number, 2; horsepower, 15; value, $375.
Automobile Motors.—Number, 52; horsepower, 120; value, $12,000.
Fan Motors.—Number, 14,560; horsepower, 2,333; value, $152,051.
Miscellaneous.—Number, 212; horsepower, 571; value, $19,071.
Aggregate Value.—$4,470,881.

Ohio.

Direct and Alternating Motors.—Number, 1,414; horsepower, 21,279; value, $366,766.
Railway Motors.—Number, 1,100; horsepower, 35,629; value, $432,051.
Automobile Motors.—Number, 1,230; horsepower, 4,575; value, $11,595.
Fan Motors.—Number, 13,200; horsepower, 1,595; value, $153,000.
Miscellaneous.—Number, 2,960; horsepower, 6,050; value, $407,000.
Aggregate Value.—$1,370,412.

Pennsylvania.

Direct and Alternating Motors.—Number, 9,067; horsepower, 263,202; value, $3,204,058.
Railway Motors.—Number, 5,360; horsepower, 321,500; value, $3,921,721.
Fan Motors.—Number, 6,800; horsepower, 1,350; value, $75,992.
Electric Elevator Motors.—Number, 60; value, $261,722.
Miscellaneous.—Number, 697; horsepower, 884; value, $40,298.
Aggregate Value.—$7,503,791.

New Jersey.

Direct and Alternating Motors.—Number, 9,268; horsepower, 86,873; value, $1,501,755.
Fan Motors.—Number, 22,857; horsepower, 2,525; value, $251,208.
Miscellaneous.—Number, 2,000; horsepower, 100; value, $20,000.
Aggregate Value.—$2,073,555.

New York.

Direct and Alternating Motors.—Number, 3,996; horsepower, 80,990; value, $1,222,255.
Railway Motors.—Number, 4,746; horsepower, 214,749; value, $2,120,000.
Automobile Motors.—Number, 18,330; horsepower, 1,760; value, $183,120.
Electric Elevator Motors.—Number, 120; horsepower, 3,240; value, $152,335.
Miscellaneous.—Number, 172; horsepower, 1,474; value, $51,600.
Aggregate Value.—$1,892,500.

Batteries and Carbons.

The production of storage batteries during the census year reached a valuation of $2,559,601, representing the manufacture of cells in which lead is the constituent metal. The data as to number of cells or weight are not easy to determine, but it is a well-known fact that Pennsylvania has long been the chief center of the industry; and the value for that state, reaching $2,124,259, is reported by the manufacturers to represent 10,796,530 pounds of lead plate. This amount of lead plate, however, accounts for only about five-sixths of the value given. The number of storage batteries produced was 11,012,035. There were manufactured 708,077 liquid primary batteries, valued at $571,370, and 1,946,688 dry batteries, valued at $316,013. The aggregate value of all batteries produced was $3,679,045. Outside of Pennsylvania the principal states producing storage batteries were Ohio, with 7,563 batteries, valued at $225,311; New York, with 6,619 batteries, valued at $104,848; Illinois, with 200,400, valued at $97,538. In the primary-battery line Indiana leads, with a total value of $327,941, and New York follows closely with $327,844. New Jersey produced 1,100,000 dry batteries during the year, valued at $100,000.

The aggregate value of carbons produced was $1,731,248, the various styles being, 172,955,922 lighting, valued at $1,263,732; 355,583 battery, valued at $30,777; 5,701,143 brushes, valued at $136,679; 41,749 furnaces, valued at $10,974; 12,176,522 miscellaneous, valued at $289,086. Six states supplied the above products, Ohio leading, with a total value of $1,311,560, which covers nearly all the carbon business. For that value the state produced 132,414,866 lighting carbons, 3,959,285 brushes, 36,749 furnace carbons and 12,000,000 miscellaneous pieces. Indiana and Pennsylvania follow, with total values of products of $182,000 and $176,784, respectively.

Arc and Incandescent Lamps.

The statistics for the production of arc lamps for 1900 show that there were produced 23,656 open-arc lamps, at a value of $276,481 and 134,531 enclosed-arc lamps at a value of $1,551,290, the total value being $1,827,771. Massachusetts leads all the other states in the production of lamps, the value of its products, $729,815, being nearly one-half of the total. Ohio and New York are next in order, with $311,500 and $231,367, respectively. It is a significant fact that the production of enclosed arcs was nearly six times that of open lamps. A great stimulus has also been given to alternating-current arc lighting, there being 73 cities which have direct-current, series enclosed arcs, while 326 cities have series alternating enclosed lamps.

Of searchlights and projectors, there were produced in the United States 8,283 lamps, valued at $225,635. New York furnished nearly the entire supply, amounting to 7,689 lamps, valued at $162,655.

The total number of incandescent lamps produced in the United States in 1900 was 25,320,198, with an aggregate value of $4,036,112. Of these 21,191,131 were of 16 candlepower, 2,906,817 were below 16 candlepower for lighting service, and 1,222,250 were above 16 candlepower. New Jersey and Ohio led in the value of their manufactures, the figures being $1,130,803 and $1,034,580, respectively. New Jersey produced a total of 11,069,158 and Ohio a total of 6,665,940 lamps. Other states producing lamps were in the order named: Massachusetts, Connecticut, Pennsylvania, Missouri, Illinois, Rhode Island, New York, Colorado and Kentucky. A total value of $593,929 for sockets, bases, etc., was reported from four states. The number of decorative miniature lamps, X-ray bulbs, vacuum tubes, etc., produced was 397,432, with a value of $72,935, New Jersey and New York leading in this line. The report states that there are over 10,000 varieties of incandescent lamps. The total value of electric-light fixtures produced was $2,065,124, New York leading with $1,551,051.

Telephony.

Since the census year 1879-80, no statistics of telephony have been compiled other than those embodied in the annual reports of the American Bell Telephone Company. Twenty years ago 148 companies and private concerns reported 54,319 receiving telephones, 3,338 employes, and 34,305 miles of wire, with total liabilities of $15,502,135. In 1900 the Bell systems reported about 1,500 exchanges, with 1,080,000 subscribers connected, using 1,254,203 miles of wire, employing 33,000 persons, and handling 2,000,000,000 conversations per year. The capital for the parent and sub-companies then stood at not less than $300,000,000. By 1900-1901 Independent companies had attained a total of about 2,750 exchanges, with 700,000 subscribers, and an investment of $150,000,000, apparatus being furnished by at least three-score manufacturers. The output of apparatus for telephone purposes in 1900 reached $10,512,412, scattered through nearly a score of states. These figures, however, are strictly those of the manufacturing side of the industry, and do not take any account of the far more striking data to be derived from a study of the subject, after this apparatus has gone into service and is in the hands of the public. It will suffice to point out that in 1900 the United States showed a per capita of one telephone in 40, while in some places, such as San Francisco, it had reached one in 12, a rate that leads the world, and which has since been growing with unprecedented rapidity.

There were 797,246 receiver and transmitter sets of telephones reported, of a value of $3,570,616, or not quite $4.50 per set, the actual price varying greatly, however, according to nature of work, style of finish, etc. There were reported for exchange work 1,002 central switchboards, valued at $2,650,396, together with products for establishments not reporting quantities valued at $1,129,398, making a total of $3,779,794. The production of interior systems is placed at 217,188, with a value of $1,837,266. No record could possibly be obtained, however, of the manner in which this production would be divided, nor, again, could the figures include the thousands of instances in which individuals have bought separate sets of apparatus and installed their own short lines. The large amount of $1,324,736 is reported for telephone supplies, including telephone lightning arresters and similar protective devices, cable heads, distributing boards, parts, etc.

Illinois leads all of the states in telephone manufacture, its products for 1900 being valued at $5,418,528, over one-half of the total. It produced 142,202 receiver and transmitter sets, 203,610 interior systems and 534 central switchboards. The corresponding figures for New York were: Aggregate value, $2,765,994; receiver and transmitter sets, 460,500; interior systems, 575; central switchboards, 26.

Phonographs and Graphophones.

In 1900 there were reported 11 establishments as

engaged in the manufacture of talking machines and parts thereof. They reported capital to the amount of $3,348,282, and the value of the products, including custom work and repairing, was returned at $2,246,274.

TELEGRAPHY.

The manufacture of telegraphic apparatus in 1900 reached a total production of $1,642,266. This included 199,410 intelligence sets (key, sounder, etc.), valued at $354,212; 40,264 police, fire, district and miscellaneous sets, the value of these and others not reported being $1,231,167; 9,101 switchboards, valued at $56,887. New York leads with $634,261 worth of productions, and New Jersey, Massachusetts and Pennsylvania follow.

WIRES, CABLES AND CONDUITS.

The value of insulated wire and cable produced in 1900 was $21,292,001, the principal states being listed as follows: New York, $6,119,878; Rhode Island, $3,912,584; New Jersey, $4,701,574; Pennsylvania, $2,696,155; Connecticut, $1,938,075; Illinois, $722,069.

The report shows for 1900 a total value of electrical conduits of $1,066,163, of which about one-half, or $545,835, is for establishments reporting an output of 14,875,386 feet. This embraces two classes of conduits; that employed for exterior work, and that used for interior work. The principal states and the amount produced by them are as follows: New York, 4,739,008 feet, and Massachusetts, 9,936,378 feet.

ELECTRIC HEATING, ANNUNCIATORS, CLOCKS, FUSES, ETC.

The number of rheostats and resistances, electric heating and cooking apparatus, welding, etc., produced in 1900 was 94,147, the total value being $1,186,878. New York produced nearly half the total, the number of instruments being 63,800 and their value $465,836.

There were produced during the census year 57,022 annunciators of various types, the total value being $224,885. New York again leads in this line, with $125,760.

Of electric clocks, there were produced 9,180, valued at $132,149, New York, Massachusetts and Illinois being the principal producers.

Of lightning arresters, fuses, etc., there were manufactured 11,264,570 devices, valued at $595,497. More than half was turned out by New York, the number being 6,015,945 and the value $314,763. Illinois was next, with 4,053,150 pieces, valued at $88,400.

MEASURING INSTRUMENTS.

The output of electrical measuring instruments is shown to have been $860,265 during the census year 1900, of which amount $584,033 was reported by concerns which returned the number of apparatus they had manufactured as 25,921. This would show an average value of about $22, an indication which merits, however, little weight, as the range is very wide, extending from minute galvanometers carried in the pocket, for testing batteries, up to complicated instruments placed on switchboards and used for noting the total current output of a central-station power house. New Jersey produced 15,607 of these instruments, their value being $482,635. Illinois was next, with 8,104 instruments, valued at $94,538.

ALL OTHER PRODUCTS.

In spite of the careful and somewhat minute division of the production of electrical apparatus into a least a score of different branches, there remains under the heading of "all other products," the large amount of $14,634,984. This section includes a large variety of electro-medical, electro-surgical, and electro-therapeutic apparatus in general; a large variety of miscellaneous appliances for electric-railway work, as well as for electric lighting—special electrical shades, bulbs and globes; electrical dental specialties; electrical house goods; scientific apparatus for schools and colleges; special forms of insulating materials and compounds; a large variety of electric insulators; electric ignition apparatus for hydro-carbon automobiles and for gas and oil engines; electric cigar lighters, portable gas lighters and gas-igniting appliances in general; a very extensive and varied class of electrical toys; a number of forms of metal appliances used as fixtures, switch boxes, cases, holders, etc.; a great many special tools for doing specific work electrically, etc. The principal states under this head are Illinois, with goods valued at $3,218,171; Massachusetts, $3,203,943; Pennsylvania, $2,225,336.

The amount received for custom work and repairing for the United States was $2,063,736, New York leading with $863,128.

Old Timers' Reunion.

On Wednesday, Thursday and Friday of next week the twenty-second annual reunion of the Old Time Telegraphers and United States Military Telegraph Corps will be held in Salt Lake City, Utah. The programme includes many interesting features. The business will all be finished up on Wednesday morning, and the remaining time will be devoted to having a general good time and visiting the many points of interest in the locality of Salt Lake City. Trips to Ogden Canyon and also to Saltair, the Coney Island of the city, are planned. An organ recital on the big organ in the Mormon Tabernacle will be given to the visitors on Thursday morning. Headquarters in Salt Lake City will be at the Kenyon Hotel.

A New Laboratory Switchboard Jack.[1]

BY F. C CALDWELL

The requirements of a good dynamo laboratory switchboard jack may be stated as follows: The jack should be able to carry its proper current without undue heating or drop. The plug should be designed so that it will be easy to insert and withdraw and so that it cannot be forced too tightly into the jack, so that it will stick. This requirement rules out the taper jack, which is also excluded by the next requirement, namely, that the jacks and plugs shall be inexpensive. Further, the jack should be such that the plug cannot be unseated by a sideway pull, and it should lend itself readily to multiplication; that is, for the purpose of inserting more than one jack in a terminal. The jack should also give a neat appearance to the front of the switchboard, and the part exposed on the front of the board should be easily and cheaply dressed up or replaced in case of burning.

As will be seen by an examination of Fig. 1 (A), the jack proper consists of a brass tube made on the turret lathe from one-inch brass rod. This is bored and reamed to three-eighths inch, and with the exception of the shoulder, turned down to five-eighths inch; the shoulder, which forms the front or exposed end, is left full diameter and is one-fourth inch long. The front edges, both inside and outside, are rounded, and the back end is threaded with a standard five-eighth-inch thread for about one inch of its length. This jack tube forms the

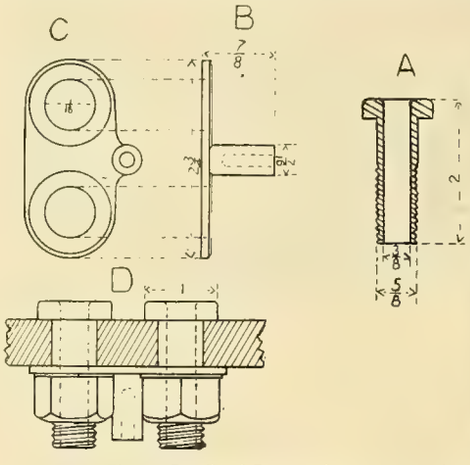


Fig. 1. Details of Construction.

Fig. 2. Board Fitted with the Jacks.

A NEW LABORATORY SWITCHBOARD JACK.

unit, and any number required can be connected up by suitable yokes on the back of the board. In the laboratory of the Ohio State University the standard yoke is a small brass casting, having two holes for the jack tubes and a lug, into which is soldered the wire. This is shown in Fig. 1 (B), (C). A standard five-eighth-inch iron nut, preferably faced off, is screwed on the back of the tube to hold the jack in the board, as seen in Fig. 1 (D), where the standard terminal having two jack tubes is shown.

The plug used with this jack is simply a piece of three-eighths-inch brass rod, six inches long, with one end rounded and slit about two inches up with a metal slitting saw; the other end is drilled for the cord, and the plug is pinned in a wooden handle with a small screw. To make it more springy, it is best to reduce the diameter a little where the plug leaves the handle.

It will be noticed that there is very little machine work on any part of this terminal. The tubes are made very rapidly on the turret lathe, and require no further treatment except reaming out and facing. The yokes require a little facing on the emery wheel, and drilling for the wire connection.

As made in small quantities and with cheap labor the cost of the tubes is about 9½ cents each, of the yoke six cents, of the nuts two-thirds cent, and of the plug complete in the handle and ready for soldering in the cord about 10 cents. Thus, a complete terminal with two tubes costs about 26 cents. If made in larger quantities, this cost could, of course, be reduced, especially by making the yokes from sheet brass with a die. It is also to be noticed that these jacks are very easy to install in the board, only one five-eighth-inch hole being necessary for each jack tube. The tubes are also very readily removed for facing off or replacing, and are very easily smoothed up in a lathe in case of burning. These jacks give a very neat appearance to the board, as is seen in Fig. 2, which shows a board fitted with the jacks.

With regard to the current-carrying capacity, a test was made by selecting 10 of these jacks which had been in use for several months, connecting them in series with plugs and cords, and sending 100 amperes through them. The highest drop between jack and plug was one one-hundredth volt, the lowest, two one-thousandths, and the average, six one-thousandths. The heating of the jacks at the end of 15 minutes was hardly perceptible.

1. Paper read before the physics section of the American Association for the Advancement of Science at Pittsburg, June 28 to July 3, 1902. The author is professor of electrical engineering in the Ohio State University, Columbus, Ohio.

Single-phase Power Transmission in New Zealand.

A hydro-electric power plant has been installed recently at Rotorua, in New Zealand, which possesses some features of interest. The town of Rotorua is situated in the North Island of New Zealand on Lake Rotorua. It decided to install a modern system of sewerage and drainage, and a steam pumping plant was designed for this work. Attention was drawn to the possibility of utilizing available waterpower in the vicinity to generate electricity for the purpose, and as a result of the investigation which followed the present pumping station is operated by electric power instead of steam.

The power house, shown in the accompanying illustration, is situated on Kaituna River, 13 miles from Rotorua. A succession of small cascades occurs in the river there, from which, if the total head were used, many thousands of horsepower could be obtained. As the present needs are small, only two of these falls were utilized, the added head of the two being 14 feet, and the horsepower developable being 200. This is considerably more than is used by the pumping station, but the town uses part of the surplus for light and power purposes.

A single-phase alternating-current system of generation was adopted, with a machine voltage of 4,000. A drop of 1,000 volts is allowed on the line, and the current is transformed down at the pumping station in the town to 100 volts. This line loss is considerable, but the available power is so much in excess of what is used that it is not of material consideration, at least for the present.

The intake for the flume (see cut) is taken off just above the first of the two falls used. The flume is calculated to carry 10,000 cubic feet of water per minute, with a velocity of two feet per second, the low fall necessitating a large quantity of water. When the flume is full it contains about 700 tons of water. The water is conducted from the flume to the turbines by riveted iron pipes five feet 10 inches in diameter.

Two turbines, made in Scotland, of the single-discharge pattern, with horizontal shafts, are used. The wheels are 40 inches in diameter, of cast iron with steel shafts. They are rated to give 100 brake horsepower at a speed of 117 revolutions per minute. The governors are King's patent pattern; they are fixed close to the wall behind the turbines. As long as the speed of the turbine is below the normal, the governor will continue opening the gate. In the event of the speed being kept low, owing to the overloading of the alternator, this might lead to serious results by overwinding the gate. To prevent this a somewhat ingenious arrangement is fitted to the governor. It consists of a train of wheels driven by the main operating shaft, and they operate a screw and sliding block, which by the time the gate is full open, comes in contact with a small lever connected with the main lever and belt fork, and holds it in the normal position, keeping the belt on the center loose pulley, and thus preventing any further movement of the gate by depriving it of its actuating movement. These governors act on a six per cent. variation of speed.

Each turbine is belted to a 50-kilowatt alternator of the Mordey inductor type, in which all the coils and wires are stationary, the revolving part, or rotor, consisting merely of a steel casting. These alternators are wound to give the full output at any pressure between 3,200 and 4,200 volts. They are run at constant speed, and the pressure variation

is obtained by varying the field excitation. This variation of pressure is necessary in order to compensate for the varying loss in the line, depending upon the load, and to maintain a constant voltage of 3,000 at the town end. The exciters are direct-connected to the shafts of the generators, and are of the two-pole type, with slotted armature.

The transmission line consists of 0.0223-inch sectional area bare copper wire. It is supported on white porcelain triple-petticoat insulators. The poles, which are steel railway rails, 24 feet long, were dipped in hot-gas tar before erection, and will be practically everlasting, whereas timber ones would probably want renewing in this locality in the course of 10 or 12 years. The line is protected at each end by Siemens horn arresters, but on account of the use of iron poles it was not considered necessary, although the district is at times subject to severe

POWER HOUSE AND FLUME AT ROTORUA, NEW ZEALAND.

thunderstorms, to provide lightning arresters along the line, as the poles themselves will act as lightning conductors.

At the town end of the line, which terminates in the pump house, there are two 12-kilowatt transformers. These transformers are used for the eight-horsepower motors for driving the sewerage pumps, and also for running the lights in the pump house. The motors are of the induction type. Each drives by means of a belt a five-inch Jennings centrifugal pump. At full load, each pump will raise about 500 gallons of water per minute 25 feet.

The distribution mains for arc and incandescent service are all insulated with vulcanized rubber, and braided. They are run on porcelain insulators on rata arms, keyed and bolted to Totara timber poles. There are separate circuits for the arcs and incandescents; transformers are fixed where required on the poles, so that no high-tension wires are carried in or on to the buildings; they receive the current at 3,000 volts and transform it down to 100 volts.

The atmosphere of Rotorua, says the London Electrical Review, from which the foregoing facts were obtained, is heavily charged with sulphur, which quickly acts on all exposed metal work. Silver, brass and plain iron particularly suffer badly; galvanized iron stands fairly well. A portion of the main line in proximity to the town had turned to the color of lead before it had been up a weey, and it is a question of concern how many years it will last.

All-British Pacific Cable.

The manager of the Canadian Pacific railway telegraphs announces that before the close of the present year the all-British Pacific cable will be completed and in operation. The cable steamer Colonia left London on August 5th, via the Suez Canal, with the balance of the unlaid cable sections, and it is hoped to have the Canadian end landed at Bamfield, B. C., by the time the Colonia arrives there. This ship brings about 4,000 miles of cable. All the receiving and sending instruments have arrived in Canada. The messages will be received on the siphon recorder and mirror instrument invented by Lord Kelvin, which is the most sensitive in the world. The duplex system of Dr. A. Muirhead, by which two messages, one from each end, pass through the wire simultaneously, will be employed on the southern section at least. Two repairing ships will be maintained constantly in commission, as there is fear of damage by earthquakes or landslips in the vicinity of the Fiji Islands. The Canadian Pacific railway telegraphs will handle the business across the Dominion.

Potter Mercury-vapor Lamp.

Henry N. Potter of Pittsburg, Pa., has recently invented a type of mercury-vapor lamp that is somewhat different from other lamps of this nature. The invention is covered by two patents (Nos. 707,975 and 707,976) issued last week and assigned to George Westinghouse. In the introductory descriptive matter of one of these patents Mr. Potter says:

"Experience has shown that the efficiency of lamps of this type depends largely on the ratio of the cross-sectional area of the path of the electric current or stream to the surface of the tube in which the mercury-vapor is hermetically inclosed. In general it appears to be a fact that a small tube having a proportionately large surface and small area of cross-section gives the highest efficiency. By reason of the peculiar property of gases, which makes them absorb light of such wave lengths as they can themselves emit when luminous, the portions of gas or vapor lying near the surface of the luminous stream in a mercury-vapor lamp are somewhat opaque to the light-rays given off by the more central portions of the gas. Moreover, the vapor of mercury has a temperature of maximum efficiency beyond which it is easily possible to heat it. Both these peculiarities conspire to render it advantageous to increase the radiating-surface and decrease the cross-section of the luminous stream. The means which I have provided for securing the result named consist in employing for the inclosing gas or vapor chamber tubes which have a portion of their bore (the central portion) occupied by a non-conducting material, and the first part of my invention is concerned with the utilization of such a tube for the purposes indicated.

"To counteract the tendency of mercury-vapor to become heated by the electric current to a temperature too high for maximum efficiency, it has been suggested that the vapor be artificially cooled—say by inner chimneys or liquid-cooling tubes within the lighting chamber; but it is plainly advisable if possible to so design the tube or lighting chamber that only enough heat is generated to bring the vapor to its temperature of maximum efficiency and to dispose this vapor in space so as to permit the greatest possible portion of the light to be freely emitted. To this end I propose to provide the luminous chamber of my lamp with a vacuum jacket whereby, for a given expenditure of energy, the temperature of the chamber, or rather of the tube forming the chamber, will be higher than it would be if the surface of the tube were permitted, as at present, to dissipate heat by radiation, conduction and convection."

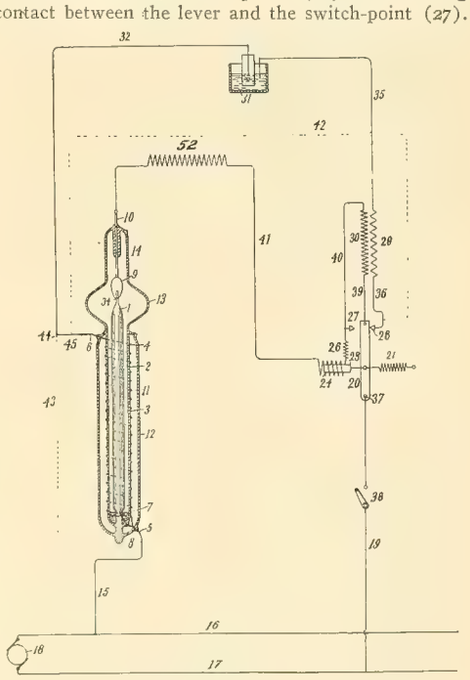
The accompanying drawing shows a vertical section of the lamp, combined with a diagram of the electric circuits. (1) is an inner tube or rod of suitable material, arranged centrally within a second tube (3) of transparent material, such as glass, so as to leave an annular space (2). Upon the tube (3) is mounted a coil or spiral of wire (4), this wire being of nickel, german silver, or other suitable material. The tube (3), together with its heating coil (4), is sealed into a glass tube (12), leaving a second annular space (11). Leading-in wires (5 and 6) pass through the tube (12) and are connected to the opposite ends of the conductor (4). The tubes (1) and (3) are joined together or braced in position at their lower ends, and a small quantity of mercury (7) is introduced into the bottom of the tube (3). A branch (8) from the leading-in wire (5) runs to the mercury (7), thus connecting the latter with the outside surface.

At the upper end of the tube (3) a bulb (13) is sealed on, having a narrow cylindrical portion (14) at its upper end. Within the bulb (13) and extending upward somewhat into the cylinder (14) is an electrode (9), constituting the anode of the lamp circuit. The anode (9) is connected to a leading-in wire (10), which passes out through the upper end of the cylinder (14). The tube (1) may have a projecting lug or extension (34) to steady the anode, and it may itself be braced or supported by any suitable means within the tube (3). It will generally be best to employ glass braces located within the bulb (13) rather than within the lighting-chamber formed by the annular space (2). The function of the bulb or enlarged chamber (13) is to constitute a cooling or condensing chamber, and the function of the projecting tube or cylinder (14) is to provide also for the collection of impurities, and so make the upper portion of the lamp perform the double service of cooling or condensing the vapors and purifying them through the deposition of the impurities contained therein.

The walls of the cylinder (14) will be cool relatively to the walls of the bulbous portion (13), the latter element being the one which discharges the greater portion of the condensing function. By reason of the position of the anode (9) at the mouth of the cylinder (14) the gases in the annular space at the mouth of the cylinder are made hot, thereby facilitating the passage of impurities into the cylinder, while at the same time violent currents of gas surging into and out of the cylinder (which might disturb the lodgment of gaseous impurities therein) are prevented. The annular space (11) is exhausted to a high vacuum to prevent as fas as possible the transfer of heat from the heated surface of the tube (3) by conduction and convection. The operating electric current passes through the annular space (2), proceeding from the annode (9) to the cathode (7). If desired, the tube (1) may be exhausted of air to reduce the pressure on its walls due to the heated atmosphere inside the tube when the lamp is operated. It is not necessary, however, that this should be done.

The operation of the apparatus as a whole is as follows: On closing the switch (38) current passes from the main (17) through the wire (19), switch-lever (20), contact-point (28), wire (36), primary of induction coil (29), wire (35), interrupter (31), wire (32), leading-in wire (6), heater-coil (4), leading-in wire (5), and wire (15) to the main (16). The current thus turned on causes the heater-coil (4) to become warm, thus heating the tube (3) and the space and matter within it, including the mercury. At the same time the interrupter (31) is at work, causing pulsations in the primary of the induction coil and an alternating electromotive force in the secondary (30).

As soon, now, as the mercury in the tube (3) has been warmed to a favorable starting temperature the secondary electromotive force causes a starting current to flow in the lamp, after which the lamp circuit is maintained in operation by the current from the mains. The current traversing the secondary of the induction coil also traverses the ballast coil (24) and is of sufficient quantity to cause the latter to attract its core (23), thereby moving the lever (20), breaking contact between the lever and the switch-point (28) and making contact between the lever and the switch-point (27).



POTTER MERCURY VAPOR LAMP.

By the first action the heater, the primary of the induction coil and the interrupter are cut out, and by the second action the secondary of the induction coil is short-circuited, thus protecting it from unnecessary and injurious heating due to the lamp current. If for any reason the lamp should go out, the lever (20) returns to contact with the switch-point (28), thereby bringing the circuits into the proper condition for restarting the lamp.

Instead of connecting up the heater in series with the primary of the induction coil and the interrupter the heater may be connected in parallel circuit with the other elements named, as indicated in dotted lines at 42 and 43. In that case a portion of the wire (32) between the points (44 and (45) will be cut away and the respective parallel circuits will have to be so modified as to operate across the voltage of the entire line.

A Mr. Wright has offered to subscribe $50,000 to the proposed 12-mile electric line to Chapel Hill, N. C., from Durham, if the people will put up the same amount.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE

Progress on Power Plant No. 2 at Niagara Falls, N. Y. By Orrin E. Dunlap. Illustrated....149, 150, 151
Hydro-electric Irrigation in Hawaii....149
Census Report on Electrical Apparatus and Supplies.150, 151, 152
Old Timers' Reunion....152
A New Laboratory Switchboard Jack. By F. C. Caldwell. Illustrated. (American Association for the Advancement of Science.)....152
Single-phase Power Transmission in New Zealand. Illustrated....152, 153
All-British Pacific Cable....153
Potter Mercury-vapor Lamp. Illustrated....153
Editorial....154
German Electrical Manufacturers. By Frank H. Mason. (U. S. Consular Report.)....155
Next Week's Edison Convention....155
Electrical Exports in July....155
Army and Navy Maneuvers....155
Electrical Workers' Strikes....155
Development of the Telephone Field. Illustrated...156, 157, 158
Strowger Automatic Telephone System. Illustrated...156, 157
Important Telephone Deal in Missouri....157
Telephone News from the Northwest....157
Indiana Telephone Items....157, 158
The Sad Plight of Elisha Robinson....158
Telephone Men....15
Railroad Telephone Line in Canada....15
General Telephone News....158
Manufacturers and Dealers....158
The World's Submarine Cables....158
Electrotechnical Industry in Russia. By Thomas E. Heenan. (U. S. Consular Report.)....159
Edison Automobile to be Tested....159
Stringent Wiring Regulations in New Britain, Conn., Modified....160
Electric Stocks Said to be a Good Purchase....160
Yerkes on London "Tubes"....160
Relative Economy of Central-station Supply and Private Power. By M. B. R....160
Production of Copper....160
More Telegraph and Telephone Combination Talk....160
Electrical Operation for Suburban Steam Lines in Newcastle, England....161
Manufacture of Incandescent-lamp Filaments from Paper. 161
Improved Composite Arc Electrodes....161

DEPARTMENTS.

Correspondence....161, 162
New York Notes....161
Canadian Intelligence....161
Information from Indiana....161
Northwestern Notations....161, 162
Personal....162
Electric Lighting....162
Electric Railways....162
Automobiles....162
Electrical Securities....162
Telegraph....162
Publications....162, 163
Space Telegraphy....163
Miscellaneous....163
Trade News....163
Business....163
Illustrated Electrical Patent Record....163, 164

CONVENTIONS AND EXPOSITIONS.

New York State Street Railway Association, Caldwell, N. Y., September 9th and 10th.

Association of Edison Illuminating Companies, Mount Washington Hotel, White Mountains, N. H., September 9th to 11th.

Kansas Independent Telephone Association, Kansas City, Mo., September 11th and 12th.

Old Time Telegraphers and Historical and United States Military Telegraph Corps Association, Salt Lake City, Utah, September 10th, 11th and 12th.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

ONE swallow does not make a summer, and one month's electrical exports may not prove to be a true indication of the coming year's business. But if the returns for July should be typical of the 11 months to follow, the fiscal year ending June 30, 1903, will be a very successful one for electrical exporters, for that month shows about 32 per cent. increase in electrical exports over the corresponding month of 1901. This is a decided reversal of conditions, compared with the spring and early summer months, and gives ground for hope that the foreign electrical business of the country during the coming fall and winter may be better than ever before.

MR. FRANK H. MASON, the very efficient consul-general for the United States in Berlin, comments most intelligently on the electrical manufacturing situation in Germany in a report reprinted on another page in this issue. He shows how the industry was artificially stimulated in former years and how, in a period of depression following the "boom," the inevitable penalty was exacted. But it is thought that bottom has been reached in the industrial depression in Germany and that henceforth matters will be on the mend. The situation is not without some resemblance to one passed through in the United States several years ago. At the present time electrical industrials in this country are financiered on a different basis, and unless all signs fail the tide of prosperity is still at full flood.

NIAGARA FALLS has been a center of electrical interest for a dozen years or more, albeit the electrical utilization of the power on a large scale has been commercial only for the last seven years. But although the electrical public is now familiar with the original installation—which, often described before the technical societies and in the columns of the technical press, has become a classic—interest continues unabated in this great hive of electrical enterprises, owing to the various extensions, new plants and up-to-date improvements, on both the American and Canadian sides of the river. As is well known, work is now well advanced on the great 55,000-horsepower plant of "Power House No. 2" on the American side, and an article on another page in this issue describes the present stage of work on this unusual installation. It is with something of surprise that one learns that current from the first unit in this plant will be available in a month or so. The new power house, like the old one, is given the best that engineering practice has to offer at the time of its construction. When the entire plant is completed it will have a capacity of 105,000 horsepower and will be the largest electrical power-generating station in the world.

IN THE Neptune Bank station of the Newcastle-upon-Tyne (England) Electric Supply Company there is a Parsons steam turbine direct-connected to a 1,500-kilowatt alternator. This unit operates at 1,200 revolutions per minute. The alternator is mounted on its own bearings. A forced circulation of oil and cooling water passes around each bearing. The air pump and condenser are situated beneath the turbine, the three-throw air pump being direct-coupled to a slow-speed motor. The circulating pump is direct-coupled to a 45-horsepower motor. The mean total load in kilowatts is 1,442. Steam is carried at 196 pounds' pressure. Superheat is given as 76° Fahrenheit and the condenser vacuum as 27 inches. These data are particularly interesting when considered in connection with the estimate of the steam turbine given by Mr. W. B. Woodhouse in a paper describing this power station, and read at a recent meeting of the British Institution of Mechanical Engineers at Newcastle-upon-Tyne. It was with this unit in mind, then, that Mr. Woodhouse wrote: "As a prime mover of electrical machinery the steam turbine approaches the ideal. It runs steadily, is free from vibration, and needs little attention. The question of steam consumption has been the difficulty. In a communication made to this Institution last year the steam consumption per kilowatt-hour was given for a number of turbines; the figure steadily improved with the size of the machine. The Neptune Bank turbine bears comparison best with that supplied by Messrs. Parsons to Elberfeld, a machine of 1,000 kilowatts' output. With units of 3,000-kilowatt to 6,000-kilowatt output, such as will be demanded in the near future, the turbine promises to outstrip all competitors." This would have seemed to be a bold prediction two years, even one year, ago, but, after years of slow progress, events are now moving with rapidity in steam-turbine development. When some of the great steam electric power plants now building in American cities are in operation, interesting results may be looked for.

AMONG the mass of interesting material brought together at the recent electric-light convention in Cincinnati were some observations on the cause of gas explosions in manholes. Captain Brophy of Boston, a trained and careful observer, said: "We have had several gas explosions take place in manholes where there was nothing but telephone cables. We had no sparking from the cables themselves. We had so many of these explosions that I made a test and found that I got sufficient sparks between the cables, where they lay loosely together. The vibration of cars and heavy teams on the roadway above caused them to spark and ignited the gas, so that in every case I am led to believe you will find a flow of current over the surface of lead cables." This was corroborated by Lieutenant James Blake Cahoon of New York in these terms: "Many of the explosions of gases in manholes and in conduit systems are due entirely to the static charge which exists on the cables, and which is set off, if I may use the term, by the jar of heavy wagons and of cars jumping over bad joints. That seems to be about the only feasible explanation which we can give of these explosions in manholes and conduits; we cannot otherwise account for them." If it is accepted as true that explosions are caused by sparks from static charges on lead cables, some means can and should be found to dissipate the charge and the danger at the same time. And so another task is apt to fall on the already overburdened underground operating department.

IF IT be not lese-majesty, we must confess that, in the past, we have had no great confidence in the accuracy of the census reports on manufactures. It is difficult to gather reliable statistics of this class, and from a careful examination of the Census Bureau's recent bulletin of manufactures of electrical apparatus in the state of Illinois we became convinced that the figures for 1890, at least, were utterly unreliable. It does not follow, of course, that the government reports for 1900 are to be looked upon with equal suspicion, and, indeed, the manufactures statistics of the last census bear on their face evidence of greater accuracy in collection and preparation than those of any preceding census. We are particularly moved to this last observation by a comparison of the census report on the manufacture of electrical apparatus and supplies in the year ended June 30, 1900 (issued last week and published, in abstract, in this issue), and the Western Electrician's estimates of electrical manufactures for the year ended December 31, 1900 (published January 5, 1901). These periods are only partially coincident; but, as the Western Electrician's annual estimates are very carefully made, the government figures, if reasonably accurate, should show no very wide divergence. It is gratifying to observe that such is the case. Bearing in mind that the classification is not exactly the same, and that the time-periods reported, while of equal duration and lapping for six months, are not coincident, the figures published by the Western Electrician a year and a half ago and those made public by the Census Bureau last week are very similar. Reducing both sets of figures to equal terms, as nearly as possible, comparisons run as follows:

	Government.	Western Electrician.
Total electrical manufactures	$104,738,719	$119,950,000
Dynamos, motors and motor-generators	30,357,827	36,000,000
Transformers	2,962,871	2,600,000
Batteries of all kinds	3,679,945	3,950,000
Carbons	1,731,248	1,625,000
Arc lamps	1,827,771	1,325,000
Incandescent lamps	4,036,112	3,400,000
Telephone apparatus	10,512,412	17,500,000
Insulated wire and cable	21,292,001	25,600,000

The similarity of these two sets of figures is quite remarkable. The only serious discrepancy is in telephone apparatus, and in this department we think the government figures are too low. The approximate coincidence indicates that both the Western Electrician estimates and the census report are substantially correct.

German Electrical Manufacturers.[1]

By Frank H. Mason.

What is called in headlines by the German press, "The Catastrophe in the Schuckert Electrical Company," has, during the last week recalled public attention sharply to the conditions under which some of the great electrical corporations of Germany were promoted and the embarrassments which some of the methods employed have more or less inevitably entailed. The event alluded to was a meeting on the 26th instant (of July) of the stockholders of the Schuckert Electrical Company at Nuremberg, at which the managers announced that, through depreciation of plant and material, insolvent accounts, and necessary appropriations for a reserve fund to meet further depreciations, the company had suffered losses aggregating 15,500,000 marks, or something more than $3,500,000. As the Schuckert company is one of the foremost corporations of its class in Europe, with an up-to-date plant and all the accompaniments of a large business, some surprise has been expressed that its affairs should make such a bad showing for its shareholders.

The explanation leads back to the fact, now well known here, that the sudden rise of some of the German electrical companies into corporations of vast resources and activities was, in some cases at least, the result of skillful and artificial creation of markets for products, rather than the supply of an actual and legitimate demand. Concisely stated, some of these companies bought their orders for electrical installations and materials by financial operations that left them shareholders in many enterprises which have since proven less promptly lucrative than had been hoped, and have thus drawn more or less heavily upon the capital of the parent companies.

To understand how all this came about, it should be remembered that German progress in electrical science was for a long time far in advance of popular appreciation of its advantages. The companies organized and equipped for the manufacture of lighting and power plants could not wait for the slow growth of public demand for such improvements, and they therefore undertook to finance and erect such installations themselves, confident that, once established and in use, the public would not fail to appreciate them and invest in their securities. This went very well for a time. It created a large and ready market for electrical machinery and materials at high prices, and supplied hesitating municipalities with electric tramways and lighting plants which their citizens greatly enjoyed, but which were built and for a time managed by the electrical manufacturing companies at their own expense. Inevitably, this process of consuming their own capital necessitated heavy loans and frequent increases in the stock of such corporations, together with a steady expansion of their manufacturing capacity. Some of the companies, especially the Schuckert corporation, made enormous investments in electric installations for the manufacture of calcium carbide, putting in the machinery at their own prices, but receiving for it little or nothing except stock in the carbide plants. Thus the supply of acetylene material was soon far beyond all legitimate requirements, prices collapsed, and the carbide industry suffered a serious and permanent reverse.

Another heavy blow for some of the German electrical manufacturing companies has been the failure of the storage-battery traction system for tramways, which is now conceded to be practically hopeless. When electric traction was introduced into this country, municipal governments were timid and hesitating. They objected to the overhead conductor because it was considered unsightly and dangerous, and in order to obtain any franchise at all the tramway companies and the electrical manufacturers who were behind them, had to agree to furnish cars that would dispense with a visible trolley. This meant either the underground-conduit system—which is so expensive to construct as to be justified only by an enormous traffic—or a reliance upon storage batteries, and the companies generally had recourse to the latter. The extent to which this has been done may be inferred from the fact that one company in Hanover has at present 274 accumulator cars in service. There, as at Halle, Hagen, and many other places, they have been found so heavy, costly, and subject to explosions as to be unremunerative. At Berlin, where many hundreds of them have been in service, all are to be abandoned and recourse had to underground conductors for centrally located streets and overhead wires for the less crowded and suburban sections.

The net result of all these conditions was that some of the electrical manufacturing companies of Germany which had gone on organizing and supplying power, lighting, carbide, and other plants, not only at home, but in Russia, Scandinavia, Austria-Hungary, and other European countries, were caught with all sail spread by the turning tide and adverse gale that set in during the summer of 1900. In the stormy weather that ensued, most industrial stocks declined sharply, the investing public became alarmed and timid, the failures of the Leipziger and other banks followed a few months later, and led on to the situation of which the meeting of last week at Nuremberg has been the ultimate result.

The encouraging features of the present condition are the fact that the credit of several of the oldest and strongest of the electrical companies remains unshaken, the general feeling that the bottom has been reached, that the obligations entailed by a system of forced development have been mostly liquidated, and that with the good cereal crops that will be harvested this year, peace throughout the world, and the hoped-for renewal of the commercial treaties which are to lapse next year, the foundation will be laid for a renewed and enduring prosperity.

1. This is a United States consular report dated at Berlin, August 1st. Mr. Mason is the well-known consulgeneral in the German capital.

Next Week's Edison Convention.

The twenty-third convention (eighteenth annual meeting) of the Association of Edison Illuminating Companies will be held at the Mount Washington Hotel (located near Mt. Pleasant House Station, N. H., on the Boston and Maine railroad) commencing Tuesday morning, September 9th. The convention will probably last four days, with a morning and a night session each day, the afternoon being devoted to recreation. One feature of the entertainment will be a golf contest. Indications point to a very successful convention from every point of view. Following is a list of the papers to be read:

"Recent Developments in Distribution System in Boston," by Sidney Hosmer, Boston; "Aspects of Safety and Reliability in High-tension Transmission and Distribution of Current from Annex Stations in Large Cities," by Philip Torchio, New York; "Construction and Operation of Underground High-tension Transmission," by H. J. Gille, St. Paul, Minn., and H. G. Carlton, Chicago; "High-tension Work in the Far West," by George H. Lukes, Chicago; "Development of New Forms of Illumination and Their Possible Influence on Central Stations (Nernst Lamps, Hewitt Lamp and Wellsbach Arc Lamp)," by George Eastman, Chicago; "The Effect of the Nernst Lamp Upon Methods of Illumination," by Murray C. Beebe, chemist, Nernst Lamp Company, Pittsburg; "The Distribution of Light from Incandescent Lamps as Affected by Shades Commonly in Use," by John W. Howell, engineer Edison Lamp Works, Harrison, N. J.; "Original Researches in Electrical and Chemical Laboratory," by Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.; "The Order System and Its Influences Upon Cost," by William M. Anthony, Chicago; "Campaigning for Business," by John F. Gilchrist, Chicago; "Advertising and Canvassing," by Arthur Williams, New York; "Commercial Conditions with Customers," by J. T. Maxwell, Philadelphia; "Some Problems in the Design, Development and Operation of Large Central-station Systems," by P. Junkersfeld, Chicago; "Utilization of Waste Energy of Central Stations," by W. H. Schott, Chicago; "Steam-pipe Covering and Its Relation to Station Economy," by Henry G. Stott, superintendent motive power, Manhattan Railway Company, New York; "Coal," by Robert Lindsey, Cleveland, and W. L. Abbott, Chicago; "Storage Batteries," by Gerhard Gottling, Boston; "Integrating Electric Meters and the Meter Department," by George Ross Green and P. H. Bartlett, Philadelphia; "Checking Electrical Instruments," by Dr. C. H. Sharp, test officer, Lamp Testing Bureau, New York; "Automatic Voltage Regulators," by W. S. Andrews, Schenectady; "The Use of Superheated Steam," by Charles H. Parker, Boston. Besides these papers there are other subjects prepared for presentation, the reports of various committees and the usual open discussion of the many papers and subjects presented.

The officers of the association are: President, Louis A. Ferguson, Chicago; vice-president, A. W. Field, Columbus, Ohio; treasurer, Alex Dow, Detroit, Mich.; secretary, Walter H. Johnson, Philadelphia, Pa.; assistant secretary, Wilson S. Howell, New York city.

Electrical Exports in July.

During the month of July, 1902, the electrical exports of the United States amounted in value to $835,665, as compared with $631,880 in the corresponding month of 1901, showing the gratifying increase of 32 per cent.

By the United States Treasury Department's classification electrical exports are divided into two classes—"electrical machinery" and "electrical appliances, including telegraph and telephone instruments." In the latter class the figures are: July, 1901, $238,803; July, 1902, $323,470. The increase here was $84,667. In electrical machinery these are the figures: July, 1901, $393,077; July, 1902, $512,195. The increase is $119,118. Thus the total increase is $203,785, or 32 per cent., as stated above.

Classified according to destination, the exports of electrical machinery for July, 1902, to some of the most important buyers, were as follows: United Kingdom, $290,636; British North America, $81,013; Brazil, $47,079; Mexico, $28,072; British Australasia, $24,328; Argentina, $7,986; Chinese Empire, $3,977; Germany, $3,594; Africa, $3,317; West Indies and Bermuda, $2,583. With the exception of Germany and Africa, all the above amounts show an increase over the corresponding month in 1901.

The placing underground of all electric wires has begun in Augusta, Ga. Five companies will comply with the city ordinance.

Army and Navy Maneuvers.

Electricity will, in the event of any attack on the United States coast line, play an important part in its defense. The joint army and navy maneuvers along the New England coast, like the recent navy maneuvers, have shown how important is the electrical communication between defending ships and forts.

The joint maneuvers were opened up on September 1st when Admiral Higginson, commanding the North Atlantic Squadron, attempted to storm the forts on the coast of Connecticut (New London) and thereby enter Long Island Sound. The attacking squadron at first attempted to run into the Sound under cover of darkness, but the electric searchlights of the different lookout stations discovered the boats before they were within three miles of the forts, although there was a heavy fog hanging over the water. This made a forced passage necessary, as the lookout stations immediately warned one after another of the forts either by telephone, telegraph, or space-telegraph messages. So complete and accurate was the system of communication that special comment was made upon it by General MacArthur in a telegram to Washington.

In no case were the ships able to change their plan of attack without the defending forces being aware of the intention, first through the medium of the searchlight and then through the various means of intercommunication. The wireless-telegraph systems worked admirably between General MacArthur's headquarters at Fort Trumbull, New London, Conn., and the various forts, messages being exchanged with great accuracy. Eight different wireless-telegraph stations were employed covering four different systems—the Marconi, the De Forest-Smythe, the Fessenden, and the Standard.

The requirements under which the attacking vessels worked required them to get by the forts and out of range before the guns of the forts could be trained and brought into general action. The failure of this attempt, as was said before, was chiefly owing to the use of the searchlight which made the waters of the different harbors so light that, by the aid of a night glass, persons could be counted in the different small boats in the offing.

Electrical Workers' Strikes.

The electrical workers (wiremen) in Chicago are still at outs with the Chicago Edison Company, and there seems little prospect of an early settlement of the matter. In the Marshall Field retail building the carpenters are putting in the molding for supporting and covering wires, while the gasfitters are installing the piping for electrical wires. The wiring, however, will stand unfinished until some sort of a settlement is reached between the wiremen and the Chicago Edison Company.

Along the same line comes the news of a strike of the electrical workers in Philadelphia, Pa. On August 25th 200 men walked out, and accordingly a great deal of important work is suspended. Among the firms affected are the following: M. R. Muckie & Co., J. F. Buchanan & Co., Francis Brothers & Jellett, Standard Electric Company, Walker & Kepler, Keller, Pike & Co., McIntyre & Co., and the D'Olier Engineering Company. The most important new buildings which are affected are the Girard Bank, the new Stock Exchange, Keith's Theater and the Annex to the Drexel Institute. The cause of the trouble was a dispute between the contractors and the electrical union over a three-year agreement signed last June by both parties. The electrical workers assert that the contractors were not living up to the agreement.

In Boston a strike of the electrical workers was also called on August 25th, when, it is said, fully 500 men walked out of the different buildings on which they were employed. The trouble stopped work on important buildings, among which are the Board of Trade Building, Journal Building, Conservatory of Music, Terminal Chambers, and Cunard Building. The trouble in Boston seems to be over the length of a work day and the amount of wages. The men demand a minimum wage of $3 for journeymen and $2 for helpers, the day to be of nine hours' duration.

According to a decision rendered by Attorney General Sheets of Ohio, building and loan associations cannot purchase the bonds of electric-railway companies and deposit them as securities. The state law provides that insurance companies may purchase the bonds of railroad companies that have not defaulted interest in three years and deposit them as security. Mr. Sheets holds that this does not apply to the bonds of electric railways. Why this discrimination is made does not appear.

DEVELOPMENT OF THE TELEPHONE FIELD.

Strowger Automatic Telephone System.

The Strowger automatic system of telephone operation has been before the public for a decade, and for nine years apparatus designed in accordance with the patents has been giving service. Mention has been made in the Western Electrician of the German installations of the system and also of some of the American plants, both early and late. Within the last two or three years the system has been greatly improved, and the following description of it should be of interest to all who follow telephone development.

With the prefatory statement that the system is devised to supplant the telephone-exchange operator by automatic appliances, the instrument at the subscriber's station will be first considered. The automatic telephone instrument consists of the usual transmitter, receiver, bells, battery and induction coil, with the addition of the selector calling apparatus, which occupies a space of five by three by two inches just above the battery, about two-thirds of

FIG. 1. STROWGER AUTOMATIC TELEPHONE SYSTEM.—WALL INSTRUMENT.

the space occupied by the ordinary magneto generator. The type of wall telephone is shown in Fig. 1. On the front of the box is the metal calling dial, 3½ inches in diameter, on the right side of which and along the edges are 10 finger holes numbered consecutively from 1 to 0. A stop is provided at the lower of the holes to limit the distance which the dial may be revolved.

To call a number, say, 761, the subscriber first takes the receiver from the hook, then, placing his finger in the hole No. 7, turns it around to the stop above mentioned; releasing it, the dial is instantaneously restored to its original position by a spring. The subscriber is now connected to a trunk line leading to a group of switches which are called the seventh hundred group. In the same manner he then calls 6 and 1 in this group. Having turned the numbers desired, he presses a button which rings the bell of the person wanted, and the connection is completed. About a second for each decimal is all the time required. In the event that the desired subscriber is busy, a buzzing sound in the receiver notifies the caller that such is the case.

The standard wall telephone (Fig. 1) is ordinarily made of polished oak, but any wood and finish can be given that may be desired. The telephone is 22 inches in height, 7½ in breadth, and five inches in depth. The calling dial is nickeled and highly polished and adds much to the appearance of the instrument.

A handsome desk set is made for office use. The case and pedestal are of drawn brass, highly nickeled. The instrument stands 12 inches high. For special office use where the regular desk telephone is not desired, a pedestal telephone is made.

The transmitter, which has been specially designed, has a cup formed from No. 9 steel. The front cap is formed from No. 9 brass. The arm is formed from No. 14 steel, made in two pieces; the base is formed from No. 12 steel. In assembling the instrument the metal diaphragm is placed in the cup; the back cup is then screwed into the cap after which the arm is screwed into the cap covering the cup. This method of building a transmitter is very simple and makes it an easy matter for the inspector to open and repair it.

The receiver has a shell made of the best hard rubber, with removable cap. The receiver is made of the regular double-pole type with concealed terminals, the permanent magnet, as well as the electromagnets, being firmly mounted in a brass cup which is in turn held in place by the receiver cap. The instrument is accurately adjusted and will permanently hold its adjustment.

The most unique and interesting part of the Strowger system is the automatic switch, which is set up in banks to form the central exchange switchboard. Front, side and rear views of the switch are shown in Figs. 2, 3 and 4, respectively. The device is 13 inches in height, 4½ inches in depth, and four inches in breadth. The upper half of the device consists of six relays, two main-line and four local, which operate the selective parts of the lower half. The latter consists of three sets of banks of 100 contacts each, one busy and two line banks, arranged in 10 rows of 10 contacts each, mounted on a semicircular structure, the axis of which is a vertical rod, about the size of a lead pencil, upon which is fixed a short contact arm about 1½ inches in length.

The rod has both a vertical and a rotary motion, each controlled by one of the magnets above mentioned. When the subscriber calls 76, for instance, the rod is lifted vertically by the first movement of the subscriber's dial, which sends a current over one side of the two-wire circuit, thus raising the rod step by step to the seventh row of contacts. The second movement of the subscriber's dial sends the current over the other side of the circuit, and the controlling magnet gives the rotary motion to the rod which moves the contact arm to the sixth contact in the seventh row, thus securing the connection with 76. When the caller hangs up his receiver, current is sent over both wires of the circuit, releasing the selector rod, which goes back to its original position.

The magnets, armatures, springs, coils, and, in fact, all parts of the switch are made of the best material that can be purchased. All bearings are of hardened steel, and no expense is spared in securing first-class workmanship. The number of parts has been reduced to a minimum. There is nothing to wear, so that this machine, which is the very heart of the automatic system, is believed to be as near perfection as it can be made.

The uppermost bank is the "busy" bank, and consists of 100 spring brass contacts arranged in 10 rows of 10 contacts each, bound and held together by two steel plates, machine screws, and hexagonal brass nuts. The insulation used consists of empire bond paper, treated with linseed oil, with a fiber filling. The "vertical" and "rotary" banks are similar in structure and consist of 100 contacts, each arranged in five rows of 20 contacts to the row. All banks are wired with No. 24—one cotton and two silk—beeswaxed and tinned switchboard wire. The vertical and rotary bank wires are twisted in pairs throughout the system. In all cases only the highest grade of insulated wire is used.

The manner in which the banks are wired and the soldered connections are made is shown in Fig. 5, which represents 10 banks completely wired and ready to be attached to the switch frame and mounted upon the shelves. The terminal head is also exhibited, showing how the wires from each contact are caught up and brought into the terminal. The interconnecting wires to the next shelf are connected to this terminal before mounting.

The automatic switches are mounted on wooden shelves, 25 switches to the shelf, each board containing six shelves, or a total of 150 switches. The actual floor space occupied by such a switchboard is 11 feet six inches by eight inches; the floor space required is three by 12½ feet, while the space allowed in making calculations for room is 39 square feet. A very important feature of the automatic switchboard is that it can be increased to any capacity by simply adding new sections, with the desired number of switches mounted thereon, without rewiring or in any way interfering with existing conditions.

About 90 per cent. of the electrical contacts and connections on the automatic switchboard are made at the factory. These connections are made under the most advantageous conditions, and are thoroughly and repeatedly tested so that their permanency is assured. The automatic switchboard requires no more room than the manual board, and no space or accommodation for the operators is needed.

The automatic system enables a large factory or business house to have a private exchange in which any number of its telephones may be connected, by any desired number of trunk lines, with the automatic exchange of the city in which the concern is located. Under such a system no operator is needed for either exchange, and the local and outside business is carried on without any conflict whatever. The meter system can be introduced, by means of which all service over the city exchange lines can be measured. In appearance these meters resemble a cyclometer, and one is attached to each individual switch. Its operation is automatic, and it records every connection secured by the telephone having the same number as the switch to which it is attached.

In a system of 100 to 1,000 subscribers the trunking feature is introduced. Ten trunk lines have been found sufficient to do the business of each 100 subscribers, but the automatic system is not limited to this number of trunks, and any percentage can be given. A board equipped for 1,000 subscribers would, therefore, have 1,000 selector switches and 100 connector switches, or, in manual phraseology, 100 pairs of cords, unless a greater percentage of connectors should be required. The connector switches are arranged in 10 groups of 10 switches each, and each group is capable of connecting to 100 subscribers; the first group connecting subscribers whose numbers are between 100 and 200, the second group connecting those between 200 and 300, and so on. In calling, the first movement of the dial would pick out one of the 10 trunk lines leading to the hundreds group desired. The next two movements would connect with the desired number in that group. To illustrate, it may be said that number 761 is wanted. Number 7 on the dial being revolved, the subscriber is automatically connected with one of the 10 trunk lines leading into the seventh group of hundreds. The next two movements, numbers 6 and 1, select the number 61 in that group, and he is immediately connected with the desired number. The apparatus automatically selects the lines which are not busy. If the first trunk line is engaged, the

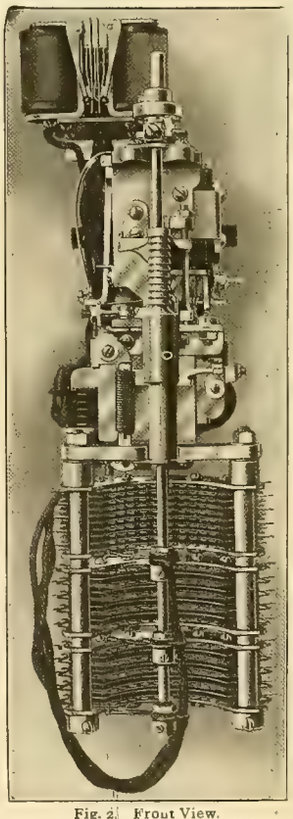


Fig. 2. Front View.

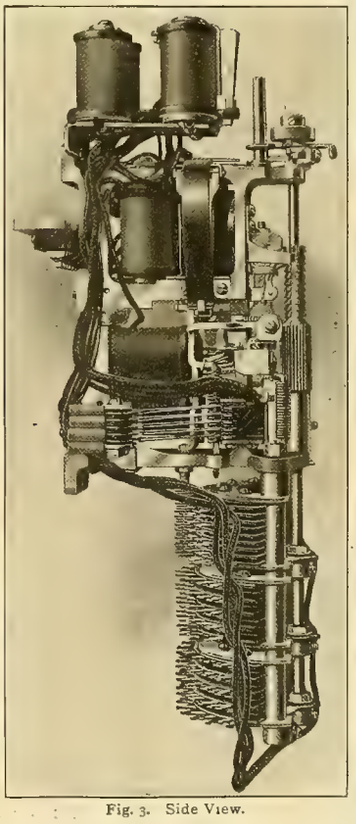


Fig. 3. Side View.

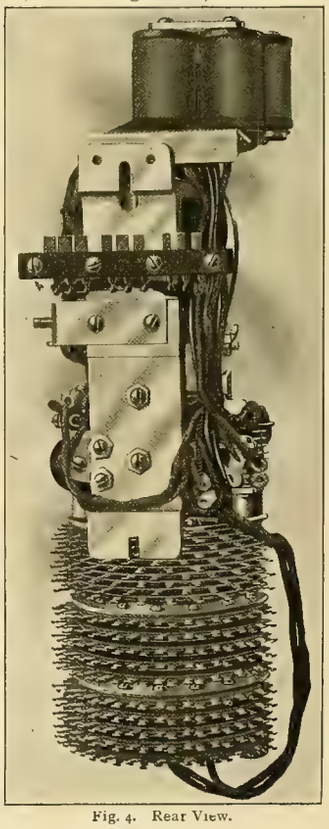


Fig. 4. Rear View.

STROWGER AUTOMATIC TELEPHONE SYSTEM.—AUTOMATIC SWITCH AT THE EXCHANGE.

connecting arm passes over it and selects the second; that being engaged also, it selects the third, and so on, until a disengaged line is found.

The method of operating an exchange of from one to 10,000 is simply an extension of the trunking system. In a 10,000-subscriber exchange there would be 10,000 first selectors, 2,660 second selectors, and 1,500 connectors. The subscriber wanting to get number 7,654 would, therefore, by the first movement of the dial, automatically select one of the trunk lines of the 7,000 group; the second movement would put him in the seventy-sixth group of hundreds; the last two movements would select the party desired, and give him the connection.

The current for operating the bell-ringing and signaling apparatus is generated at the central exchange, 50-volt storage batteries being used, which can be charged from a direct-current circuit. In case this is not available, a small motor-generator can be used to charge with. The line current only amounts to from 0.05 to 0.1 ampere, while the local current requires about 0.5 of an ampere. A pole-changer is used to operate the ringing circuit, the busy signal and trunk selectors in small exchanges.

Fig. 6 is an illustration of the original automatic

FIG. 5. STROWGER AUTOMATIC TELEPHONE SYSTEM.—SET OF 10 CONTACT BANKS AND TERMINAL.

exchange installed for the German government in Berlin. This exchange, with 400 stations, was constructed to demonstrate the practicability and secrecy of the automatic system and its superiority to the manual, and was operated under the auspices of the Imperial German Postoffice from May 20, 1900, to July 7, 1901. During this period official telephone experts carefully watched the operation of the exchange, and every test was applied to discover its weak points. The service of the system was so satisfactory that at the end of the period above mentioned it was officially accepted for introduction into the German empire, and the experimental plant was paid for and made a part of the Imperial telephone system. Since then German telephone engineers have spent months at the factory in Chicago, making a thorough study of the system and the methods of manufacturing, with a view to superintending the making of apparatus at the factory which has been built at Carlsruhe, and the installing of official automatic exchanges throughout the German Empire.

The manufacturing rights of the Strowger system in the United States are controlled by the Automatic Electric Company of Chicago. This company is capitalized at $3,000,000 and has recently secured the lease of a new six-story and basement brick factory building at the corner of Van Buren and Morgan Streets. The building has a floor space of between 98,000 and 100,000 square feet. Machinery is now being transferred from the present factory at Washington and Union Streets, and by January next the new works will be in full operation. The company is under contract to turn out 45,000 telephones by February 1st. Part of these orders are for exchanges in Columbus and Dayton, Ohio, and the contracts were obtained after an inspection trip given to a party of telephone men from Ohio, Michigan and New York by the company to the New Bedford and Fall River (Mass.) exchanges, each of which operates a 1,000-subscriber Strowger automatic system.

This trip, which was taken about two months ago, was participated in by about 20 gentlemen, including such men as H. D. Critchfield, John T. Barlow, James C. Reber, Maxime Reber, W. C. Pritchett, H. A. Lanman and F. R. Davis of Columbus, Dayton and Cleveland, Messrs. Land and Tarte of Grand Rapids, Mich., and Joseph B. Ware of Detroit, Mich. The party was under the guidance of Joseph Harris, general manager, A. E. Keith, general superintendent, and J. F. Crook, advertising manager, respectively, of the Automatic Electric Company.

As a result of the trip, contracts were closed for a 7,000-line exchange for the Citizens' Telephone Company of Columbus, and a 6,000-line exchange for the Dayton Home Telephone Company of Dayton, the ultimate capacity of each exchange being 10,000 telephones. The Columbus exchange is to take the place of a manually operated multiple system that was installed about two or three years ago. The old wires, conduits and distribution system will be used, but a new building will be erected especially for the automatic switchboard. It is expected that $50,000 a year will be saved with the new system by dispensing with the operators. The maintenance cost will be about the same. At Dayton a new building will also be built, and the whole exchange will be new, as at present there is no Independent company operating there. The Automatic company is under contract to install both systems by February 1st, and one of the provisions is that the service will be as efficient as at the automatic exchange in Fall River.

Besides the above orders, the Automatic Electric Company expects soon to close contracts for about seven exchanges of over 5,000 subscribers each in Ohio and Michigan cities. The company is also working on an order for 25,000 telephones for the Illinois Telephone and Telegraph Company, to be installed in Chicago by April 1, 1903, and has a further order from the same company for 75,000 more, to be delivered as needed.

Important Telephone Deal in Missouri.

A telephone deal of some magnitude has been consummated in Missouri. It involves the telephone systems of the towns of Joplin, Webb City, Carterville, Oronogo and Carthage. The company which controls the above-mentioned exchanges is known as the Mineral Belt Telephone Company This company was sold to Theodore Gary of Macon, Mo., as the head of a new company, the consideration, it is said, being $250,000. The number of telephones controlled by the old company was 2,200, but extensive improvements are under way, including a multiple switchboard with an ultimate capacity of 4,000 telephones, and these improvements will be continued by the Gary company.

The new company will issue $150,000 of 5½ per cent. 10-year bonds, and will attempt to confine the sale of these bonds to people living in the district which it serves. The capitalization of the company will be $200,000, of which $75,000 will be preferred stock.

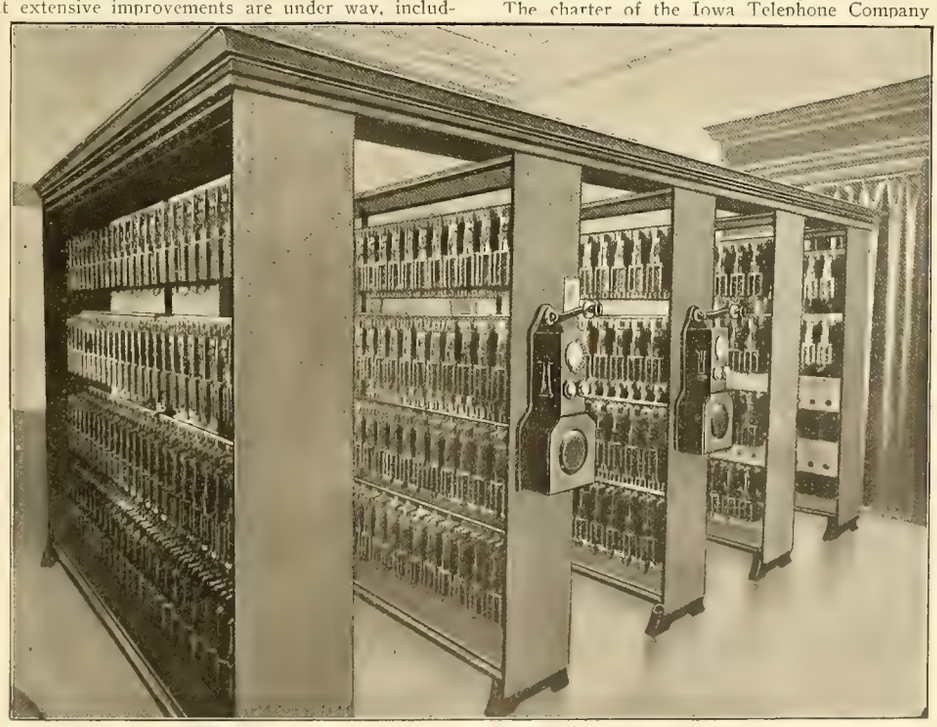


FIG. 6. STROWGER AUTOMATIC TELEPHONE SYSTEM.—BERLIN EXCHANGE.

The Bell Company has completed its new system at Richmond, Va., which is equipped with all modern devices. Over 3,400 lines are now installed and the switchboard has a capacity of 3,800 additional lines. One thousand of the telephones will be equipped with the nickel-in-the-slot attachment.

Telephone News from the Northwest.

The Northwestern Telephone Exchange Company is building a long-distance line from Crookston, Minn., to St. Vincent. Warren, Minn., is on the route. The local telephone company sought to make arrangements for connection, but the Northwestern would do so only on its own terms, which the local company would not accept. Now the City Council of Warren informs the Northwestern that unless it will make connections with the local concern, it will not be admitted to Warren. And the rumor is that the company will build around Warren.

The stockholders of the Badger State Long-distance Telephone Company met at Janesville, Wis., and decided to allow the company to be sold under mortgage foreclosure. A pool will be formed, however, to buy in the system.

The Marshfield (Wis.) telephone exchange may install a central-energy system.

The Elbow Lake (Minn.) Telephone Company has raised the capital stock of the company from $10,000 to $50,000.

The Vought-Berger Company of La Crosse, Wis., manufacturer of telephone instruments and supplies, has secured a larger building for its plant.

The Cedar Valley Telephone Company of Cedar Falls, Iowa, has issued a warning to farmers not to purchase poles from a young man who represents himself to be in the employment of that company. His game is to sell the telephone poles to farmers for fence posts or wood. He is careful not to try anyone with telephone connection. He represents that the line is to be abandoned, and the poles are a dead loss unless sold at some price.

O. H. Eaton, a farmer near Sioux City, Iowa, "held up" a party of linemen of the Iowa Telephone Company who were running a line across his land. The company sought to buy a right-of-way, but Eaton would not sell. So condemnation proceedings were resorted to. Eaton was finally convinced that the party was moving legally, and retreated with his shotgun.

The Hawkeye Telephone Company of Des Moines reports a very strong demand for rural telephone service from farmers of Polk County.

The Jasper County Telephone Company has built a copper-circuit toll line into Des Moines, and gives connection with a large number of cities, including Grinnell, Oskaloosa, Ottumwa, Marengo, Marshalltown, Iowa City, Cedar Rapids, Muscatine, Keokuk and Burlington.

Farmers are making a heavy demand upon the Cedar Valley Telephone Company for rural connections, and are ordering connections faster than they can be put in. One farmer was determined to be supplied, and camped in the office until he was offered $2 a day to serve as lineman, which convinced him of the scarcity of help.

The charter of the Iowa Telephone Company in Dubuque will expire in September, and it is understood that the company will seek a renewal. R.

Indiana Telephone Items.

Last week the State Tax Board paid attention to appeals from the valuations it made on telegraph and telephone companies early in the session. Members of the board said they had altered many valuations and were inclined to be lenient toward the telephone companies. Telephone men before the board testified, almost without exception, that the low rates with which the public is furnished telephone service makes it impossible for the companies at the present time to reap large profits from the business. However, on account of the increase in

the number of companies now operating in the state, of which rural lines form a good share, the total assessment on telephones will be $600,000 higher this year than last. The hearing of appeals demonstrated that a great many companies, in order to obtain franchises, had agreed to furnish telephones at rates that are too low.

The Western Union Telegraph Company has asked the United States court perpetually to enjoin the tax board from certifying the valuation made of its property this year. The board fixed the valuation of its property in this state at $2,242,722, while the company says it should not have exceeded $1,164,662. The board reduced the valuation from $63 to $57 a mile, but this reduction did not satisfy the company, hence the suit.

City Attorney Funkhouser of Evansville still insists that the municipal telephone plant will be a reality, and that it will be but a few months until the system is in operation. F.

The Sad Plight of Elisha Robinson.

[From the Pekin (Ill.) Times.]

Elisha Robinson of Harker's Corners, Peoria County, has filed a suit against George Blandin of the same locality, asking that he be given damages in the sum of $2,000. A writer, in speaking of the suit, says that for charging him with electricity until he became a veritable human battery, to whom knives, forks, razors, nails and all steel objects cling with a strange pertinacity, rendering it dangerous for him to enter a hardware store or blacksmith shop, he wants George Blandin to pay him the sum of $2,000. In addition to charging him with the strange fluid until he became a walking magnet, the complainant declares that his entire system was wrecked by the charge, and that since that time he has been physically incapacitated.

Service was served on Mr. Blandin a day or two since. The plaintiff declares that while a storm was in progress recently at the village some of the telephone wires in that vicinity were blown down. He was attempting to repair the damage when Blandin, who has a telephone on the line, went into his house and taking hold of the crank—these are the old-style telephones, which you have to wind up like a grindstone when you want to call anyone—rung with great vigor. This gave Robinson such a shock that he was unable to release his grasp on the wire by reason of the tremendous charge of the subtle fluid then running riot through his system. He was wound up like a Kansas grasshopper, and when the ringing stopped he was in a fearful state.

The first thing he noticed that led him to make the discovery that he had been transformed into a human magnet with great drawing power was when he came to shave on the following Sunday. No sooner had he applied the razor to his face than the weapon immediately stuck fast, and he declared that it took all his efforts, coupled with a great deal of skill, to get the blade away from his features without bringing a section of his face with it. Then he began to notice that the nails in the fences drew out when he came by, and for him to sit down at the table was to immediately become the target for a flying mass of cutlery. This did not only put him to discomfort but also delayed operations on the part of the rest of the boarders.

There is a good deal more in his history, much of it quite as nonsensical as the foregoing. At the September term of court Blandin will have to make answer to the wholesale charge of magnetizing Robinson in so cruel and heartless and agonizing a manner.

TELEPHONE MEN.

Levi Sprague, formerly president of the Erie Telephone and Telegraph Company, died at his home in Lowell, Mass., on August 28th, from heart disease. Mr. Sprague was 92 years old.

Chicago daily newspapers give prominence to the report that Mr. John I. Sabin may resign as president of the Chicago Telephone Company. The statement seems based on Mr. Sabin's declaration before the Board of Review that he "is not, never has been, and never intends to be a resident of Chicago." Mr. Angus S. Hibbard, the general manager of the Chicago Telephone Company, has long been a highly respected resident of the city.

Alfred Stromberg, president of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, has just returned from a 10-week trip to his old home near Stockholm, Sweden. Mr. Stromberg is much improved in health and enjoyed his well-earned vacation. While in Sweden Mr. Stromberg visited several telephone-manufacturing establishments, which he inspected with interest. Mr. Stromberg resumes his duties with renewed vigor and is working on a number of new inventions which will prove interesting to the telephone industry.

Railroad Telephone Line in Canada.

The Canada Atlantic Railway Company has about completed a private metallic-circuit telephone line between Ottawa and Depot Harbor, on the Georgian Bay. The system will be one of the most complete and up-to-date private systems possessed by any company. In its construction, covering a distance of 262 miles and return, about 534 miles of copper wire have been used. The object in inaugurating such a service is to relieve the telegraph lines and afford better communication with the elevators of the company, with which there is much detailed business transacted.

GENERAL TELEPHONE NEWS.

The Cumberland Telephone Company of New Orleans, La., is having considerable trouble through the strike of its linemen, which has been going on now for several weeks, and which was mentioned in the Western Electrician at the time of its inception. The telephone company has applied to the mayor for the right to arm its men in order that they may protect themselves. All attempts at a settlement of the strike have failed, and the Cumberland people are bringing workmen from the outside to take the strikers' places. The strikers have severely beaten several of these men, and this is the cause of the company's appeal to the mayor.

There has been recently published a combination directory of the exchanges and toll stations of the Henderson Telephone Company and Carolina and Virginia Telephone Company of Henderson, N. C., the Carolina Telephone and Telegraph Company of Tarboro, N. C., and the Interstate Telephone and Telegraph Company of Durham, N. C. The book—it has over 200 pages—is compiled and published by Frederick C. Toepleman, general superintendent of the Henderson Telephone Company, and is a most excellent piece of work. A folding map is given to show the toll lines and connections of the companies named. The lines represented on the map show a total of over 2,000 miles. The longest extends from Chase City, Va., to Beaufort, N. C.—a distance of 300 miles.

W. A. Hawkins of Mount Jackson, Va., who is at once a horticulturist, poultry farmer and telephone electrician, appears to be an enthusiast on farmers' telephone lines. He issues a neatly printed little sheet entitled Farmers' Telephone Pick-ups, and this is his "song-word," or, in more familiar phrase, the burden of his song: "Every farmer build and keep in repair one-half mile telephone line, and all in a county connect and mutually exchange courtesies." Mr. Hawkins' advice-word is as follows: "Keep it purely a farmers' system—owned, operated and controlled by farmers, having no entangling alliances with any party or company whose interest or intentions you may think do not coincide with yours, for they may cause you to depart from the path you have mapped out."

The Pittsfield (Mass.) city government has granted a franchise to the Berkshire County Telephone and Telegraph Company, an Independent company. This franchise allows the company to do business in Pittsfield. It contains a proviso that renders it void if the company sells, leases or otherwise disposes of its rights to any other person or corporation within five years from the date of the acceptance of the franchise. For every 2,000 inhabitants of the city the company must furnish one instrument free for municipal use, and whatever other instruments the city may require are to be furnished at 50 per cent. of the regular rates. The granting of this franchise prepares the way for a telephone war in Pittsfield. As the city government has passed an ordinance ordering that wires be placed underground, the Berkshire company will be compelled to build conduits for its wires.

MANUFACTURERS AND DEALERS.

The Eureka Electric Company of Chicago has just obtained a contract from the city of Chicago for furnishing telephone apparatus for the fire-alarm telephone service. This speaks well for the well-known Eureka apparatus, as this is the first Independent apparatus to be used by the city of Chicago, which had previously employed Bell apparatus exclusively. Eureka apparatus was selected after a competitive test with all the other leading makes on the market.

The Claypool Hotel, Indianapolis, a very complete hotel being constructed by the Indiana Hotel Company, will own and operate a complete telephone exchange, with telephones in each room, parlors and offices. The telephone service will be under the direction of the hotel management, and will be entirely for the convenience of the guests. The system will be connected with the public city exchange and state toll-line system, so that long-distance connection may be made from any part of the house. The equipment will be furnished by the International Telephone Manufacturing Company of Chicago, and will embody all the improvements in this line recently evolved by this company. The system will be a full central-energy, lamp-signal, double-supervisory switchboard equipment, with strictly long-distance telephones. The switchboard, cabinet work and the telephone woodwork will be of solid mahogany for the parlor floors, of white walnut for and ladies' parlors, and will match the fittings throughout the entire house. The International company is said to be having a large call for its special long-distance transmitter. It is reported that this instrument is designed and constructed along the most scientific lines, and is one of the loudest, most distinct and durable transmitters ever produced.

The World's Submarine Cables.

"The Submarine and Land Telegraphs of the World" is the title of a monograph prepared by the Treasury Bureau of Statistics, which will appear in the forthcoming Monthly Summary of Commerce and Finance. It presents some information regarding the submarine telegraphs of the world which is especially interesting at this time in view of the prospective construction of an all-American cable across the Pacific. It shows that the submarine telegraphs of the world number 1,750. Their aggregate length is nearly 200,000 miles; their total cost is estimated at $275,000,000, and the number of messages annually transmitted over them is more than 6,000,000. Adding to the submarine lines the land-telegraph systems by which they are connected and through which they bring interior points of the various continents into instantaneous communication, the total length of telegraph lines of the world is 1,180,000 miles, the length of their single wires or conductors 3,800,000 miles, and the total number of messages annually sent over them about 400,000,000, or an average of more than 1,000,000 each day.

Nearly a score of cables have been laid across the Atlantic, of which no less than 13 now successfully operate between the United States and Europe, while three others span the comparatively short distance between South America and the African and South European coast lines. The Mediterranean is crossed and recrossed in its entire length and breadth by numerous cable lines, and the "Mediterranean of America," the Gulf of Mexico and the Caribbean Sea, is traversed in all directions by lines which bring its islands and colonies into speaking relations with each other and with South America, Central America and the United States.

Every body of water lying between the inhabited portions of the earth, with the single exception of the Pacific Ocean, has been crossed and recrossed by submarine-telegraph lines. Even that vast expanse of water has been invaded along its margin, submarine wires stretching along its western border from Siberia to Australia, while its eastern borders are skirted with lines which stretch along the western coasts of the two Americas. Several adventurous pioneers in Pacific telegraphy have ventured to considerable distances and depths in that great ocean, one cable line running from Australia to New Zealand, a distance of over 1,000 miles, and another extending from Australia to the French colony of New Caledonia, 800 miles seaward. A cable which is to connect Canada with Australia, across the Pacific, is now being laid at the joint expense of the United Kingdom and the British colonies affected, and has already been completed from Vancouver, British Columbia, to Fanning Island, just south of the Hawaiian Islands, and it is expected that the entire line will be completed by the end of the present year.

The chief obstacle in the past to the construction of a transpacific cable was found in the fact that mid-ocean resting places could not be satisfactorily obtained or arranged for, no single government controlling a sufficient number of suitable landing places to make this seem practicable, in view of the belief that the distance through which messages could be sent and cables controlled was limited. With landing places at Hawaii, Wake Island, Guam, and the Philippines, however, no section of a cable stretching from the United States to Asia and touching at these points would have a length equal to that now in daily operation between France and the United States. The length of the French cable from Brest, France, to Cape Cod, Mass., is 3,250 miles, while the greatest distance from land to land on the proposed Pacific route would be that from San Francisco to Hawaii, 2,089 miles; that from Hawaii to Wake Island being 2,040 miles, from Wake Island to Guam, 1,290 miles, from Guam to Manila 1,520 miles, and from Manila to the Asiatic coast 630 miles. While the depth of the Pacific is somewhat greater than that at which any cable has been laid, the difference between its depth and the greatest depth reached by cables in the Atlantic would be very slight, the cable recently laid from Haiti to the Windward Islands being in 18,000 feet of water. The recent survey for a cable between the Pacific coast and Manila justifies the belief that a route can be selected in which the depth will not exceed 20,000 feet, and may not exceed 18,000 feet. The recent survey made by the Bureau of Equipment, Navy Department, under the direction of Rear-Admiral R. B. Bradford, disclosed the greatest ocean depths heretofore known lying between Midway Island and Guam, and being 31,614 feet, or but 66 feet short of six miles depth of water. This depression, however, which has been named the "Nero deep," in honor of the vessel from which the sounding was made, can be avoided by a detour, and it is believed that the necessary depth will not exceed 20,000 feet, and may not be more than 18,000 feet.

The members of the street-car men's union of the North and West Sides of Chicago have unanimously decided to submit to arbitration their differences with the Union and Consolidated Traction companies. Clarence Darrow was named as arbitrator for the union. The grievances of the South Side men are already in the hands of an arbitration board, so the strike that was threatened on all the surface traction lines in Chicago seems to be averted for the present.

Electrotechnical Industry in Russia.[1]

By Thomas E. Heenan.

Until recent times, the electric industry has made extremely slow progress in Russia. Unfavorable circumstances have combined to impede the industry and prevent it from reaching the level found in other countries. One of the principal causes of this lack of development was the absence of schools in which to educate electricians. Foreign engineers and specialists prefer to have recourse to materials and apparatus made abroad, of which they know the value, rather than to try to build factories and works in Russia for the production of the articles required by them. Of late, however, the government, private companies, and individuals have opened special schools for electricians, and, in addition, the special art and artisan schools have introduced an electrotechnical course. The influence of these special schools and courses has not been slow to make itself felt, and of recent years electric industry has made immense progress.

Many towns and cities are lighted by electricity, and electric tramways are numerous. Nearly all of the large factories and industrial establishments have adopted electric lighting and have applied electricity to the distribution of motive power. Electric energy has also been utilized in mining enterprises, particularly in the south of Russia. The use of electricity in soldering, in the extraction and refining of metals, as well as in certain electrochemical works, and in the production of carbons and hypochlorites, is now well developed in Russia.

With the increased and varied applications, the demand for apparatus has grown enormously, and dynamo machines, motors, transformers, lamps, conductors, armatures, etc., find a large sale. In response to this demand, workshops and factories have been established which produce more particularly the accessory supplies and conductors. There are but two factories in Russia which produce electric machines and lamps, and in consequence most of these articles are imported. Germany and Switzerland furnish the largest number; next comes England, and then follow the United States, France and Belgium. Statistics on the subject are not obtainable at the present time. It is possible, however, to estimate approximately the situation of certain branches of electrotechnical industry in Russia, and this estimate is undoubtedly below the actual condition.

Electric Lights.

A few years only have passed since such cities as St. Petersburg and Moscow began to have their streets lighted by electricity. At present, there are more than 50 towns which employ the electric light, and many other places are erecting the necessary apparatus. The rapidity with which the use of electricity has spread at St. Petersburg will serve as an example of the popularity of this manner of lighting. The first central station was installed in the city in 1881. The power of that station was about 250 kilowatts. Until 1885, there were only a few stations opened, and the power increased very slowly. After that year the power of the stations and their number grew rapidly, and in 1898 there were 169 stations, having together 29,000 kilowatts of power. In 1898 and 1899, three additional central stations were constructed at St. Petersburg, and at the present time the power of all the central stations, taken together (exclusive of the private stations), reaches 15,000 kilowatts. Work near completion will raise the power at these stations to 30,000 kilowatts. The number of private stations is about 100, and these have a total power of more than 39,000 kilowatts.

St. Petersburg is lighted by means of arc lamps on the principal streets and by incandescent lamps on ways of less importance. In addition to the arc lamps on the streets, there are about 300 lamps fed from private stations. Electric motors, having a power of about 4,500 kilowatts, have been installed. In many of the private stations storage batteries have been put up, and their capacity exceeds 50,000 ampere-hours. The number of dynamo machines erected at these stations is over 500. As a rule, the current is continuous. Steam engines are principally employed, but gas and petroleum engines are also in use.

All of the large stations work with alternating currents, and one of them uses three-phase current. The greater part of the distribution network is underground, and consists of armored cables. Aerial conductors are not in use, except at a few stations. The aggregate length of the network is over 625 miles. The voltage of the current of this network is from 2,000 to 3,000 volts.

In Moscow and in other towns, both large and small (particularly those situated in the industrial region), the use of electricity has made no less rapid progress than in St. Petersburg. In the beginning the stations constructed were almost all for continuous current, but in the later ones the preference was for the single-phase and three-phase alternating current. The network is sometimes underground and sometimes overhead.

1. From advance sheets of consular reports. Mr. Heenan is consul at Odessa, Russia, and his communication is dated July 12, 1902.

Electric Traction.

Electricity is also coming largely into use for tramways. The first electric railway built in Russia was the one at Kief, which dates from 1893. In 1898 45 cities had constructed such lines, their length exceeded 312 miles, and nearly 10,000 kilowatts was in use for the motors. The number of motor cars was about 300, and there were many cars without motors. Most of the tramways are worked by continuous current. The total length of wire for the electric tramways in St. Petersburg is estimated at 1,875 miles. Aerial conductors and underground conductors will be used, and, on the principal streets, accumulator traction. Nearly 400 motor cars will be in use, and 300 without motors. Other cities also contemplate the employment of electricity on a large scale, and plans are under consideration for its use on the great steam railroads of Russia. These projects include the construction of an electric railroad to connect neighboring towns on the western frontier of Russia, and the establishment of a road to cross the Caucasus Mountains, between the town of Suhkum and one of the stations of the Vladikavkas railway. For this latter road it is proposed to utilize the hydraulic force of the mountain streams. Electric traction is already in use on the railroads serving large factories, in the mining industry, and in other enterprises.

Power Transmission.

The use of electricity for the distribution of motive power is spreading, and to-day all of the machine works of Russia have adopted this method. Enormous central stations have been erected at places where such factories exist; for instance, at the Kolomna machine shops, at the works of the Sormovo Association, at the Putilov works, and many others. All of the larger elevators on the Vladikavkas railway and on the Moscow-Kazan railway are supplied with electric motors. Up to the present, electricity has scarcely been used at all for the transmission of energy for great distances. Projects, however, are under way to utilize the waterfalls of Marva and Imatra. The Russian government has granted a concession to a company to supply power to St. Petersburg from the Volhov Rapids. The estimated cost of the enterprise is about $14,000,000. It is said that the power to be transmitted will equal 150,000 kilowatts, and the maximum transmission distance is 188 miles. The company has undertaken to provide the public lighting of St. Petersburg gratuitously, and hopes to furnish current to individuals at about half the price hitherto charged in similar enterprises. The engineer of the scheme is a Russian, named M. Dobrotvorsky. It is also intended to use the colossal force of the Dnieper Cataracts for the transmission of energy.

Electrochemical Industry.

The progress of the electrochemical industry and of electrometallurgy is interwoven with the utilization of hydraulic force as motive power. For instance, there are even now several establishments which obtain copper and refined metal by the electrolytic process. Such establishments exist in the Ural and the Caucasus, and have an output that is important. Thus, the works of Siemens Brothers, at Kedabeg, in the Caucasus, annually produce some 500 tons of copper. Many less important works in St. Petersburg, Moscow, Nizhni, Novgorod, etc., utilize steam power for the refining of copper and impure copper waste by the electrolytic process. Some of these works obtain as by-products of the electrolytic process other metals, such as lead, antimony, etc. There are as yet very few special electrochemical works in Russia; one factory near the Imatra Rapids produces carbide of calcium, and other works for a similar purpose also exist. A large electrochemical factory has been erected in the government of Kharkof, for the production of caustic soda. Electric soldering is in use in metallurgical and mechanical works, and also in the railway shops; this is accomplished with the aid of the Volta arc, a Russian invention. It is said to be superior to the ordinary process of welding by fire, and is in use in 70 important machine works in western Europe.

Electric Appliances and Machines.

It will be seen that the application of electricity has progressed in Russia, and that electrotechnical appliances will have a great future in this country. Russian factories cannot supply the demand, and the deficiency is made up by foreign firms which have their representatives here. It is true that Russian manufacturers produce many cables and insulated conductors. At St. Petersburg and Moscow there are a number of factories in this line, and their output compares favorably with the foreign articles. The most important of these establishments is the Siemens and the Riben, both of which produce cables of the most complicated character. Nevertheless, cables in large quantities are imported from abroad, the home manufacturers not being able to supply the market. Accumulators are also manufactured in various towns in Russia. There are a number of establishments in St. Petersburg which produce accumulators of original design, or after the best-known foreign models, such as the Julien, the Tudor, and others; and the importation is small. Such appliances as circuit-breakers, commutators, rheostats, and carriages, as well as armatures for lamps, are also manufactured in Russia, but not nearly enough to supply the demand. Measuring and counting instruments are scarcely manufactured at all in this country, although the demand for them is enormous, especially of late, since central stations have been constructed in a number of towns. These instruments are imported from France and Germany. The manufacture of porcelain insulators and of porcelain appurtenances in general is so largely developed in Russia as to satisfy the home demand completely, and no insulators are imported. Incandescent lamps are not manufactured in Russia at present; an establishment formerly existed for the manufacture of these lamps, but foreign competition was so strong that the attempt was abandoned. The lamps are at present imported from Germany, France, England, Austria and Sweden. Arc lamps are produced in this country, but only in limited quantities, and the greater number of those used are imported from Germany. Carbons for the arc lamps are also manufactured in Russia, though most of them come from abroad.

As regards electric machines, such as dynamos, motors and transformers, they are manufactured by only one firm—Siemens & Halske, at St. Petersburg. This house makes annually dynamo machines and motors, of which the aggregate strength is about 6,000 kilowatts. It is also the only firm in Russia which produces appliances required in electric traction.

One branch of the electrotechnical industry is fully supplied by the home manufacturers, and that is the signaling and telegraphic apparatus in use on the railways, to indicate whether the road is open or closed. As regards telegraphic appliances proper, some are manufactured in Russia and some come from abroad, chiefly from Sweden and Germany.

How to Extend United States Trade.

It will thus be seen that the demand for electrotechnical apparatus and machines in Russia is relatively but little satisfied by the home manufacturers, and the progress in the application of electricity for transportation, manufacturing and domestic economy, will undoubtedly enormously increase the market for foreign appliances. American manufacturers should have their share of this trade, and there is but one way to secure it—that is, to establish branch houses in this country and place the same in the hands of competent men. The Germans hold the field in supplying this country with electric appliances, because they are ever present and always patient; they study their customers, ascertain their financial conditions, give long credit with reasonable interest, and employ men who are either German-speaking Russians or Germans born in Russia, who, of course, speak both Russian and German.

It will require more than a casual visit to Russia on the part of our business men, if we are to win our proper share of the future business to be done in electrical appliances. It is not too much to say that in no other branch of trade is there likely to be such material progress in Russia.

Edison Automobile to Be Tested.

Thomas A. Edison is reported to be building a special vehicle which will be fitted with his new storage battery, and which he will enter in the 500-mile durability run, to be held in October, under the auspices of the Automobile Club of America. The proposed journey will be from New York city to Boston and return. This will be the first time that the battery has been tested in public. The new battery will give a longer mileage than anything now on the market, it is asserted, but it will not, as has been stated, cost much less than the present storage battery.

The New York Mail and Express gives the following as from an interview with Mr. Edison: "A storage battery, to deserve the name, should be a perfectly reversible instrument receiving and giving out power like a motor-dynamo without any deterioration of the mechanism of conversion." Mr. Edison has been working on the problem of a true storage battery for a number of years. For his present invention, he claims that he can, with a battery weighing a little less than the ordinary lead battery, run 85 miles without a stop.

The proposed run will be made under rules liberal to the electric machine allowing of stops for the changing of batteries, etc. The machine which Mr. Edison will enter in the contest will be of runabout order and will be equipped, as has been said, with the very latest of his experimental batteries. The run will be started on October 8th and the promoters expect about 125 participants. All classes of machines are eligible, and provision in the rules has been made for gasoline, steam and electric vehicles. Each automobile will have an official observer, who will make a detailed report of the trip to the club. His report will include the number of stops and their duration, repairs made and any other items of interest that should affect the contestant's percentage in the final reckoning. The time schedule allows six days for the trip, and speeding faster than 15 miles an hour will be cause for disqualification. This is the longest duration trip ever promoted by a club in America.

The Avery Manufacturing Company, Peoria, Ill., contemplates installing a complete electric plant in its factory.

Stringent Wiring Regulations in New Britain, Conn., Modified.

The New York, New Haven and Hartford Railroad Company's electric branch running into New Britain, Conn., has been causing the company considerable trouble, growing out of the stringing of high-tension wires through that town. Stringent requirements were asked of the company as to the manner of stringing these wires, and for a time the railroad people were forced to cut down their power by reducing the voltage on the line. This, of course, reduced the speed of the cars, and the company was unable to run on anything like schedule time. An agreement has now been reached which allows the company to resume the use of the high-voltage circuits.

The trouble seems to have been brought about by a misunderstanding. N. H. Heft, chief of the electrical department of the road, in a letter to the New Britain council, explained the company's position in the matter to the effect that under the interpretation put on the company's specifications for its wire stringing by the New Britain council, it would have been unable to operate the road successfully. The requirement of the New Britain council was something to the effect that all high-tension wires of the company must be placed not less than a given distance above the tallest building along the line. After some argument this interpretation of the specifications was nullified. The company had strung its wires through the town in the usual manner, and was using them when the town council brought up the question of the company's not having fulfilled the building requirements and forced a cut in the voltage. The system used is a third-rail one with high-voltage supply utilized by transformer stations along the line.

Electric Stocks Said to Be a Good Purchase.

These are the views of the Daily Financial News of New York: "The activity in stocks of the electric companies is the forerunner not only of greater activity, but of phenomenal rises. The demand for electrical supplies in the United State is enormous and very profitable, while the export demand is increasing greatly. In every state of the Union trolley roads are being built, and the demand for electrical equipments is such that the companies engaged in the manufacture of electrical equipments are behind in their orders. The great rises in the stocks of the General Electric, Westinghouse, Hall Signal, Crocker-Wheeler and other companies, have made fortunes for those who purchased those securities six months ago. The combinations which have been so successfully carried through by railroad companies are now in operation by the managers of electric companies. There is no better field for combinations than that of the electric companies. The purchase of the Sprague Company by the General Electric Company is only the first step in the direction of amalgamating the electrical equipment and lighting companies which own valuable patents and are doing a successful business. When it is considered that the owners of the railroads control a gigantic business in railroad electric equipments and supplies it is only necessary for them to combine these interests and, with the orders they control, pay a handsome dividend. After making careful inquiries we do not hesitate to say that the stocks to buy for big advances are the stocks of the electrical equipment and supply companies. Buy them and hold them quietly for a time and enormous profits will be realized."

Yerkes on London "Tubes."

Charles T. Yerkes arrived in New York from England on August 17th. Mr. Yerkes spoke quite freely of his London underground-railway plans and denied emphatically the rumor of a possible union between the Morgan interests and his own, saying that such a combination had never been considered and would not be. In speaking of what comprised his company's system and of the parliamentary grants that had been obtained for it, Mr. Yerkes said: "We have four different franchises passed by Parliament. These four, with that of the Metropolitan District railway, which is run by steam, comprise our system. The underground roads of London carry about 200,000,000 persons annually, and the completion of our system will increase the traffic from 50 to 100 per cent. We will operate about 1,000 cars, and the motive power will be furnished by the third rail. In 18 months we expect to have our lines running. Last year we did not get far advanced, but a new company with a capital of $25,000,000 has absorbed the old company, which was capitalized at $1,000,000. When completed our lines will go in an oval under the heart of the city of London, and different lines will connect with this oval. This makes through lines from the mouth of the Thames at the sea with the town of Richmond, 60 miles away. When finished there will be 66 miles of double track to connect with other lines 40 miles in length, all electrically equipped, and the majority of the distance being run through subways practically the same as the one now under construction in New York."

Relative Economy of Central-station Supply and Private Power.

By M. B. R.

It is a matter of considerable interest to all manufacturers, and particularly to those located in the Niagara Falls power district, or in other similar power districts, to determine with what relative economy this hydro-electric power may be employed and to what extent in connection with it their own power should be used.

In the first place, considering both economy and convenience, it is now generally admitted that in large plants having numerous buildings electrical drive is essential. The superior economy of the central-station or Niagara power, aside from its cheapness, is particularly evident in fluctuating and peak loads. Such loads are found in most shops where large machines are continually being thrown on and off. With the private plant, where it is necessary that it should be designed to meet the higher requirements of power, the efficiencies of the boilers, engines and dynamos at the average and low loads are much under the normal efficiencies at their rated capacities. In using central-station powers no such decrease in economy occurs.

There are, however, other conditions which, within certain limits, effect a greater ultimate economy in the use of the private power plant. In all large factories it is necessary to have considerable boiler power for heating purposes alone, while most of them require throughout the year some steam for their various processes or tests. The efficiency of the boilers when used for such irregular duty is very low. By using them for generating power as well, they can be run at their full capacity by overloading at the peaks, and their average efficiency will thus be greatly increased. Such a use is especially economical when power is developed in connection with the heating plant.

As an illustration of the economy to be obtained by the above methods of operation, I may mention the power equipment of one of the large engineering and manufacturing concerns in the city of Buffalo—the Buffalo Forge Company. In the six shops comprising this plant electric drive is employed exclusively. Formerly Niagara power alone was used on the drive, and the boilers were used simply for testing and for heating the plant. The plant now installed is of sufficient size to enable the company to utilize at all times the full steaming capacity of its boilers. The power thus developed is used in connection with that received from the Falls. The boiler plant consists of a battery of two 125-horsepower return-tubular Erie City boilers, supplied with induced draft. Furnishing power to the shops, and supplementing the Niagara power, are two 100-kilowatt, direct-current, General Electric generators, each direct-connected to a 12 and 20 by 14-inch horizontal tandem-compound Buffalo engine, running non-condensing. A 30-horsepower air compressor belted to a single vertical engine, drives the pneumatic hoists and small pneumatic tools throughout the shops. A 40-horsepower dynamo, used in lighting the offices, completes the equipment.

The offices and shops are heated by the hot-blast system. By means of steam-driven fans the air is drawn through the steam coils of the heater and distributed through galvanized-iron pipes or ducts to all parts of the various buildings. By this arrangement a uniform temperature of 60 degrees in the shops and 70 degrees in the offices is maintained with great economy. The heaters, except in extremely cold weather, require only the exhaust steam from the power plant and their own engines. We see, therefore, that the cost of running both power plant and heating plant together is practically no greater than running either one alone, since the engine is capable of converting only about 10 per cent. of the calorific value of the steam into work.

Besides providing for the above uses, considerable boiler power is required at times for the tests. These comprise running and power tests of engines, tests of the various types of belted exhaust fans and blowers, and of electric and fan units directly connected to high-speed engines. The demand for power in these tests is very irregular. While on occasions it may reach as high as 300 horsepower, the usual peaks are about 150 horsepower, and the average load about 80 horsepower.

The average load on the boilers is about 300 boiler horsepower, with peaks of about 450 boiler horsepower, or loads from 120 per cent. to nearly 200 per cent. of the rated boiler horsepower. Of particular interest in this connection is the great increase in capacity and ultimate economy in operation of the boiler effected by the use of high intensities of draft. The induced-draft plant consists of a special 90-inch full-housing, bottom-horizontal-discharge exhaust fan, exhausting from the smoke breeching and discharging into a short stack. It has an overhung blast wheel, driven by a 4½ by five-inch direct-connected single vertical engine capable of running the fan at speeds varying from 300 to 600 revolutions per minute and producing corresponding drafts of from one-half to 2¼ inches of water with the flue gas at a temperature of approximately 500 degrees F. A Foster regulator automatically governs the speed of the engine to produce the proper draft to maintain a constant steam pressure in the boilers. By this arrangement demands for steam are readily met to double the rated capacities of the boiler without noticeable decrease in pressure and with no other attention than to proper firing and water supply. Nor does this high rate of driving lower the efficiency of the boiler, as one might naturally suppose. With a ratio of heating surface to grate surface of 45 to 1, which is usual in boilers made at the present time, the loss of heat in the flue gas at double the rated performance is only about four per cent. more of the total heat of the coal than at the rated capacity, while the radiation loss remains practically constant for all rates of driving and is therefore reduced from about 12 per cent. to nearly six per cent. of the total heat of the coal. This shows the total efficiency of the boiler to be about the same. If the maximum capacity of the plant were increased by doubling the number of boilers, instead of increasing the performance by increased rate of combustion, twice as much coal would be required in keeping up steam throughout the 24 hours a day. This, in plants having irregular loads for 10 hours a day, amounts to a considerable portion of the coal bill, which, we see, is greatly reduced by resorting to higher rates of driving at the peaks and employing fewer boilers.

In the instance of such a manufacturing establishment as the above, it is seen that the power developed by utilizing at all times the full capacity of the boiler plant will cost less than central-station power. Each additional electric horsepower within the capacity of the boiler will require but from 2½ to 3½ additional pounds of coal per hour. The additional cost of such power will therefore be only about $0.0044 per horsepower-hour for coal, or only about $0.0053, including cost of maintenance and interest on cost of engines, dynamos, power house, etc. When generated in connection with the heating plant, the cost of the additional power will be that of maintenance, etc., or $0.0008 to $0.0010 per horsepower-hour, plus $0.0005 for fuel. From these considerations, it is evident that private power is the cheaper when generated in connection with the heating plant, also that economy is to be obtained by generating sufficient power to utilize at all times the full boiler capacity.

Production of Copper.

The production of copper in 1901 is reported by Charles Kirchhoff in "Mineral Resources of the United States," for 1901, now in press, by the United States Geological Survey. The total production of domestic copper in the United States in that year was 268,782 long tons, as against 270,588 long tons in 1900. The total imports of copper in the United States in 1901 from all sources and in all forms amounted to 124,938,323 pounds, as compared with 103,895,026 pounds in 1900, with 93,172,191 pounds in 1899, and with 50,268,499 pounds in 1898. The total value of the exports of copper from the United States in 1901 was $36,071,448, as compared with $58,875,439 in 1900, with $43,485,654 in 1899 and with $35,545,251 in 1898. Germany is by far the largest customer for copper.

The estimated consumption of copper in the United States in 1901 was 382,761,014 pounds, as against 356,891,121 pounds in 1900. The stock of copper on hand in the United States on January 1, 1902, was estimated as being at least 300,000,000 pounds, equivalent to six months' production. The world's production of copper in 1901 was 511,803 long tons, as against 487,206 tons in 1900, 463,693 tons in 1899, and 429,379 tons in 1898.

By far the most important of the new mines which have entered the world's market in recent years is that of the Greene Consolidated Copper Company, whose properties are located at Cananea, Sonora, Mexico. There is every reason to believe that, before the close of the current year, the production of this company will reach 4,500,000 to 5,000,000 pounds of fine copper per month. Such a rapid development has never before been witnessed in the copper-mining industry.

More Telegraph and Telephone Combination Talk.

The Boston News Bureau has the following on the possibility of a merger of leading telephone and telegraph interests in the United States: "We understand the buying of American Telephone and Telegraph in the Boston market is by large New York interests and that behind it are plans not only for the union of the Western Union and Postal Telegraph companies, but for all the telephone and telegraph interests of the United States. Volumes of figures were long ago prepared, showing the saving of such union, but there was more brains than money in the combination then proposed, and the Philadelphia people who had charge of it broke up financially. Now the matter is being taken up in an embryo way by the people who have the financial ability to carry it out, if no obstacles other than financial ones are met with. This is the real cause of the recent sharp advance in Western Union and American Telephone and Telegraph shares. A gentleman who is closely associated with the Postal Telegraph Company says: 'In spite of denials, it is nevertheless a fact that plans are now being formulated for a consolidation of the Postal Telegraph, the Western Union and the American Telephone and Telegraph companies.'"

The W. Whittem Textile Company of Asheville, N. C., is in need of an electric-light equipment.

Electrical Operation for Suburban Steam Lines in Newcastle, England.

The Northeastern Railway Company is planning to install electric traction on its suburban lines in the vicinity of Newcastle, England. The lines to be electrically equipped are now operated by steam and serve a district with a dense industrial population that lies to the north of the Tyne between Newcastle and the sea. The total length of line to be equipped in the first instance is some 37 miles, mostly double track, and although the actual details have not yet been decided upon, it is stated that the directors are inviting tenders for a third-rail system. As far as the passenger traffic is concerned, it will be worked on the multiple-unit system. It is proposed that a normal train should consist of two motor coaches and one trailer coach, the carriages being probably of the vestibule type. With this arrangement the length of trains can, of course, be increased should the traffic requirements need it. Electric locomotives may, possibly, be provided for freight traffic.

It is intended to take current from the Newcastle-upon-Tyne Electric Supply Company, which at present is said to be supplying current at a lower rate than any other company in the kingdom. The scheme, if fully carried out, will probably involve an expenditure of some £200,000 by the railroad company, and of a much larger sum by the supply company.

The results to be expected from this conversion to electrical operation are in the direction of retaining and probably increasing the present traffic, rather than in greater economy of working, though it is believed that the expenditure will be somewhat reduced. The scheduled speed it is proposed to raise to 22 miles an hour, including stops.

Manufacture of Incandesent-lamp Filaments from Paper.

A very fine paper is used for making the filaments of incandescent lamps by the Premier Electric Lamp Company of Liverpool, England. The paper is obtained from Sweden, in the form of scrap, and is, apparently, valueless, owing to the smallness and irregular shape of the pieces. The first process consists of reducing the paper to pulp by immersion in a chemical solution. When this process is completed, the pulp is placed in a glass vessel with an exhaust pump attached and the air and gases are extracted, after which the pump is reversed and the pulp is forced through a very fine hole in the bottom of the vessel, and emerges as a thread of clear gelatine. This thread is passed around a drum on which it dries, reducing it to about half its original thickness. It is then ready for conversion into filaments, and is said to have a strength out of all proportion to what might be expected. These threads are then carbonized and made up into bundles of 25 of uniform lengths. Each bundle is then fixed on a carbon frame in such a way that no thread overlaps another. The frames are of all sizes and shapes, varying according to the size and shape of the filament required. The threads are then wound around, and the ends secured by an adhesive solution. They are then packed in plumbago crucibles and carbonized at a temperature of about 100° C. When taken out of the crucibles they are easily detached from the frames, the adhesive solution and some string adjustments having completely disappeared. They have now a brilliant polish, which is afterward reduced by a process designed to secure evenness of resistance. The filament is now ready for fixing into the base of the lamp, which is treated in a vessel containing hydro-carbon gas. This apparatus is automatically operated, so that the lamp glows just long enough to take up the required quantity of carbon from the gas to offer the proper resistance to the electric current.

Improved Composite Arc Electrodes.

C. R. Boehm of Charlottenburg, Germany, has invented a new type of composite arc electrode which is claimed to obviate such disadvantages as unsteadiness of the arc, formation or slag and production of smoke and injurious vapors. Finely divided fluorides, such as fluorides of sodium, calcium and magnesium, are intimately mixed. To one part of this mixture one part of pulverized carbon is added, and a paste formed by the addition of tar or other binding substance. In the case of cored carbons, the core is formed of a mixture of fluorides and carbon, to which is added a silicate. The magnesium fluoride is not reduced in the voltaic arc of the carbon, but is dissociated; the metallic magnesium thus produced being of an extraordinary reducing power, liberates the metals from their metallic salts so that the produced spectrum is a pure metal spectrum, whereas other arcs produced by metallic salts without the addition of magnesium fluoride show an impure spectrum of the salts or oxides employed, which are only partially reduced to metals. When the calcium fluoride is present an intensely yellow light is produced, which, however, becomes of a flesh color when magnesium fluoride is present mixed with the other metallic salts in the proportion of equal or equivalent molecular weights.

CORRESPONDENCE.

New York Notes.

New York, August 30.—Judge Lacombe, in the Circuit Court, has vacated the stays granted Arabella Huntington and Charles T. Barney in actions brought by them to enjoin the Rapid Transit Commission from continuing with the construction of the tunnel in Park Avenue, near their residences at the corner of Thirty-eighth Street. Judge Lacombe granted the above stays on August 27th, and they were returnable on September 2d. In vacating the stays the judge held that the complainants had failed to satisfy the court that they would be able upon the trial to show that the state had deprived or in any way threatened to deprive them of their rights as abutting property owners. The complainants stated in their claim that the tunnel, upon reaching their location, would pass within seven feet of their building line instead of 30 feet as was indicated, they claimed, by the plans. Upon examination, by engineers, the tunnel was found to be under construction exactly according to specifications and plans.

At the special stockholders' meeting of the Interborough Rapid Transit Company, mentioned in my last letter, it has been voted to increase the capital stock of the company from $25,000,000 to $35,000,000, the purpose being to raise funds to defray the expense of building the projected tunnel from Manhattan to Brooklyn, connecting with the Manhattan underground system.

On August 22d, schedules were filed in bankruptcy by the United Incandescent Light Company of 812 Greenwich Street.

Argument was made before Justice Hall, in the Supreme Court, last week, in injunction proceedings to stop the payment of salaries of police telegraph operators on the rank of sergeants of police. The salary of a police sergeant is $2,000, and it is hoped to cut this to $1,400, which is the salary of patrolmen. The proceedings tend to set aside as unconstitutional the legislative act raising police telegraph operators to the rank and pay of sergeants.

Two new New York electrical concerns have been incorporated since my last communication. One is the firm of R. A. Schoenberg & Co., with authorized capital of $100,000, to manufacture electric and telephone supplies. R. A. Schoenberg and Samuel Wheeler are interested. The other is E. B. Latham & Co., with a capital of $100,000, to manufacture machinery and electrical supplies. A. L. Strassburger and J. H. Pattan are among the incorporators. O.

Canadian Intelligence.

Toronto, Ont., August 29.—Mr. F. H. Clergue has signed contracts awarding the construction work of the St. Marys Traction Company to the Falk Company of Milwaukee. The work includes the roadbed, tracklaying, and the electrical equipment of the complete street-railway system at Sault Ste. Marie. The contracts for the plant of cars and motors will be let soon.

The citizens of St. John, N. B., are clamoring for an extension of the electric street railway from the city to Fairville, the Bay Shore, Millidgeville, the Public Park, the Cemetery, Rothesay and Red Head, and, as the local press, backed up by some of the shareholders, is pressing the matter warmly, the company will probably accede to the wish of the public, and build the extensions.

Charles Archer of Dawson City has given notice of an application to the Dominion Parliament for an act incorporating a company, to be known as the Canadian Yukon Western railway, with power to build and operate an electric railway from Dawson City in a westerly direction to the boundary line and along the northwesterly shore of the Yukon River so as to connect with any other railway on the American side of the boundary line.

A party of capitalists is promoting a scheme to build an electric railway from Toronto to Hamilton. The plan is to hug the lake shore as closely as possible, which the present line running to Long Branch does not propose to do when extended, it being at times one-half a mile from the lake, whereas the proposed new line will run with the lake as the line of limitation to the south. The promoters are now figuring out the best route to follow through Mimico to Toronto city limits. The route is settled as far as Etabicoke.

In Halifax the Electric Tramway Company has been successful in securing the property and assets of the Halifax Gas Company, which were sold by auction a few days ago and bought in by W. M. Dowall of Montreal, who represented the bondholders. The tramway company now controls the gas and electric lighting of the city, as well as operates the street railway. There were claims of about $776,000 against the gas company, and the bondholders' bid was $200,000. H.

Ottawa, Ont., August 30.—Francois Breton, clerk of works in the Public Works Department of the Dominion government, has received orders to get ready to start this week for the Isle of Anticosti and Labrador, where stations will be built to operate Marconi's wireless system of telegraphy.

The new stone power house of the Consumers' Electric Company of Ottawa, which is affiliated with the Hull and Ottawa Power Company, has just been completed, and the machinery has all been installed, with the exception of the switchboard. The temporary frame structure will be abandoned shortly. About 10,000 horsepower has been developed for heat, light and power, which can be furnished in large quantities. Over $500,000 has been expended on this work. An idea of its magnitude may be gained when it is said that over 125,000 cubic feet of solid rock has been excavated. The company is now in a position to furnish about 12,500 horsepower of electrical energy.

Frank W. Bevan, chairman of the board of directors of the Anglo-American Telegraph Company, London, who is at present visiting the chief commercial centers of Canada, says that the cable business is better now than it has been for years. He does not think there is any reason to fear competition from the Marconi telegraph system. Mr. Bevan did not think that the Marconi system had been sufficiently perfected to be capable of accurately transmitting brokers' intricate quotations. W.

Information from Indiana.

Indianapolis, September 1.—The State Tax Board has adjourned, after having added between $7,000,000 and $8,000,000 to the tax duplicate. The board did not deal with real estate, but largely with public utilities. The increase is largely due to the increased number of interurban electric-railway systems. The board refused to alter the valuations of the interurban companies, and this action may result in higher fares. The board, while disposed to be lenient, thought that the growing interurban traffic would not justify a reduction of the assessments made at its first session.

Two new traction companies were incorporated last week. The South Bend and Northern Railway Company is to construct a link between the street-railway system of South Bend and the South Bend and Southern Michigan railway. The connection will be made at the state line. The other company is the Fort Wayne, Logansport and Lafayette Traction Company, with authorized capital of $1,000,000. This project has been under consideration for some time by the Union Traction Company syndicate. The directors are C. F. McCulloch, A. L. Drum, N. C. Sampson, C. A. Baldwin, H. E. Guthrie and H. C. Stillwell, and all except the two last are now officially connected with the Union Traction Company. The company will build from Fort Wayne to Logansport, Delphi and Lafayette. The line will parallel the lines now being operated between Fort Wayne and Huntington, and between Peru and Wabash. It will connect at Logansport with the Indianapolis Northern, now building between Indianapolis and Logansport. The old canal bed will be used between Lafayette and Logansport, suits having already been filed to condemn the right-of-way. When this line is completed the Union Traction Company's syndicate will have the greatest system of interurban roads in the country. The total capitalization is $9,000,000, and the mileage will approximate 450 miles.

Charles S. Henley has been granted a franchise for a street-railway system in the city of New Castle, making the third line to tap the city.

Armed men are standing guard at the place where the Union Traction Company is attempting to cross the Lake Erie and Western railroad, near Elwood. The railway company insists on the electric line going under or over the railway tracks and refuses to allow the crossing to be put in.

A large force of men under Superintendent Quick is constructing the Indianapolis Northern line between Indianapolis and Carmel. A bridge will be built over White River at Broad Ripple. Work on the same line is progressing between Noblesville and Kokomo.

The Indiana Legislature will be asked next winter to enact a law fixing a maximum passenger rate of 1½ cents a mile for interurban lines. This is urged because the cities granting franchises cannot regulate fares outside of their corporate limits. Many think a state rate will be necessary if the public continues to enjoy low fares, as it is not wholly improbable that the steam roads may some day absorb the more important interurbans and raise the rate to three cents a mile. The interurbans will oppose the bill on the ground that it will be impossible to finance any project with as low a rate as 1½ cents fixed by statute. F.

Northwestern Notations.

Minneapolis, August 30.—The Burlington railroad expects to have its electric line between Deadwood and Lead, S. D., in operation by September 5th. The line has been completed and the power plant has been ready to run for several weeks, but the cars for the line failed to arrive.

The estimated cost of a municipal lighting plant for Dell Rapids, S. D., is placed at $7,000. A special election will probably be called to vote on the matter.

The Dubuque and Pacific Railway Company of Dubuque, Iowa, has filed a change of title to the Iowa Traction Railway Company. It is believed the change is made in order to construct an electric railway from Dubuque to Anamosa and other points.

The estimated cost of a municipal electric-lighting plant for Duluth, Minn., for street and commercial lighting is $150,000. This covers simply the wiring and connections, and does not include the power.

The Electrical Workers' Union of Waterloo, Iowa, has made a demand upon the electric-light and telephone companies for a nine-hour day and a continuation of the present wages of $2.25. The demand includes the linemen of Cedar Falls also.

The directors of the Mankato and St. Peter Railway and Lighting Company met at Mankato, Minn., and voted to pay all outstanding bills. The organization is to be continued, as it is hoped that some proposition may yet appear whereby the proposed system can be built.

The proposed Fargo and Moorhead Electric Railway Company has asked the council of Fargo, N. D., to be permitted to use wooden poles instead of iron, claiming that the latter are unobtainable at present. The council contemplates a limit to the time during which wooden poles can be used.

R.

PERSONAL.

Walter Alexander has been elected superintendent of the city electric-light plant of Rochester, Minn., succeeding W. G. Rowen, who has resigned to go to the state of Washington.

H. A. Orr, superintendent of the Water, Light and Power Company of Anderson, S. C., will become general southern agent for the Stanley Electric Manufacturing Company with headquarters in Atlanta.

J. W. Larish, electrician of the Western Union Telegraph Company for the New England states, has resigned to engage in other business. The office in Boston of which Mr. Larish was the incumbent has been abolished.

Thomas W. Reynolds, for several years manager of the San Francisco office of the Western Union Telegraph Company, committed suicide on August 27th. He left a letter in which he expressed a fear of approaching insanity.

Frank C. Mason, the well-known superintendent of telegraphs for the Borough of Brooklyn of the New York Police Department, has purchased a farm of 80 acres, not far from Utica, N. Y., in anticipation of his retirement in 1894.

J. E. Thomas of the firm of Thomas & Dietz, dealers in electrical supplies, Cleveland, Ohio, died on August 24th at his home in Cleveland. He was 45 years old, and leaves a widow and two children. Mr. Thomas had been suffering with Bright's disease.

W. G. Wagenhals, general manager of the Mill Creek Valley Street Railway Company of Cincinnati, Ohio, resigned his interests in the road on September 1st. The company's possessions passed into the hands of the Cincinnati Traction Company. Mr. Wagenhals retires from active business for the present at least. He is the inventor of an electric headlight and other useful appliances.

Thomas Nevins of East Orange, N. J., died on August 21st in Ireland. He was an American railway man who had gone abroad several months ago to attempt the consolidation of the tramway lines between Manchester and Liverpool in England, with the idea of subsequently converting these lines into trolley roads. The proposed corporation was to have been known as the South Lancashire Electric Traction Company. It is thought that, had Mr. Nevins lived, the scheme would have been successful.

Edward P. Whitford, a well-known Chicago telegraph operator, died on August 28th, at the Onwentsia Clubhouse, Lake Forest, Ill., where he was in charge of a force of operators working in connection with a golf tournament in progress there. Mr. Whitford was for many years in charge of the Board of Trade quotation service. In later years he had had charge of the Chicago American (newspaper) office of the Postal Telegraph-cable Company. He was 59 years old, and is survived by a daughter.

H. W. Morris, formerly engineer of the Gibbs Electric Company and more recently secretary and engineer of the Milwaukee Electric Company, has joined with John Obenberger, formerly general foreman of the Gibbs Electric Company and more recently superintendent of J. & J. Obenberger. The two gentlemen will do business under the name of the M. & O. Company. The new firm will locate in Milwaukee, and, having taken over the machine shop of J. & J. Obenberger, will manufacture a line of dynamos and motors.

E. M. Scribner, formerly assistant sales manager of the Bryant Electric Company, has recently been placed in charge of the supplies of the Western Electric Company in all its branches. Mr. Scribner is a brother of Charles E. Scribner, the well-known telephone engineer of the Western Electric Company. W. F. Hessell, formerly assistant manager of sales in the New York branch of the company, has been placed in charge of supplies at the Chicago branch. Frederick K. Kretschmar is now manager of the company's advertising department.

Thomas B. Whitted, manager of the sales department of the Denver office of the General Electric Company, has resigned to become consulting engineer for the various electric and gas properties controlled by Joseph J. Henry in western cities. Mr. Whitted is one of the best known men in the electrical business in the West. Starting nearly 10 years ago in the shops of the General Electric Company at Schenectady, N. Y., he worked his way step by step until three years ago he became engineer of the Denver office and a year later manager of the sales department. His success, both as salesman and engineer, and his genial disposition have endeared him to a large circle of business and personal friends, all of whom will extend their best wishes and congratulate Mr. Henry in securing such an able man.

ELECTRIC LIGHTING.

W. A. Holloway of Plaquemine, La., asks bids on an electric-light plant for a town of 6,000 people.

The citizens of North Amherst, Ohio, are agitating the question of erecting a municipal lighting plant.

The Tonopah Light and Power Company of San Francisco, Cal., has been incorporated with $50,000 capital stock by W. C. Watson, C. W. Waller and others.

The West Virginia Heat and Light Company of Pennsboro, W. Va., capital stock, $200,000, has been incorporated by W. C. McBride of Washington, Pa., and others.

The Shawnee Electric Company of Shawnee, Okla., has asked for an electric-lighting franchise in Holdenville, I. T., and, if granted, will erect a plant there.

Ruston, La., is in the field for a 2,200-volt, 60-cycle, 90-kilowatt alternator; also an exciter and 25 series alternating-circuit, 6.6-ampere lamps, with constant-current transformer. Four thousand pounds of No. 6 slow-burning weatherproof copper wire and an 80 or 100-horsepower return tubular boiler are also needed. Mayor B. F. Thompson may be addressed.

The invasion of cheap electric lighting in some of the suburbs of Chicago is said to have been one cause for the recent consolidation of some of the suburban gas companies, by which lower gas rates are made possible. The contest for lighting in the Thirty-fifth Ward of the city has resulted in an agreement between the Yaryan company and the Cicero Light and Power Company by which the ward is equally divided between the companies.

A contract has just been closed in Duluth, Minn., for the installation of 3,000 lights in one of the largest department stores in the Northwest. The showcase and window lighting is to be particularly effective. There will be a five-panel white Italian marble switchboard and two Ideal engines direct-connected to General Electric dynamos; also one motor-generator, to be used as an auxiliary in case of any trouble to the plant. The motor-generator will be run by 500-volt street-railway current. This work will be installed by the Northern Electrical Company of Duluth.

Theodore K. Jackson, the receiver appointed for the Yaryan Electric Company of Evanston, Ill., has announced that the company will consider all contracts nullified by virtue of the appointment of a receiver and will renew contracts only upon a 10-cent-per-kilowatt-hour rate, the former rate being 7½ cents a kilowatt-hour. He stated further that unless the council increased the limit fixed by the company's franchise from 10 to 20 cents a kilowatt-hour, made the rate for heating upon a basis of square feet of radiation instead of that of the cubic contents of the house, and modified the clause requiring the company to extend its service, the plant would be closed.

The Shoreham Hotel in Washington, D. C., is to be fitted up with electric-light fixtures worthy of note. Contracts have been signed with the E. P. Brooks Company of Washington which cover, it is said, a larger expenditure than has ever before been recorded for a similar amount of work and stock. All ceiling lights will be ornamented with "art glass," and the dining room and lobby will be furnished with a dozen or so very heavy chain chandeliers. Every bedroom in the hotel will be supplied with a chandelier, several bracket lights and a desk light. The contract does not include the dynamos and engines which are to supply the current for lighting purposes.

ELECTRIC RAILWAYS.

The first link in the electric-railway system from Danville, Ill., to Urbana, Champaign and Springfield, Ill., was opened to the public on August 27th. The completed portion of the road extends from Georgetown to Danville, and is 12 miles long.

On August 30th the employes of the tramway lines in Geneva, Switzerland, went on a strike because the manager of the electric workshops, who is an American, dismissed 42 of them from the shops and offered them positions as conductors.

The Chicago and Milwaukee Electric Railway Company has nearly completed its new line from Lake Bluff to Libertyville, Ill. The company has built four miles of track through one of the finest sections of agricultural country in Northern Illinois. The road will be six miles long when completed. A brick depot and power house have been completed at Libertyville. The road is an air line, has no curves or grades, and will ultimately be extended to Fox Lake, and will carry both passengers and freight.

A deal has been on for some time by which the consolidation of the Neuse River Electric Power Company and the Raleigh. (N. C.) Street Railway and Lighting Company may be brought about. The power company's plant is situated six miles from Raleigh on the Neuse River and was only recently finished. It cost in the neighborhood of $90,000. The power circuits are strung to the city, and the advantages of consolidation are apparent.

The Cottage Grove Avenue cable, which handles the street cars on Wabash Avenue in Chicago, broke at 8:30 o'clock on the evening of August 21st and compelled thousands of people to reach their homes by other means. This line of cars carries South Side passengers, and reaches a district six or seven miles distant from the heart of the city. The break was the worst that has occurred in the cable system in 20 years—in fact, repair was not attempted until daylight. The horse cars, which are usually seen on the line after 1 p. m., were of necessity idle, as the tracks were blocked every few blocks by trains of the cable cars.

The Danville, Urbana and Champaign Railroad Company, with principal office at Urbana, Ill., recently filed incorporation papers placing its capital at $250,000. The company intends to construct an electric road from Danville, Ill., to Springfield, Ill. The incorporators and first board of directors are Roy Wright, Urbana; William E. Coffin, Urbana; William B. McKinley, Champaign, and George F. Duncan and Edward Woodman, both of Portland, Ore. It is understood that this railroad is a continuation of the electric railroad which is being constructed between Danville and Champaign, and which is expected to reach Champaign this summer.

The construction of two new sections of the Paris Metropolitan railway is now being carried on. The section which is now in use makes almost a straight line across the center of the city, following the general direction of the Seine. The new sections will make a wide detour on each side of the Seine, thus forming an approximately circular line surrounding the middle part of the city. The portion on the north bank is now nearly completed, while that of the south bank, which was begun later, is not so far advanced. A peculiar feature of the northern part is that it is partly overhead. The overhead part is about a mile long, the total length of the northern branch being 6½ miles. This branch follows along the line of the boulevards, and the overhead part will not be too near the houses, as it passes along the central strip, having streets on either side of it.

AUTOMOBILES.

A remarkable ride of 118 miles upon asphalt pavements was made a few days ago by Mr. Newby in an electric automobile made by the National Vehicle Company of Indianapolis. Some of the newspapers publishing accounts of this ride, says Mr. J. K. Pumpelly, somewhat confused the feat with the claims of the Edison battery. The battery that propelled a vehicle this distance on one charge was made by the Western Storage Battery Company of Indianapolis and performed this trip after making 218 miles over country roads on three charges.

ELECTRICAL SECURITIES.

All the outstanding bonds of the Binghamton (N. Y.) General Electric Company, amounting to $700,000, have been called for redemption.

TELEGRAPH.

Chicago is not the only city that is experimenting in the employment of girls as telegraph messengers. Omaha has also taken the scheme under consideration and intends giving it a trial.

The Western Union Telegraph Company is said to be making preparations as rapidly as possible to form the connections through Pennsylvania made necessary by the failure of the Pennsylvania railroad to renew its contract with the company.

The strike of messenger boys still continues in Chicago, but the messages are successfully delivered by the girls employed to fill the boys' places. The boys are endeavoring to interest different important public men in their cause, though seemingly without avail. The telegrams will be delivered by the girls in daytime and by men at night.

The German Atlantic Telegraph Company in Cologne is issuing four per cent. debentures to the amount of 20,000,000 marks to provide for the cost of laying a second cable between Germany and the United States, the present cable having already proved inadequate for the increasing traffic. A new agreement has, at the same time, been concluded between the company and the Imperial Postal Administration, whereby the company's privilege is extended until 1945.

PUBLICATIONS.

The American Blower Company of Detroit, Mich., has issued an attractive booklet showing a number of views in its factory.

The proceedings of the meeting of the Illinois State Electric Association, held at Rock Island, Ill., on September 24, 1901, have recently been issued in pamphlet form by the secretary, H. E. Chubbuck,

Quincy, Ill. The publication also contains the names of members, list of officers and committees for 1902. A valuable feature is a set of tables giving data regarding electric-lighting stations in Illinois, compiled by the secretary.

SPACE TELEGRAPHY.

A project is on foot to establish wireless-telegraph stations in Greece or on the island of Crete for the purpose of communicating northward with Italy and southward with Egypt. If established, a great reduction in telegraph rates between these countries might be brought about.

Owing to the illness of Captain Harry Knox, who had been selected as president of the board to witness and report upon the wireless-telegraph tests being made between Washington, D. C., and Annapolis, Commander Arnold has been appointed in his stead. The other members of the board are Commanders Dyer and Badger and Lieutenants Beecher and Hudgins.

A message of greeting was received by President Roosevelt on August 27th at Ellsworth, Me. It came from Catalina Island, off the southern coast of California, and was transmitted to the mainland by space telegraphy. The message marked the installation and operation of a wireless-telegraph station on the island, which, heretofore, had had no communication either by telegraph or telephone with the shore.

Rear-Admiral Higginson, commander of the defending squadron in the recent naval maneuvers, in his report to the Navy Department, had this to say of wireless telegraphy: "I take this occasion, however, to urge upon the department the establishment upon all vessels of the navy a wireless-telegraph outfit. In my opinion, it is of incalculable value, and no expense should be spared to hasten its adoption."

MISCELLANEOUS.

A valuable deposit of asbestos has been discovered in the upper peninsular of Michigan, near the Ropes gold mine and a short distance from the town of Ishpeming. Numerous test pits have been dug, and the asbestos is found to exist in a deposit 800 feet long by 200 feet wide. The fiber averages five inches in length and is worth $40 a ton, it is said.

Business men in Syracuse, N. Y., are up in arms against the board of fire underwriters in that city. The board has recently caused numerous business blocks to be rewired at great expense. The resident portion of the town has not escaped its notice, either. The citizens assert that the board has instituted rulings in regard to the wiring of buildings which are altogether unnecessary and that these rulings give too much money to the electrical construction people.

The Philadelphia Company, Pittsburg, Pa., has made a report of its earnings for the seven months of the present year up to July 31st. The total income of the company was $4,013,686, with a total expenditure account amounting to $2,394,191. This leaves a net income of $1,619,495, which is an increase over the earnings for the same period last year of $249,109. The Philadelphia Company controlls rapid-transit, electric-lighting, artificial and natural-gas properties. Most of its securities are held by Baltimore (Md.) men.

TRADE NEWS.

The Cincinnati Elblight Company has been incorporated with a capital of $25,000. The manufacture of lighting supplies in Cincinnati is purposed by the concern.

Sealed proposals will be received at the office of W. B. Armour, city clerk, Memphis, Tenn., up to September 11th, for furnishing cables and all material for installing fire and police-telephone wires in underground conduits.

The Electric Construction and Machinery Company of Rock Island, Ill., has been incorporated with a capital of $25,000. The company intends to manufacture electrical machines and apparatus. The incorporators are J. T. Marron, W. H. Dickman and H. T. Schmidt.

The Midland Electrical Company is being organized in Des Moines, Iowa. It will manufacture and job electrical supplies and will engage in contracting electrical work. H. S. Towner is promoting the organization. A building located on West Locust Street has been leased.

The Champaign (Ill.) News says: "A patent has been granted J. W. Forster of Lincoln on his incandescent electric-light bulb, and a factory will be built in Lincoln for the manufacture of the new invention. The Forster Company has already organized with a capital of $250,000, and work will soon begin on the factory."

The Maxwell E. Mayer Company of Jersey City, N. J., has been incorporated with a capital of $100,000. The principal office of the company will be at 55 Montgomery Street, Jersey City. The purpose of the company is to manufacture electrical supplies. The incorporators are C. E. Hartshorn, M. L. Osgood and R. E. Hirsh, all of Jersey City.

The Signaloid Chemical Works, manufacturers of coloring and frosting compounds for incandescent lamps, have been sold by H. Greeder, founder of the business, to Messrs. Johnson & Hueston of 81 Fulton Street, New York city. The title of the concern is unchanged, but the office has been removed from Jersey City to the New York address mentioned.

A recent consular report from Amsterdam gives the information that there is a great demand there for catalogues of American firms in the iron and steel, coal and electrical trades. The Amsterdam consul, Frank D. Hill, who is preparing a room to be devoted to catalogues and folders, asks firms to send them to him. He has received many inquiries of late concerning American industries of this sort.

Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until September 30th, for the mechanical and electrical equipment of the United States courthouse and postoffice at Indianapolis, Ind. Plans and specifications of the work may be seen at the office of the supervising architect, or at the office of the architects, Rankin & Kellogg, 1012 Walnut Street, Philadelphia, Pa.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until 2 p. m. on September 19th, for the installation of a conduit and electric-wiring system for the United States custom house and postoffice at Brunswick, Ga., in accordance with drawings and specifications, copies of which may be obtained from the supervising architect in Washington or at the office of the superintendent of construction at Brunswick, Ga., at the discretion of the supervising architect.

Reports from Montreal, Ont., are to the effect that the electrical enterprises of that city are doing a greater business this year than ever before. An electrical engineer of the city is quoted as follows: "The expansion and development in all electrical lines is one of the most extraordinary and encouraging phases of the trade of the city." The Northern Electric and Manufacturing Company on Aqueduct Street, which employs over 400 hands, owing to a great increase in its business, is building an extension to its plant which will give work to an additional hundred men. The companies supplying electricity for power and light state that they have increased their customers by at least 15 per cent. over last year. The new electric power station of the Montreal Light, Heat and Power Company on Prince and Wellington Streets, is about completed, and is already in operation.

BUSINESS.

The plant, stock and business of the Belknap Motor Company of Portland, Me., will be sold at auction on Thursday, September 11th.

The Medora Milling Company, Medora, Ind., makes a specialty of producing chestnut poles in all lengths from 20 to 75 feet. The company states that its product is used by many telephone, telegraph, electric-light and street-railway companies. The firm is in a position to furnish a choice assortment of poles to electric-railway companies.

The Electric Appliance Company, Chicago, selling agent for Packard incandescent lamps, lately asked its customers for their opinion regarding the lamp. The hundreds of testimonials that have resulted from this request have been numbered, and are being exhibited as a chain of evidence of the excellence of Packard lamps. They make an exhibit of which both the manufacturer and the selling agent have a right to be proud.

Thomas Potter, Sons & Co. of Philadelphia, manufacturers of oilcloth and linoleum, have adopted electric power distribution for the operation of their oilcloth and linoleum printing machines, including the blowers used for drying oilcloth, elevators, and other general work throughout their plant. They have recently purchased from the Westinghouse Electric and Manufacturing Company six induction motors, which will be added to their present equipment.

The American School of Correspondence of Boston has made an arrangement whereby its students are admitted to the classes of one of the great resident technical schools without further examination, their work counting toward a degree of bachelor of science. The American School has been offering a limited number of free scholarships to deserving young men for the purpose of securing a few representative students in the large shops. The school now announces that after September 30th no more free scholarships will be awarded. This is a good opportunity for a bright young man to get a course in mechanical, steam, textile and sanitary engineering (including heating, ventilation and plumbing) and mechanical drawing. Tuition to successful applicants will be entirely free, the only expense being (as in all schools) for postage and instruction papers.

The constantly increasing number of electric vehicles which are equipped with batteries of Exide accumulators, manufactured by the Electric Storage Battery Company of Philadelphia, has prompted this company to anticipate the convenience of its customers by opening a number of Exide battery depots in different localities for the purpose of maintaining the batteries of its manufacture in the best possible manner. These Exide depots are fully equipped and are placed under the charge of experienced battery men. They are located as follows: New York, 148 West Eighteenth Street; Philadelphia, 250 N. Broad Street; Buffalo, 200 Pearl Street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Olive Street; Detroit, 101 Woodward Avenue. Users of the Exide battery are requested to consult with the engineer-in-charge of the nearest station when desirous of securing advice or new parts for their equipment.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 26, 1902.

707,557. Telegraphic Apparatus. Charles M. Davis, Chicago, Ill. Application filed July 27, 1901.

The apparatus has a main-line circuit including a fixed contact, a vibrating lever co-operating therewith, devices for controlling the vibrating movements of the lever to open or close the main-line circuit, a relay, a sounder, and means actuated by the relay for operating the controlling devices.

707,562. Electro-therapeutic Battery. Thomas J. Dunn, Jersey City, N. J. Application filed January 3, 1902.

A pocket form of battery having a cylindrical battery, with vibrator and regulator is described.

707,591. Underground Trolley System. Fred A. Howarth, Johnstown, N. Y., assignor of one-half to Henry L. Shaver, Cohoes, N. Y. Application filed November 22, 1901.

The system combines a supply conductor a flexible tubular inclosure therefor comprising a series of insulated conductive sections, supports for the conductor extending through transverse apertures in the tubular inclosure wall, and means for yieldingly supporting the inclosure sections out of contact with the conductor.

707,606. Trolley for Use in Electric Traction. John G. Lister, Sheffield, England. Application filed December 14, 1901.

The trolley consists of a socket, a spindle therein, a lever pivoted to the spindle, a spring acting between the spindle and the lever and a trolley wheel mounted on the lever.

707,612. Page-printing Telegraph. Giuseppe Musso, S. Angelo dei Lombardi, Italy. Application filed July 3, 1901.

A main line or circuit and transmitting means for producing electrical impulses of different strength therein, are combined with a receiver which comprises an armored solenoid rotatably mounted and adapted to take different positions corresponding to the intensity of the impulse or current. A circuit-closing arm is operatively connected with the solenoid, and type-writer operating circuits are controlled by the movement of the arm.

707,614. Driving Mechanism for Portable Electric Conveyors. William L. McCabe, Tacoma, Wash. Application filed December 17, 1901.

The mechanism consists of a suitable frame, an endless conveying belt, pulleys for supporting the belt on the frame, an actuating drum and a tension drum also engaging the belt at a point near the center of the conveyor frame and a motor mounted centrally in the frame and geared directly to the actuating drum whereby the device is well balanced.

707,617. Target. John L. McCullough, Brooklyn, N. Y. Application filed June 15, 1901.

The target has a face plate, a movable indicator adapted to move in and out from behind the plate, a lever which actuates the indicator, means for holding the indicator out of sight, normally behind the face plate, and an electromagnet which moves the lever in the direction to expose the indicator to view

707,622. Snap Push-button Switch. William J. Newton, New York, N. Y., assignor to Frank M. Dyer, New York, N. Y. Application filed October 17, 1901.

The switch has a spindle with contact arms insulated upon its opposite ends and an operating lever pivoted to turn upon the spindle. A locking device is provided for the spindle.

707,626. Electric Mine Exploder. Wilhelm Norres, Schalke, Germany. Application filed March 28, 1902.

Parts of the device are a conical firing stopper containing the fuse composition, a metal pipe fixed within the stopper, conducting wires inserted into the metal pipes, and an explosive shell having a splitted open edge by means of which the shell is simply set upon the conical firing stopper.

707,639. Electrical Safety Alarm and Signal Mechanism for Railways. John L. Ricketts, Philadelphia, Pa., assignor to Leonard R. Fletcher, Philadelphia, Pa.; Eliza J. Fletcher administratrix of Leonard R. Fletcher, deceased. Application filed March 19, 1900.

A normally closed car circuit contains a magnet and a track circuit has a contact whereby it is connected in series with the car circuit when the engine or car reaches the contact. Means are provided whereby such track circuit is automatically thrown in circuit with a relatively high resistance magnet when the engine or car leaves the contact.

707,653. Electric-lamp Support. Clarence M. Stead, Leeds, England. Application filed December 17, 1901.

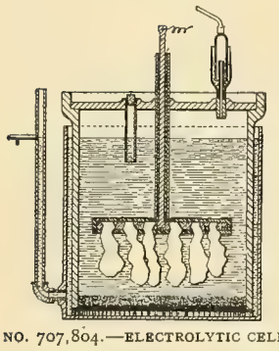
A pendent piece formed as an inverted cone or conoid over its lower part, and as a hollow cylinder over its upper part, has side strand holes. An approximately flat lamp plate, having a central opening, fits over the cylindrical part close to the base of the conical or conoidal part and lamp-holder openings.

707,660. Hoisting Apparatus. Edgar H. Watlington, Ridgewood, N. J., assignor to the Sprague Electric Company, New York, N. Y. Application filed January 13, 1902.

The device comprises a carrier, a boom carried thereby, a truck riding upon the boom, a motor carried by the carrier and another motor carried by the truck.

707,663. Rail Bond. Morris F. Whiton, Hingham, Mass. Application filed February 3, 1902.

The bond is composed of a laminated strip having flat feet and an intermediate extensible portion. Solder is interposed between the several layers composing the flat feet, a rivet passes through the layers, and a strip of sheet solder is attached at one end to the bottoms of the flat feet.



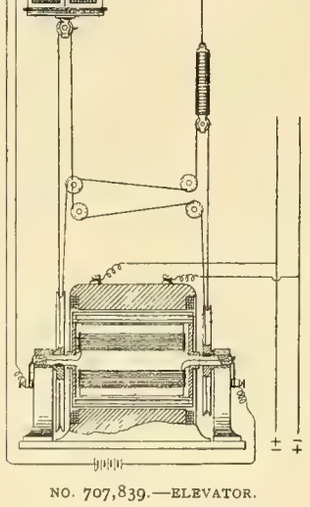
NO. 707,804.—ELECTROLYTIC CELL.

707,666. Electrode for Storage Batteries. Henry Woodward, London, England. Application filed January 15, 1901.

An accumulator plate comprising a number of strips crossing each other and pivotally connected together to permit expansion and contraction is described.

707,699. Charging Switch. Miller R. Hutchison, New York, N. Y., assignor to the Hutchison Acoustic Company. Application filed November 15, 1901.

One claim reads: The combination of a storage battery, a source of electricity, a charging switch consisting of a polarized electromagnet and contacts controlled thereby, a circuit including the battery the source of electricity, the magnet and the contacts in series and means for manually closing the contacts to complete the circuit.



NO. 707,839.—ELEVATOR.

707,731. Electric Battery. Ernest A. G. Street, Paris, France, assignor to Société Anonyme le Carbone, Levallois-Perret, near Paris, France. Application filed April 22, 1902.

In an electric cell combined with an electrode is a receptacle containing depolarizing material and connected directly to the electrode but having a recess on the side adjacent to the electrode. The recess is freely open to the electrolyte.

707,750. Machine for Making Chain. Luis Wirtz, London, England. Application filed February 25, 1902.

Means are provided for electrically heating and welding the wire from which the chain is made.

707,754. Brush Mechanism for Dynamos. William L. Bliss, Brooklyn, N. Y., assignor to the Bliss Electric Car Lighting Company, New York, N. Y. Application filed February 3, 1902.

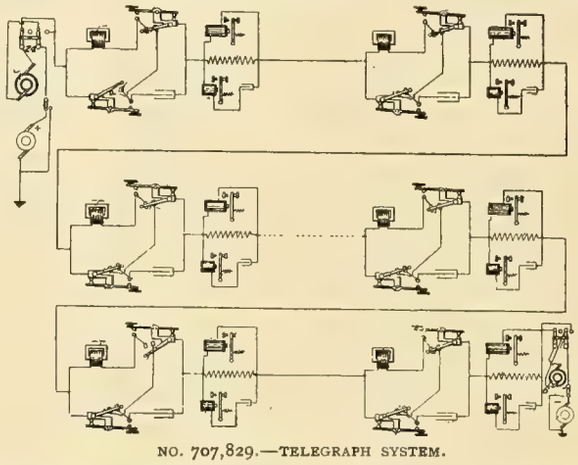
A rotary armature and commutator are combined with brush-holders, a rocking support for the brush-holders and a removable stop for limiting the rocking movement of the support.

707,761. Circuit-closing Device. Albert B. Chance, Centralia, Mo. Application filed July 25, 1901.

The device comprises a terminal, a vertically disposed spring-metal contact strip secured at one end and having its free end arranged normally out of engagement with the terminal and adapted to be moved into contact therewith, a pivoted switch lever having a long arm and a short arm, and a spring acting on the long arm of the lever for normally forcing the arm upwardly.

707,763. Electromagnetic Switch. John L. Creveling, New York, N. Y., assignor to the Safety Car Heating and Lighting Company. Application filed November 18, 1901.

The switch includes a coil receiving current from a generator, a coil adapted to receive current from a battery, the coils being on opposite sides of an air gap and serving to set up a number of fluxes diverging at the air gap, and a device controlled from the generator for affording means for the passage of current through the battery coil at predetermined times.



NO. 707,829.—TELEGRAPH SYSTEM.

707,776. Oscillating Electric Furnace. Paul L. T. Héroult, La Praz, France, assignor to Société Electro Metallurgique Francaise, Froges, Isère, France. Application filed August 21, 1901.

In the furnace are combined an electrode, a support, a collar or loop surrounding the electrode and holding it on the support, copper wedges pressed against the electrode by the collar, and a connection between the wedges and the electric circuit.

707,797. Rotary Apparatus for the Production of Diffused Electric Discharges. Marius Otto, Neuilly, France. Application filed November 12, 1901.

The apparatus comprises a pair of stationary conducting disks having each a covering or facing of dielectric material, and a conducting disk movably mounted between the dielectric-covered faces of the stationary conducting disks.

707,804. Electrolytic Cell. Adolph Sommer, Cambridge, Mass. Application filed August 17, 1899.

An apparatus for the electrolysis of saline solutions is described. It comprises an anode compartment, a cover therefor, a cathode, an anode in the compartment having a non-conducting horizontal flat upper surface, and a tube for the introduction of material to be electrolyzed, the tube leading through the cover and terminating above the anode. (See cut.)

707,829. Telegraphy. Albert C. Crehore, Tarrytown, N. Y. Application filed October 21, 1901.

The system combines continuous and pulsatory current receivers arranged in shunt relation to one another and having a condenser in the pulsatory current branch, transmitters for the two sides of the system arranged in shunt relation to one another, an inductance in the branch with the continuance-current transmitter, and a condenser in the branch with the pulsatory current transmitter, the transmitter being independent of those containing the receivers. (See cut.)

707,830. Telegraphy. Albert C. Crehore, Tarrytown, N. Y. Application filed October 21, 1901.

A superposed current-telegraph system is described. It consists of a pulsatory current generator adapted to generate an approximate sine-wave electromotive force and condenser shunts or branches around apparatus for the continuous-current side of the system, each shunt having its capacity balanced by inductance.

707,835. Means for Generating Counter Electromotive Force. Herbert H. Dow, Midland, Mich. Application filed April 21, 1900.

The voltaic element described comprises electrodes and suitable electrolyte, the opposing faces of the electrodes being of opposite sign and of a granular construction, the electrodes and their faces being of similar material.

707,839. Elevator. Edwin R. Gill, New York, N. Y., assignor to the Invention Developing Company. Application filed December 16, 1899.

One claim reads: In an elevator, a car, driving mechanism therefor, rotary magnetizable poles adapted to turn therewith, a magnetizing circuit for the poles, means on the car for varying the current in the circuit, a closed rotatable circuit close to the magnetizable poles and means for imparting rotary movement to the closed circuit. (See cut.)

707,842. Electric Fan. Gardner C. Hawkins, Boston, and Herbert L. Flint, Cambridge, Mass., assignors to the Boston Electric Heating and Power Company, Portland, Maine, and Boston, Mass. Application filed March 29, 1901.

The fan comprises a telescopic standard carrying at its upper end a motor having a vertically arranged armature shaft, means to clamp the sections of the standard together in any adjusted position, a fan secured to the upper end of the shaft, extensible conductors within the standard and connected to the motor, and a controller for the motor carried by the standard, the construction being such that the motor may be operated at any adjusted position of the standard.

707,843. Electric Switch or Cut-out. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va., and Philadelphia, Pa. Application filed December 11, 1901.

The device has a traveling contact bar, a series of stationary contacts, means for locking the contact bar to each contact, an operating plate, a spring connecting the operating plate to the contact bar, means controlled by the movement of the operating plate for distending the spring, and means carried by the operating plate and adapted to engage and force the contact bar from the contact to permit the distended spring further to move the contact bar into locking engagement with the next contact in series.

707,844. Electric-railway System. John C. Henry, Denver, Colo.; Susie A. Henry, executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Application filed April 9, 1901.

The system comprises track sections, a direct-current supply circuit, sectional conductors and switches controlling their connection with the supply circuit, local circuits connected to the track sections and including electromagnets controlling such switches, rotary converters connected to the direct-current supply circuit, and distributing circuits receiving alternating current from the rotary converters and including stationary converters connected to energize by induction the local track-section circuits. (See cut.)

707,890. Variable-feed Clutch. William A. Wood, Ansonia, Conn. Application filed November 22, 1901.

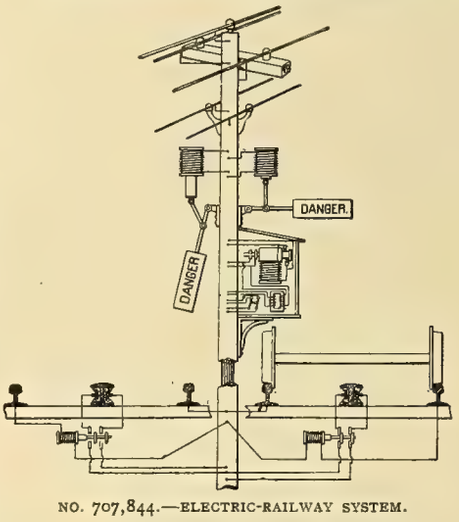
A variable-speed transmission gear adapted for use with an electric motor is described.

707,894. Automatic Cut-out. George E. Andrews, Providence, R. I. Application filed November 1, 1901.

The cut-out comprises mains carrying currents of different potential and provided with separate fuses, a fuse connected with both of the mains by means of shunt wires leading thereto, contact lugs connected with the mains respectively, and a fuse-controlled member for automatically connecting the lugs together.

707,938. Electrically Operated Valve Gate. Alexander Orr, Gloversville, N. Y. Application filed April 21, 1902.

The apparatus consists of a valve stem for operating a valve, motor mechanism for actuating the valve stem, the mechanism being provided with a revoluble arm, a lever provided with a boss for engaging the arm, thereby normally restraining the mechanism, and means controllable at will for actuating the lever, thus causing the boss momentarily to disengage the arm.



NO. 707,844.—ELECTRIC-RAILWAY SYSTEM.

707,952. Circuit-breaker. Frederick Benzinger, Union Hill, N. J., assignor to the General Incandescent Arc Light Company. Application filed January 29, 1902.

In the automatic circuit-breaker described are combined a switch lever, a latch for the lever, mechanism for lifting the latch a limited distance, and mechanism for releasing the latch.

707,959. Telegraphy. Albert C. Crehore, Tarrytown, N. Y. Application filed October 21, 1901.

In a superposed-current telegraph are combined a continuous-current receiver and pulsating-current receiver in shunt relation to one another upon the main line, and having a condenser in the branch containing the pulsating-current receiver, and transmitters for the two sides of the system placed in branches or portions of the circuit independent of the branches containing the receivers.

707,967. Automatic Switch for Electric Pumps. Alfred C. Griscom, New York, N. Y., assignor of one-half to Richard Collings, New York, N. Y. Application filed November 12, 1901.

Combined in the invention are a main-line circuit, a pump circuit, a pressure gauge, a solenoid and contact pieces at the opposite ends of the solenoid, the core of the solenoid being so located with respect to the contact pieces that it will make circuit through one set and break circuit through another set at each movement of the core, thereby simultaneously making or breaking circuit through the pump and breaking circuit through the solenoid.

707,975. Mercury-vapor Lamp. Henry N. Potter, Pittsburg, Pa., assignor to George Westinghouse, Pittsburg, Pa. Application filed July 24, 1900.

For this and succeeding patent see page 153.

707,976. Mercury-vapor Lamp. Henry N. Potter, Pittsburg, Pa., assignor to George Westinghouse, Pittsburg, Pa. Original application filed July 24, 1900. Divided and this application filed December 31, 1900.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, SEPTEMBER 13, 1902. No. 11

A Notable Central-station Supply—Power and Lighting for Marshall Field & Co.

The erection of a large new building to supply additional space for the retail store of Marshall Field & Co. in Chicago has been one factor in bringing about an installation for electric light and power supplied from a central station that is probably not surpassed in this country or abroad. This new building is 12 stories high with basement and attic, and occupies about a fourth of a city block at the southeast corner of State and Randolph Streets. Immediately adjoining it on the south and facing on State and Washington Streets is what is known as the Singer Building—an eight-story building that has been the home of the retail branch of Marshall Field & Co. for a number of years. To the east of this and facing on Wabash Avenue and Washington Street is the Annex Building, which is of more recent construction. The first five floors and basement of this building are occupied by the retail store, the upper floors being devoted to the John Crerar Library and private offices and studios. A general view of this group of buildings, taken from the corner of State and Washington Streets, and showing the separate buildings from left to right, in the order described, is given in Fig. 2 on the next page. In addition to these three buildings, Marshall Field & Co. occupy three smaller buildings facing on Wabash Avenue in the center of the block, the Truax, Green and Power Buildings by name.

These buildings, owned or leased and almost exclusively occupied by the retail department of Marshall Field & Co., cover nearly the entire block bounded by State, Randolph and Washington Streets and Wabash Avenue, as indicated in the ground plans in Fig. 3, and comprise a notable mercantile center. To supply alone the necessary electric current for lighting such a group of buildings is a proposition of no small order, to say nothing of the power. Before the erection of the new building the older buildings were supplied with light and a small amount of electric power by an isolated plant in the basement. For a year or more before the completion of the new addition negotiations were carried on by the Chicago Edison Company with the management of Marshall Field & Co., in an endeavor to get the firm's business for the central station. That these were finally brought to a successful issue is due to the energetic missionary work done by Mr. Louis A. Ferguson, second vice-president of the Chicago Edison Company. A contract was made by which the electrical systems of the retail store, of the firm's large wholesale store at Adams and Franklin Streets and of its various other buildings were thrown on the central-station supply of the Edison company and made dependent on that service alone. The isolated plants in both of these large store buildings have been removed and a great amount of steam and hydraulically operated machines changed to electric power, as well as additional lights added.

The contract for wiring the new building of the retail group was the largest wiring contract thus far awarded in the city of Chicago, and provided for about 22,000 16-candlepower lights and over 1,000 horsepower in motors. Additional wiring contracts were made, which provided for wiring new feeders and additional lights in the old retail stores, besides additional mains, feeders, switchboards, etc., in the wholesale building. The contracts for the entire construction work, amounting to upward of $200,000, were awarded to the Chicago Edison Company, and the work has been installed by the engineering and construction departments of that company, in accordance with specifications prepared by C. W. Wilkes, engineer for the architects, D. H. Burnham & Co.

Retail Store Supply.

By far the largest amount of current that is covered in the contract with the operating department of the Edison company is used in the retail store buildings. The connected load in this block of buildings amounts to more than 2,800 horsepower in motors and an equivalent in lighting of over 40,000 16-candlepower lights. Reducing the power and light to 16-candlepower equivalent shows the total connected load in the retail store to be about 82,000 16-candlepower lights.

Before taking up the interior wiring of the retail store, it may be interesting to note the method used in taking care of such a large installation by the central-station company. It is very evident that it would require a large amount of copper to transmit such a large supply of electrical energy from the Edison stations on the Chicago River across the business section of the city to the points where service enters the building, if this transmission were to be by means of the straight three-wire Edison 110-volt, direct-current system. In order to avoid a large part of the expenditure for copper, etc., and to maintain the necessary pressure, the power is transmitted from the main station at Harrison Street and the river, by means of alternating current at a pressure of 9,000 volts (thus using much smaller cables) to two sub-stations—one located under the Boyce Building on Dearborn Street and the other under the Masonic Temple, at the northeast corner of Randolph and State Streets, directly across the street from the new Field building.

The Masonic Temple sub-station is designed

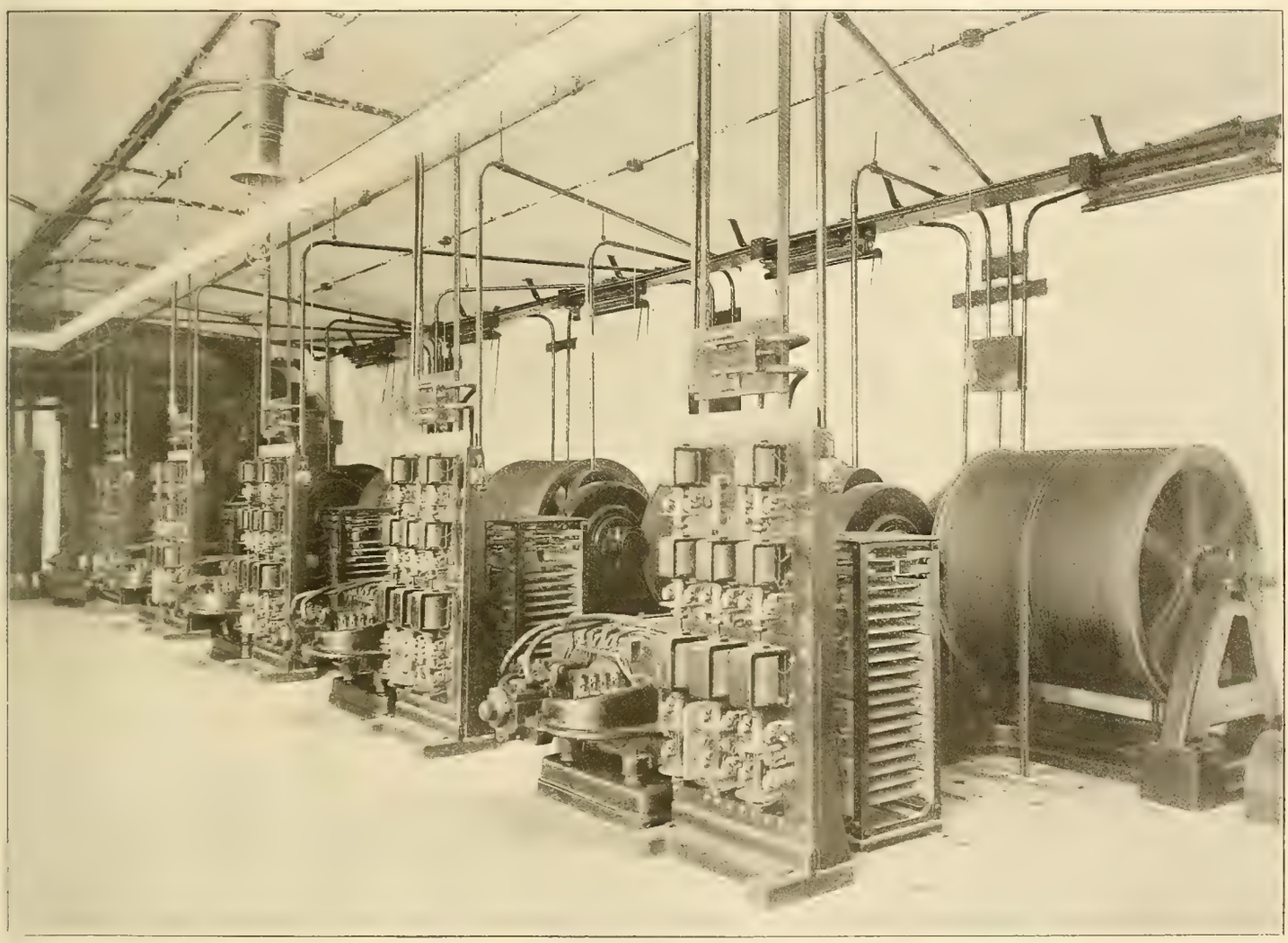


FIG. 1. POWER AND LIGHTING FOR MARSHALL FIELD & CO.—ROW OF ELEVATOR MECHANISMS IN NEW RETAIL BUILDING.

FIG. 2. MARSHALL FIELD & CO.'S RETAIL STORE.

for an ultimate capacity of 6,200 kilowatts, and there are already in operation five 500-kilowatt rotary transformers at this point. The Boyce Building sub-station has a capacity of 3,000 kilowatts, with 2,000 kilowatts already installed. As is shown in the accompanying diagram (Fig. 3), the services are brought in at various points around the block occupied by the Marshall Field buildings, and each of these services supplies current both from the main underground system and from one of the above-named sub-stations. All of the services, except those on the Washington Street side of the building, have a feeder connection to the sub-station in the Masonic Temple, while the service on the Washington Street side of the block connects with the Boyce Building sub-station. The arrangement of switches at each service is such that current can be supplied from either source.

In order to bring its service to this large customer's premises an expenditure is necessitated by the central station that is by no means small. It is estimated that the cost in the sub-stations and the feeders from the sub-stations to the building for this one store amounts to over $100,000, and, furthermore, this estimate does not include the cost of generating capacity in the main central stations, or the cost of high-tension cables over to the sub-stations.

Interior Wiring.

Taking up the interior wiring at the retail store more in detail, the following features of interest may be noted: The current for the buildings' load is taken from the street mains through 26 service switches, located at 14 different points in the basement, as indicated in Fig. 3. At each of these points there is located a service board, consisting of slabs of two-inch black-enamel slate, supported by heavy angle-iron frames, and having the service switches and Thomson wattmeters mounted on the face. The service boards are encased in cabinets made up of No. 10 sheet steel, having double doors fitted with heavy nickel-plated vault-door handles. One of these service boards (Fig. 4) is located on Randolph Street and supplies current for feeding the lights in the east half of the new building and also all of the power for elevators, fans and pumps in the new building. The switches on this board are as follows: One 1,750-ampere, three-pole, double-throw switch, controlling 6,000 lights; one 2,500-ampere, double-pole, double-throw switch, controlling 500 horsepower in motors, and one 1,000-ampere switch controlling 3,800 lights.

In order to care for this load three sets of feeders consisting of a total of 12 1,000,000-circular-mil cables, eight 500,000-circular-mil cables and two 300,000-circular-mil cables are run from the switchboard along the ceiling under the alley to the two wire shafts in the east portion of the building. They are run in 2½-inch loricated conduits, held in place by means of pipe hangers, as shown in Fig. 4, and from the bottom of the wire shafts they are continued up the shafts, supported on split porcelain hangers, which are securely fastened to heavy cast-iron cable racks.

The power feeder is run directly up to the attic and terminates in two large power sub-centers—one being located in the south section of the building and one in the north section. On each of these power boards there is a double-pole knife switch for each elevator or other motor supplied. Each switch is provided with an enclosed cartridge-type fuse.

The lighting feeders terminate in copper-distribution centers, located on the fourth and fifth floors. Fig. 6 illustrates the center on the fourth floor. From these centers (four in number) risers are run up and down the wire shafts, taps being taken off at each floor. On each floor and at each shaft there is installed a cut-out cabinet, consisting of a panel of black-enameled slate, having mounted thereon a polished panel board, with a double-pole knife switch to protect each circuit. These panel boards were manufactured by the General Incandescent Arc Light Company of New York and are of a special design, being the largest panels for this purpose used in the city. These circuits are protected by a no-arc cartridge fuse. In addition to these individual circuit switches, there is provided a main knife switch, to control all of the circuits emanating from the cut-out cabinet. These panel boards are made up as indicated in Fig. 5, which shows one of the panels on the fifth floor, and vary in size from 30 to 75 circuits. Some of the circuits are designed for four outlets having capacities as high as 75 lights each. Each panel board is encased in a heavy steel cabinet made up of No. 10 sheet steel and fitted with double doors and nickel-plated vault-door handles.

From these cabinets branch circuits are run in loricated steel conduit to the various outlets. In designing these circuits great care was taken to proportion the size of copper so that the variation in pressure between any two outlets will not exceed one-half a volt. This required in many cases the use of wire as large as No. 8 B. & S. gauge, even though it had to feed only 12 lights.

The lights for the west half of the new building are fed from two services at the curb wall on the State Street side. The switches comprise two 1,000-ampere, three-pole, single-throw switches, with a capacity of 5,200 lights, and two 1,500-ampere switches of the same type, controlling 6,600 lights.

The elevators in the Singer Building and also the lights for the north half of the Singer Building are fed from services installed at the curb in the northwest portion of the building. The switches consist of three 1,000-ampere, one 1,500-ampere and one

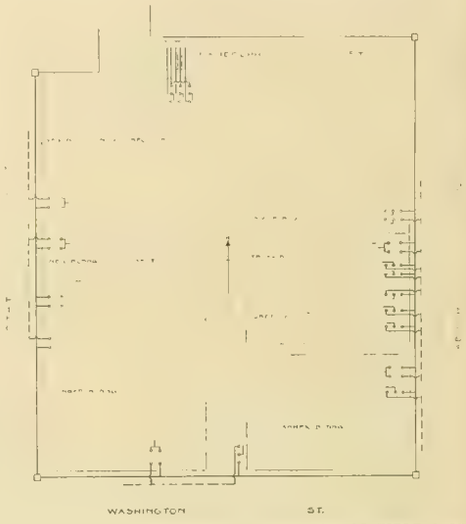


FIG. 3. POWER AND LIGHTING FOR MARSHALL FIELD & CO. —DIAGRAM OF SERVICE CONNECTIONS AT RETAIL STORE.

600-ampere, three-pole, single-throw switches, and the lights controlled number 7,600.

The current for the elevators in the Annex Building is taken from a service installed at the Washington Street curb, underneath the alley, or Holden Court, through a 1,000-ampere, double-pole, double-throw switch.

The lights for the Annex Building are fed from services located at the Wabash Avenue curb in the northeast portion of the Annex Building. One 1,500 and one 1,000-ampere, three-pole, single-throw switch control all the lights in this building below the sixth floor, while those above the fifth floor, principally used by offices, studios and the John Crerar Library, are supplied through a 200-ampere, three-pole, double-throw switch.

Current for light and power in the Truax, Green and Power Buildings, all occupied by Marshall Field

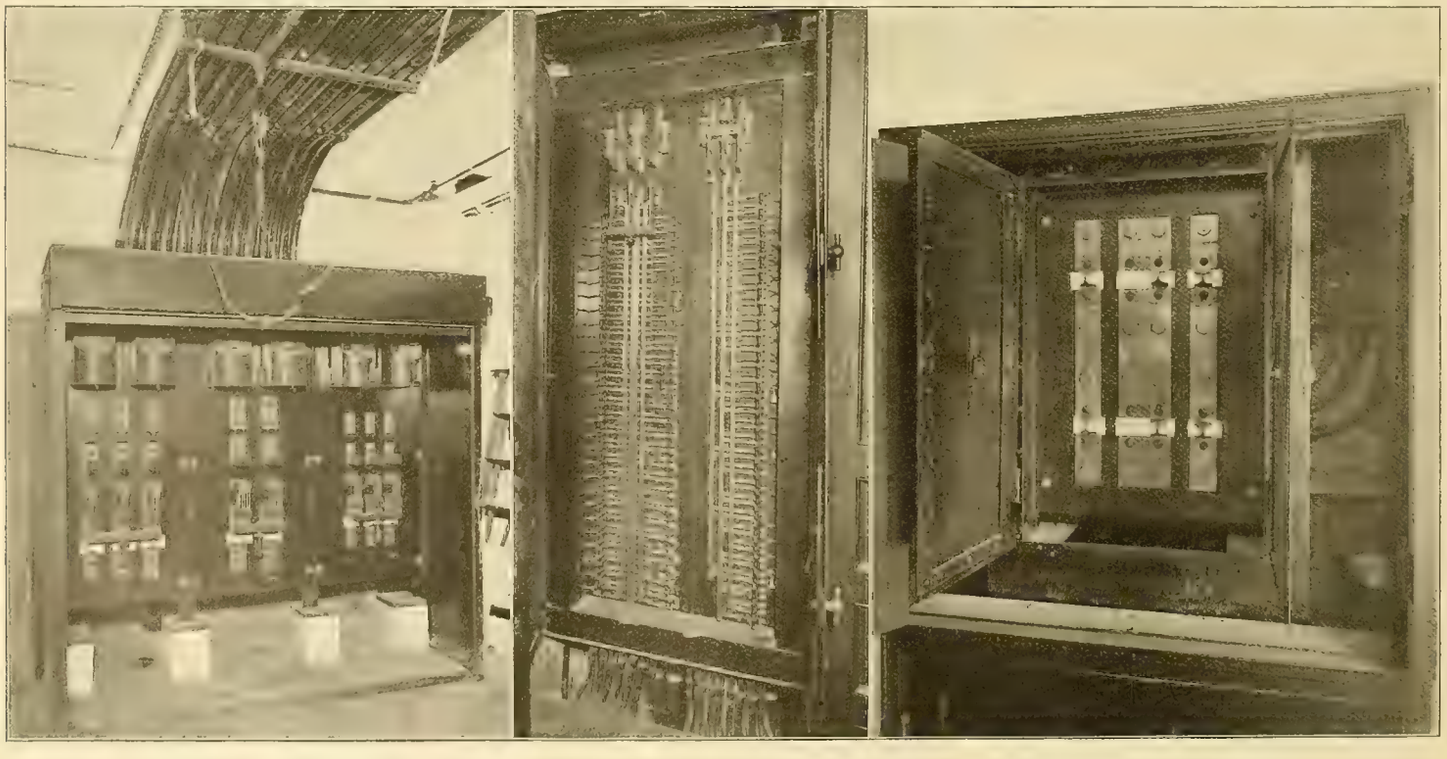


Fig. 4. Randolph Street Service Board, Showing Cable Distribution. Fig. 5. Typical Panel Board. Fig. 6. Typical Center of Distribution.

POWER AND LIGHTING FOR MARSHALL FIELD & CO.—FEATURES OF WIRING IN NEW RETAIL BUILDING.

& Co., and also for the power in the pump room, is taken from eight separate services on the Wabash Avenue side. The service switches for all of this work, as stated before, are so arranged that any or all feeders can be thrown on either of the mains which lead directly from the sub-stations, or they can be thrown on the general system of street mains, thus providing a very advantageous method of double feeding.

Elevator Equipment.

Of the power in the retail group of buildings, about 1,850 horsepower is for the operation of elevators, there being 46 of these installed, each having a capacity of 40 horsepower. The motors for these elevators are located in the attic, so that no space is occupied in the basement by elevator machinery. These elevators are all of the drum type, and were installed by the Otis Elevator Company, the installation being the largest order for electric elevators ever executed in the West, if not in the country. The elevators are of the tandem or double-worm and gear, direct-connected type. In the new building there are installed 21 of these elevators in groups of four to six each. The motors, drums and elevator mechanisms of one bank of five of these elevators are shown in Fig. 1. The machines are all controlled by the electromagnetic control system, the switches for which are mounted on separate boards, as shown in the illustration. In the old Singer Building there are 11 new elevators of the same type and 14 are now being installed in the Annex and other Wabash Avenue buildings, these 25 machines taking the place of steam and hydraulic elevators of a variety of makes. The passenger elevators have a capacity of 3,000 pounds each at 350 feet a minute and the freight elevators 3,500 pounds at 250 feet a minute.

A special feature of these elevators is their method of illumination, there being more light provided in each car than in any other installation in the city. In the center of the car, above the dome of Tiffany glass, there is a cluster of four 16-candlepower lights, while in the corners of each car there are four more lights, making a total of eight lights per car.

Lighting Fixtures.

The electric-light fixtures installed throughout the new building are of very ornamental and substantial design. The general type of six-light fixture that is used on most of the floors is indicated in

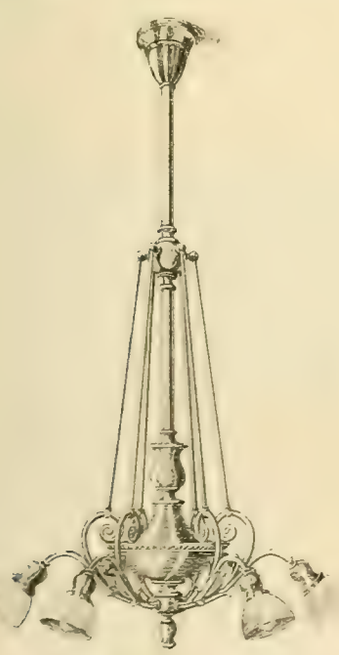


FIG. 7. POWER AND LIGHTING FOR MARSHALL FIELD & CO.—TYPICAL SIX-LIGHT FIXTURE IN NEW RETAIL BUILDING.

Fig. 7. These fixtures are of ornamental bronze. In the tea and reception rooms the chandeliers and brackets are of various attractive designs in keeping with the arrangement and ornamentation of the rooms. The total number of fixtures installed is 2,600, and the total amount of the contracts amounted to about $49,000. James Corday & Co. of Chicago made the installation.

Some chandeliers of a special and very ornamental design are located in the main State Street entrance of the new building. There are three in number and each of them weighs between 1,200 and 1,500 pounds; special hangers were necessary to support them. Two of the chandeliers are shown in Fig. 8, from which a good idea of their beauty may be gained. The glass used is of the Fabrile ware, and the construction work was done at the Tiffany Studio, New York city. The chandeliers are fed from a special service switch at the State Street service, and the lights are controlled by means of 21 switches, placed in a cut-out cabinet located on the stair landing. Each chandelier is wired for 80 lights, 50 being brackets on the outside of the globe and the remaining 30 on the inside of the globe.

Show-case Lighting.

To light the various show cases throughout the building water-tight iron floor boxes were installed, each box being fitted with a brass cover. About 400 of these boxes were installed, having a total capacity of over 5,000 lights. From these boxes tap circuits were run to light up the show cases. This lighting consists of special small troughs, placed in the upper front edge of the show cases, being protected from view by means of bands of mirror about two inches wide. In the trough are placed special small Edison sockets for use with miniature lamps.

FIG. 8. POWER AND LIGHTING FOR MARSHALL FIELD & CO.—TIFFANY CHANDELIERS IN ENTRANCE TO NEW RETAIL BUILDING.

Miscellaneous Power.

Outside of the heavy demand on the power supply of the buildings occasioned by the elevator motors, the principal use for power is for pumps and other machinery in the basement. There are installed four 15-horsepower motors, driving house pumps, with two two-horsepower motors, driving return pumps. A refrigerating system of a capacity of 50 tons of refrigeration a day is to be installed, and cooled water will be forced throughout the buildings and to the tea room for drinking purposes by two 15-horsepower motor-driven pumps. The refrigerating plant will be operated by two 20-horsepower brine pumps and two 75-horsepower ammonia compressors, all electrically driven. The pneumatic-tube cash-carrier system is operated by two 75-horsepower and two 40-horsepower motor-driven blowers. Compressed air for use in operating the elevator doors and cleaning furs and for dental purposes in the Annex Building will be supplied by duplicate compressors, driven by 75-horsepower motors and by a small compressor operated by a 7½-horsepower motor. Other power motors include a five-horsepower direct-lift motor, a two-horsepower centrifugal pump and two 50-horsepower ejector compressors for lifting sewerage to the level of the street sewers. An interesting feature of the new building is a set of nine electric dumb-waiters that travel between the attic and basement. They are automatically operated by means of push buttons and have a capacity of 100 pounds each at a speed of 400 feet a minute. They were installed by the Burdett-Rowntree Manufacturing Company of Chicago, which also put in the system of electric signal lamps at the elevators.

Private Telephone Exchange.

An indication of the amount of business handled through the retail store and of the popularity of its resting room is shown by the large private telephone exchange which is installed in the building. The exchange is a branch of the Chicago Telephone Company's system and is located on the third floor, as shown in Fig. 9, immediately in the rear of the public resting and reception room. The switchboard represents the very highest type of private branch-exchange switchboard construction, and has all details as complete, perfect, and up-to-date as the latest relay central-office switchboards. In fact, the board may be classed as a common-battery relay private branch - exchange switchboard equipped throughout with lamp signals. The switchboard consists of two seven-panel, three-position sections of mahogany switchboard, patterned after the standard relay switchboards in the Chicago Telephone Company's central offices. It is now equipped for 300 private branch-exchange lines and 40 trunk lines leading to the Central Exchange. All subscribers' lines and trunk lines are multipled in front of all operators.

The ultimate capacity of these six operating boards, four positions only being as yet fully equipped, will be 400 lines. Most of the instruments are equipped with coin boxes and are essentially public telephones, a charge of five cents per call being made, the subscriber depositing a coin in the box before connection is completed. A small apparatus room for storage batteries, distributing frames, fuses, switches and power apparatus is provided separate from the switchboard quarters. The storage battery is used both for signaling and talking purposes.

The great number of relays used on its switchboard are all mounted on a special iron relay rack in the rear of the board, back of the public telephone booths. Connecting the switchboard with the apparatus room, where cables from distributing boxes located at various points on every floor of the large building terminate, are approximately 1,200 pairs of

wires, all in cables drawn into iron conduit. The whole installation is made as fireproof and complete as possible, and is amply protected from mechanical injury.

WHOLESALE BUILDING'S LIGHT AND POWER.

Turning from the equipment of the retail store to that of the wholesale building, one finds a smaller electrical installation, but still one of considerable proportions. While most of the lights had already been installed in the wholesale store, the arrangement of feeders was entirely changed and a large number of additional lights were wired. The scheme for the work in that building was about as follows:

The central-station service enters the building in the basement under Quincy Street at two points, a separate service switchboard being installed at each of these points. Each service is capable of carrying the probable maximum load which will be on the building at any one time, thus giving two independent sources of supply and doubling the factor of safety. Besides this, each of these services itself is in duplicate, there being at each service a feed from the underground system of the Edison company and also a direct feed from one of the power stations. In one case the feed comes direct from the battery at 139 Adams Street; in the other it comes direct from the Harrison Street station.

On the opposite side of the large basement room which these services enter there is the large main operating board, which is shown in Fig. 10. This board is supplied with current from each of these services by a heavy feeder, consisting of 10 1,000,000-circular-mil cables. Accordingly, this main operating board has practically four sources of supply. The board is built according to the latest improved methods, with bus-bars at the back of the board and switches in front. The switches include four large triple-pole switches for controlling the four lighting feeders of the building, also double-pole knife switches, allowing one switch for each motor in the building.

In the same room in which are located the above-named switchboards there are installed two General Electric compound-wound motors, belted to Gould triplex power pumps, as shown in Fig. 11. These deliver water to the roof tanks at the top of the Adams Street building, and also to tanks in the attic of the Jackson Boulevard building, directly south. The motors are controlled automatically by floats installed in each tank, the arrangement being such that in case the water is shut off from any one tank, it will not affect the operation of the automatic switches and starters which are installed in the basement. These pumps are also used to pump water to the pressure and gravity tanks installed in connection with the sprinkler system. They deliver water against a pressure of 150 pounds when used on the sprinkler system.

Included in the motor installation of this building are 17 electric elevators. What is considered a remarkable record was made in installing 14 of these machines. The work consisted in removing 14 steam elevators and replacing them with those of the electric type, and the work was done by the Otis Elevator Company between April 1st and June 15th without any interruption of the service.

There is a total of about 700 horsepower in motors, including elevators, installed throughout the building, while the lighting consists of about 300 five-ampere incandescent arc lamps and about 4,400 16-candlepower incandescent lamps, making a total connected load in 16-candlepower equivalent of about 18,000 lights. Adding this to the total of 82,000 16-candlepower equivalent in the retail store, makes a grand total connected load for the two stores of over 100,000 16-candlepower equivalent. This does not include several large power motors, which will probably be installed in the near future.

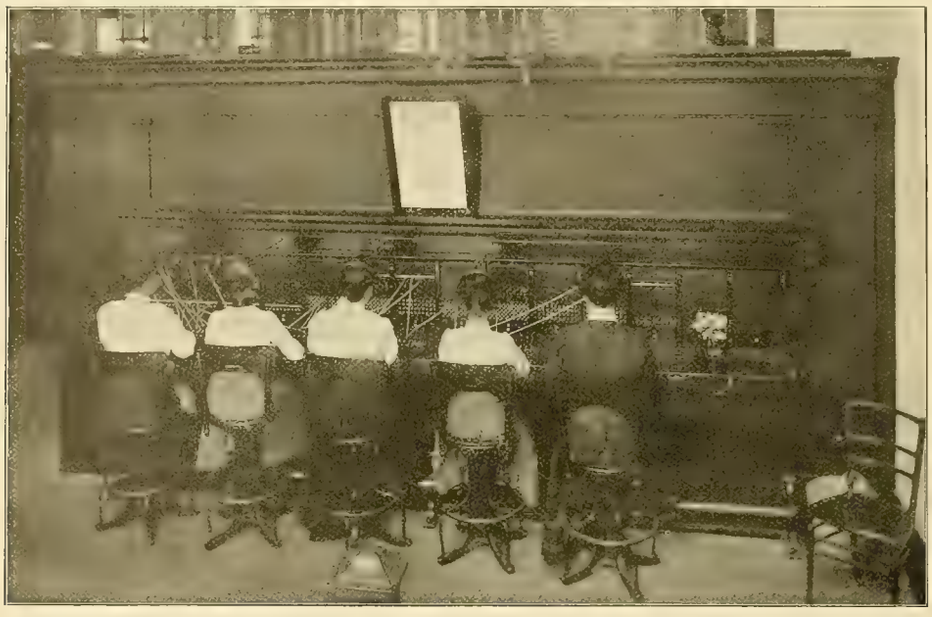


FIG. 9. POWER AND LIGHTING FOR MARSHALL FIELD & CO.—PRIVATE BRANCH TELEPHONE EXCHANGE.

CONCLUSION.

Without doubt this contract for the supplying of electric power equivalent to that consumed by 100,000 16-candlepower incandescent lamps stands as the largest amount of current sold by any central-station company in the world to a private customer. An idea of the size of the contract may be gained by regarding this capacity of 100,000 lamps as a load for a central station in a good-sized city. That number of incandescent lamps in itself would undoubtedly be considered a good load for a city between 100,000 and 200,000 population and probably is a figure that is not far from the number of incandescents now supplied by such cities as Toledo, Ohio, or St. Paul, Minn.

New Engineering Building at University of Michigan.

Work has been begun on a new engineering building for the University of Michigan, at Ann Arbor, Mich., which, when completed, will relieve the present crowded conditions of the engineering department and afford a fitting and commodious building for the engineering students. The architects for the building are Mason & Kahn of Detroit. The structure will contain 1,500,000 cubic feet of space, will be of pleasing and substantial architecture, and is to be erected at a cost of about $150,000.

The site selected for the building is the southeast corner of the campus that is intersected by the beautiful "diagonal walk." The structure will be erected something in the form of an "L," the two long sides facing the streets, while extending west from the east side will be a wing. An elevation of the building looking northwest from the corner of the campus is shown in the accompanying illustration, which is reproduced from The Technic. Spanning the diagonal walk will be an arcade, 14 feet wide and 66 feet long, above which rises the central portion of the building, with a ground plan 66 by 57 feet, and a total height of some 75 feet, being four stories in the clear.

Extending to the left or west of this central portion is the south wing, 60 by 174 feet, and on the right, is the east wing, 60 by 213 feet, with an extension to the north, 22 by 100 feet, for the prolongation of the naval tank. To the west of the north end of the east wing will be the north wing, 60 by 60 feet, for the steam laboratories, with a projection, 34 by 34 feet, for experimental work in high-pressure steam. Stretching the building out in a straight line it would have a total length of over 500 feet, exclusive of the extension for the naval tank.

The first story will be built of rock-faced native field stone, the rest being of a dark reddish-brown, vitrified paving brick, while the roof is to be red tile. All floors are to be of concrete and expanded-metal construction, thus rendering them fireproof and also practically soundproof. Through the center of each wing on all floors and through the central part extends a continuous corridor, 11 feet

Fig. 10. Main Switchboard.

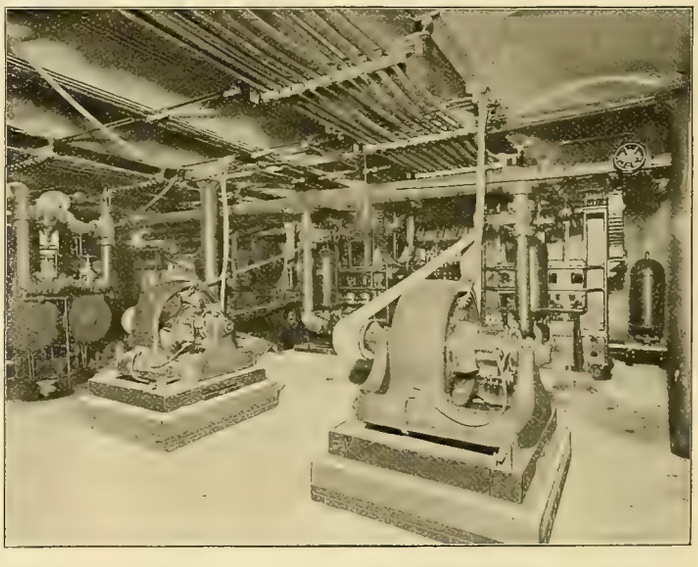
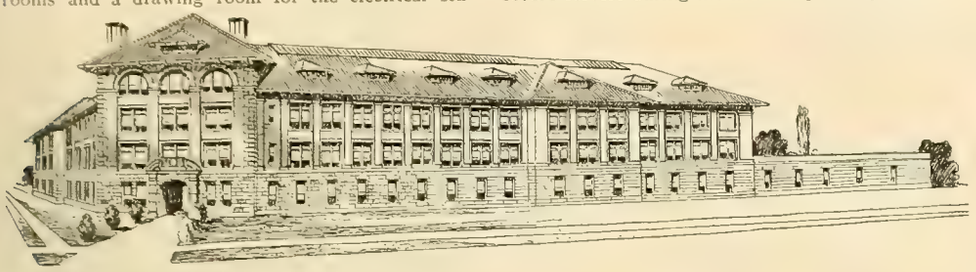


Fig. 11. Electrically Driven Triplex Pumps.

POWER AND LIGHTING FOR MARSHALL FIELD & CO.—VIEWS IN WHOLESALE BUILDING.

wide, out of which open the various lecture rooms, recitation rooms, drawing rooms and offices. This main corridor will be about 400 feet long on each of the floors.

A considerable portion of the south wing will be devoted to the electrical engineering department. On the first floor will be located two large electrical laboratories, each 52 by 30 feet in size. One of these rooms will be used for direct current for heavy machinery and the other for alternating current for heavy machinery. The smaller rooms on this floor will include a photometry room, 10 by 20 feet; a calibration room, 11 by 20 feet; a battery room, 12 by 22 feet; three research rooms, an instructor's room, office, toilet room, etc. Two large recitation rooms and a drawing room for the electrical students will be located on the second floor of this wing.



NEW ENGINEERING BUILDING AT UNIVERSITY OF MICHIGAN.

Perhaps the most interesting feature of the building will be the naval or ship-testing tank, for the department of naval architecture. This tank is the only entirely inclosed and protected tank for this purpose located at any educational institution in the world. The tank will be 22 feet wide, 300 feet long and 10 feet deep, with dry dock, model rooms, etc., attached and a gallery running entirely around it. Although primarily for marine investigations, this tank will also be available for the mechanical engineering department and will prove a valuable adjunct to the hydraulic laboratory.

Other rooms in the east wing will be devoted to physical or engineering testing, compressed-air work, computing, research, instructors' uses, refrigeration, etc. In the north wing will be located the hydraulic laboratory, steam-engineering laboratory, boiler room, gas and fuel-analysis rooms, calibration room, rope and belt-transmission room, etc. The entire fourth floor of the building will be devoted to the work in stereotomy, mechanism and drawing. On the whole, the building, fitted up as it will be, with the latest and most practical equipment, will be a valuable addition to the university's engineering department, which now occupies a small engineering building and engineering shops, and has use of other laboratories and the campus heating and lighting plant.

Alternating-current Interurban Railway Between Washington and Baltimore.

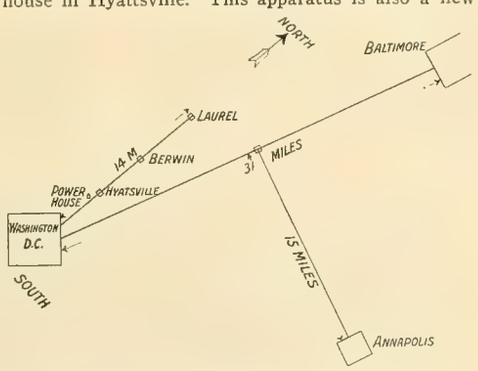
An interesting and novel use of alternating-current apparatus is to be made on the Washington, Baltimore and Annapolis electric railway, which is to operate an interurban line from Washington to Baltimore, about 40 miles in length, with a branch to Annapolis, 15 miles in length, as shown on the accompanying map. The contract for the electrical equipment has recently been let to the Westinghouse Electric and Manufacturing Company of Pittsburg. Details regarding the new system have not been given out, but it is stated that by its use the limitations of the induction motor and the disadvantages of the multiplicity of overhead conductors necessary in polyphase systems will be avoided and that it will have advantages over the direct-current system.

For the road which is now being constructed between Washington and Baltimore, single-phase, alternating current will be generated in a main power house, located at Hyattsville, by three 1,500-kilowatt, single-phase, Westinghouse generators, delivering current at 15,000 volts and driven by cross-compound, Hamilton-Corliss engines. This station is to be of more than average size and is in no sense experimental. The power house will be built of brick, with stone and concrete foundations, and will contain in addition two 125-volt direct-current generators, to be used as exciters, for the alternators and a large switchboard with electrically operated oil switches, circuit-breakers, lightning-arresters, etc. Current will be distributed from the power house at 15,000 volts to transformer stations, located at suitable intervals along the line. These transformer stations will contain only stationary transformers with the necessary switches and fuses, but no moving machinery, and will, therefore, not require the presence of an attendant. From these stations current will be fed to the single trolley wire at 1,000 volts. The pressure of 1,000 volts which has been adopted for the trolley wire is not a necessary part of the system, as a much higher voltage could have been used if it had been deemed advisable by the engineers of the road.

The cars will probably be 60 feet in length and weigh about 50 tons each. They will be supplied with Master Car Builders' trucks, designed for high speed, the track is to be laid with 80-pound rails, and it is expected that the distance of 31 miles will be made in 45 minutes, including stops. The cars are to be equipped with four motors, each of 100 horsepower, and it is expected that a normal speed of 40 to 45 miles can be attained and a speed of 60 miles reached when necessary. The motor, which is the novel part of the equipment and the key to the entire system, is a variable-speed motor having characteristics adapted to railway service and in all respects equal, it is said, to the present direct-current railway motor. It has been developed and tested in severe service during the last few years by the Westinghouse company, under the supervision of B. G. Lamme, assistant chief engineer.

As stated before, the power house is now being erected at East Hyattsville, Md., where the railway company owns a site of three acres. The power house will be completed in about 12 months, will be 133 by 203 feet in size and cost in the neighborhood of $350,000. It is located conveniently to water for condensing purposes and to railway facilities for handling coal, and will furnish power for the Chesapeake Beach railroad, which is to discontinue the use of steam, and perhaps, in addition, to manufacturing plants to be located in this neighborhood.

The company is to take over a small direct-current road, about 14 miles long, running from Washington to Laurel, Md., as shown on the map, and current for this line will be furnished by two 200-kilowatt, single-phase, rotary converters, located at the power house in Hyattsville. This apparatus is also a new departure and of considerable interest, especially since it shows the possibility of operating the new system with existing direct-current plants.



WASHINGTON-BALTIMORE ELECTRIC RAILWAY.

The engineer of the new road is the Cleveland Construction Company, of which Will Christy is president. The officers of the Washington, Baltimore and Annapolis Railway Company are: President, W. H. Lamprecht; secretary, Otto Miller, both of Cleveland, Ohio. The directors are as follows: W. H. Lamprecht, F. T. Pomeroy, F. N. Wilcox and Otto Miller, all of Cleveland, Ohio; Will Christy of Akron, Ohio; James Christy, Jr., of Washington, D. C., and W. L. Marbury of Baltimore, Md. It is also stated that Henry Everett, E. W. Moore and W. J. Mandelbaum & Co. of Cleveland, are largely interested in the enterprise.

Arbitration of Street-railway Troubles in Chicago.

The arbitration board to which the differences of some of the employes with the Chicago City Railway Company were submitted has presented its report, and the board's findings are regarded as a victory for the men. The board consisted of ex-Judge S. S. Page (attorney for the company) for the company, J. H. Bowman (a well-known union man) for the union, and A. C. Bartlett (prominent hardware merchant) as the third disinterested member. A general increase of 10 per cent. was granted the men and in addition the working day was defined as 9½ hours, with time and a half for overtime, and a holiday every other Sunday. About 2,000 men are affected by the settlement, the classes of labor including car-body workers, rough painters, handy men, grip repairers, pit-room men, washing-machine men, brass cleaners and laborers, and in the general shops, car, motor and grip repairers, inspectors and dopers. The award is binding on both sides to the controversy. It applies, however, only to members of the union, and the result of this provision is expected to be an influx into the organization of the few hundred men who still remain out of it. The life of the agreement is from September 1st of this year to September 30, 1903. On the latter date also expires the agreement which was made some weeks ago with the motormen, gripmen and conductors. It is stated that the increase in the men's wages will increase the company's expenses by $180,000 a year.

The Chicago Union Traction Company has selected Walter Heckman, an attorney, as its representative on the arbitration board which is to decide the differences with its men. Clarence S. Darrow represents the union, but the third man has not been selected yet.

Pickard Wireless-telegraph Apparatus.

Greenleaf W. Pickard of Boston, Mass., has recently brought out some new wireless-telegraph apparatus. The coherer which he has invented is shown in Fig. 1 and comprises a non-conducting tube with conducting wires entering the tube from opposite ends. Surrounded by the tube and connected to the wires are metallic plugs which have their adjacent ends provided with concavities so as to form a pocket whose greatest width is between the center of the adjacent ends of the plugs and whose narrowest width is between the extreme edges of the adjacent faces of the plugs. Metallic filings or particles are located in the pocket below the axial line of the plugs.

The circuit at the receiving end includes the coherer and a relay. The latter operates a decohering

FIG. 1. PICKARD WIRELESS-TELEGRAPH APPARATUS.—COHERER.

circuit, while in shunt to this circuit is a recorder circuit. A lever or armature operated by the relay energizes the recorder and decohering circuits, the decohering means being regulated according to the resistance of the receiving means.

Fig. 2 shows the arrangement of the system. Aerial and ground connections are provided, together with the transmitter and receiver. Means are arranged to disconnect the coherer from the receiver, and a switch, which comprises a pivoted lever of insulation material having contacts on each end for making the connections, is used to connect the transmitter or receiver to the aerial and ground connections. Mr. Pickard's inventions are covered by three patents, issued last week and assigned to the Consolidated Wireless Telegraph and Telephone Company.

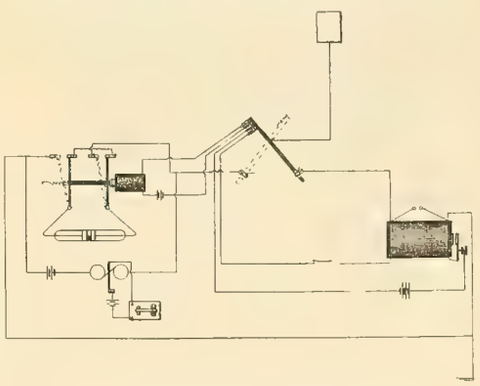


FIG. 2. PICKARD WIRELESS-TELEGRAPH APPARATUS.—ARRANGEMENT OF SYSTEM.

Electric Railways Affect Carriage Trade.

In the United States census report on "Carriages and Wagons," prepared by James K. Dawes, is this interesting statement: "It will not be amiss to call attention to the natural effect produced on the industry by the remarkable and rapidly increasing extension of the electric-traction systems during the last few years. These systems connect the thickly populated cities with the surrounding towns and villages, and afford not only the residents thereof, but also the rural communities through which they pass, rapid and convenient methods of communication. Thus at a minimum expense rural and suburban communities are brought into close touch with the city markets, and in consequence the use of carriages and light wagons has been largely reduced."

Progress in Space Telegraphy.

By Emile Guarini.

I. The Marconi System.

In these later days space telegraphy, and especially the Marconi system, has made great and rapid progress, as seen from a scientific, technical or commercial point of view.

The first form of the apparatus which was given practical application consisted of a transmitter (Fig. 1) in the form of a key opening and closing the circuit of a variable electric current. This key and a suitable source of current were inserted in the primary circuit of an induction coil. The secondary of this coil, which has one of its terminals grounded and the other joined to the antenna (vertical wire), works an oscillator or producer of oscillatory waves of high frequency.

The receiver (Fig. 2) was made up of an antenna grounded through an induction coil, the latter being in circuit with a battery and a relay.

As is well known, one of the greatest accomplishments to be achieved in space telegraphy is the securing of secrecy for the dispatches. Mr. Marconi believes that he will be able to accomplish this result by means of syntony. With the apparatus used by Mr. Marconi up to 1898, in which the antennæ were connected directly to the transmitter and receiver, respectively, syntony was not possible, unless neighboring wireless stations employed antennæ differing considerable in length from those used in connection with the Marconi apparatus. In the case of there being only slight differences, a definite code was necessary to assure secrecy.

The best results have been obtained with the arrangement shown in Fig. 3. Here the antenna is grounded through the primary of an induction coil, the secondary of which is in circuit with a condenser and a coherer, the condenser being put into the circuit in such a manner that it divides the secondary coil into two equal coils or parts. By this arrangement, if each half of the secondary is made equal to one-fourth of a wave length, the coherer becomes placed between a positive and a negative center of potential, or, better expressed, between two points of maximum difference of potential, which, according to the arrangement, are the only ones between which it will act.

The results of the syntonization are still more marked by putting a condenser (Fig. 4) in parallel with the coherer. Marconi found that, by using now the apparatus shown in Fig. 5, the transmission was greatly improved, and the resulting communications bettered. In this arrangement one terminal of the primary of the induction coil—Marconi designates the coil as a "jigger"— is grounded and also joined to an antenna through a solenoid.

Mr. Marconi has also been able to receive several messages at the same time. This was done by joining several receivers to a single antenna (Fig. 6), each receiver being set to respond to a different wave length. The transmitters may be set up in different stations or they may be grouped together in one station, each employing its own antenna, or all being joined to a single antenna.

The transmitter has received a great deal of Mr. Marconi's attention, with the result that he has determined upon several modifications of it. First, he intends to increase the energy of discharge CV^2 by increasing the transmitter's capacity C. Second, he has determined to divide the sending energy into a repeated number of oscillations (Fig. 7), instead of sending it out in a single oscillation as was done by the apparatus shown in Fig. 1. Third, he has decided upon increasing the radiating power of the antennæ.

The first desired modification (capacity increase) was obtained, in one manner, by placing a condenser in the discharge circuit (Fig. 8). The antenna is grounded through the secondary of an induction coil, the primary of which is put in circuit with a condenser and the oscillator knobs (Fig. 9). Fig. 10 represents the ensemble of the transmitter as described above.

By the second scheme for increasing the energy of discharge, one ball of the oscillator, which is grounded, is also put in connection with a second antenna (Fig. 11).

Mr. Marconi has also brought out a very successful transmitting apparatus of another type. In this arrangement the antenna is made up of two concentric cylinders. Of these, the exterior one is joined to one terminal of the secondary of a second induction coil. The interior cylinder is grounded, as is also the other terminal of this secondary coil. Marconi often made use—as in the experiments betweet Biot and Calvi—of two or more induction coils, their primaries being joined in series and their secondaries in parallel.

The Marconi system has already been installed in numerous places. It has been adopted for use on the steamboats plying between Ostend and Dover. The land station at La Panne is shown in Fig. 12. The English Naval Department has also installed a great number of Marconi stations on its warships and on the coast. Many other countries are now adopting the system. A company has recently been organized in America with a capital of $6,000,000 for the exploitation of the Marconi patents in the United States.

In the last 15 months the Marconi system has been subjected to three great official tests.[1] In April, 1901, the Marconi International Marine Company

1. Mr. Guarini appears to have overlooked Marconi's receipt of intelligible messages on the steamship Philadelphia in mid-Atlantic, from Cornwall, England, over a distance of 1,500 miles, last February.—Ed.

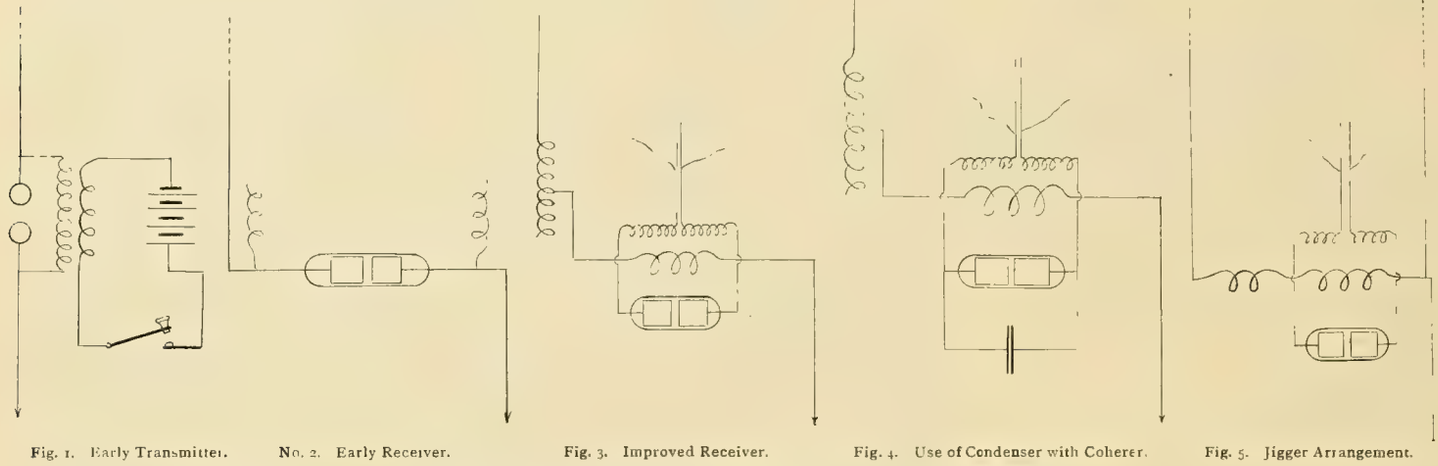


Fig. 1. Early Transmitter. No. 2. Early Receiver. Fig. 3. Improved Receiver. Fig. 4. Use of Condenser with Coherer. Fig. 5. Jigger Arrangement.

PROGRESS IN SPACE TELEGRAPHY.—DIAGRAMS OF MARCONI APPARATUS.

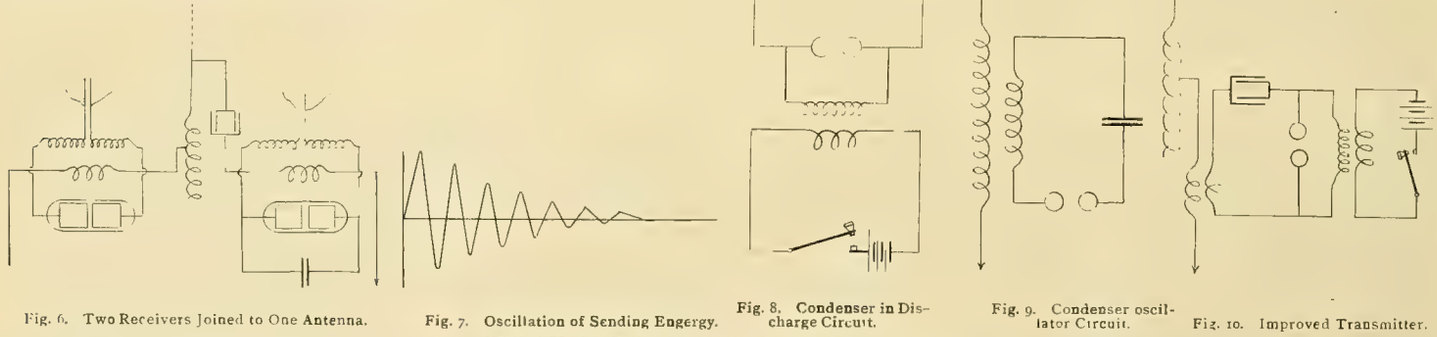


Fig. 6. Two Receivers Joined to One Antenna. Fig. 7. Oscillation of Sending Engergy. Fig. 8. Condenser in Discharge Circuit. Fig. 9. Condenser oscillator Circuit. Fig. 10. Improved Transmitter.

SPACE TELEGRAPHY.—DIAGRAMS OF MARCONI APPARATUS.

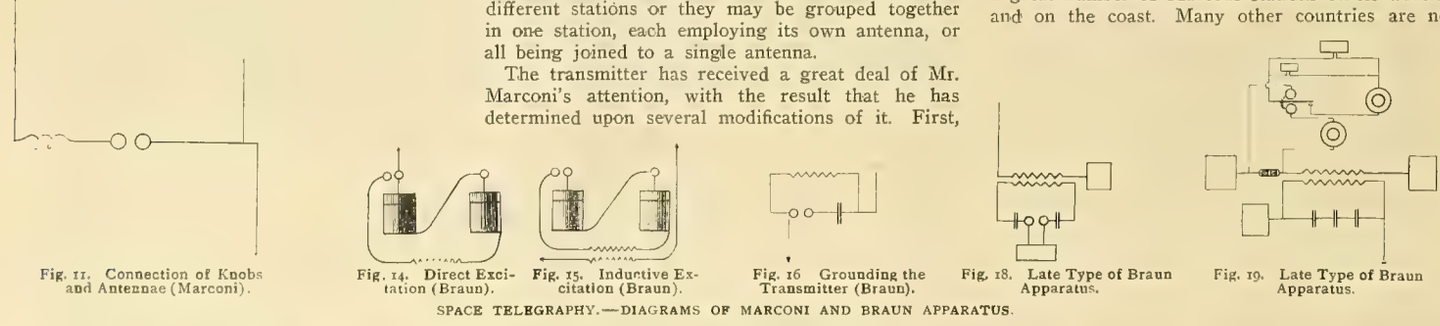


Fig. 11. Connection of Knobs and Antennae (Marconi). Fig. 14. Direct Excitation (Braun). Fig. 15. Inductive Excitation (Braun). Fig. 16 Grounding the Transmitter (Braun). Fig. 18. Late Type of Braun Apparatus. Fig. 19. Late Type of Braun Apparatus.

SPACE TELEGRAPHY.—DIAGRAMS OF MARCONI AND BRAUN APPARATUS.

established communication between Biot and Calvi, a distance of nearly 107 miles. In this test, the antennæ were raised to a height of 193.8 feet. A straight line drawn from the topmost point of the antennæ support came tangent to the surface of the water at a distance from the station of 537.5 yards.

Experiments have proved that, at certain hours of the day, troubles, due to atmospheric electricity,

FIG. 12. SPACE TELEGRAPHY.—LAND STATION AT LA PANNE, BELGIUM.

hinder communications if very sensitive coherers are used and special precautions are not taken. The good results of syntonizing have been proven conclusively, but results obtained from trials of double communication have not been very convincing at the distance between Biot and Calvi—107 miles—the former tests of multiplex communication by Marconi having taken place over a distance of about 30½ miles.

In October, 1901, Italian naval officers successfully established communication between a station on Mount Argentaro and Madelena Island, a distance of 124.2 miles. They hope now to establish communication between Rome and the island of Caprera, a distance of 155¼ miles, in order to free themselves from the cable which joins the Italian Peninsula with the Island of Sardinia. The tests already made and those to be made are of great strategic importance to Italy.

Since January, 1901, regular communication has been maintained between the Lizard and St. Catherines, on the Isle of Wight, a distance of 186¼ miles. The height of the antennæ used is 157 feet, and the antennæ are multiple; that is, several cables are joined in parallel.

Mr. Marconi, unknown to the general public, commenced his transatlantic operations early in 1901 by establishing stations on the Lizard in England and on Cape Cod in Massachusetts. The results of these trials are not known, and probably never will be, owing to the secrecy observed by all who can give the desired information. The two stations, which were of enormous power and which cost in the neighborhood of $70,000, were destroyed in September (1901) by severe storms.

Having re-established the Lizard station, made up of powerful machines and 20 masts of a height of 210 feet (Fig. 13), Mr. Marconi decided to attempt communicating with a station situated near St. Johns, Newfoundland. The distance between the last two stations is about 2,112 miles. At St. Johns the English government gave its aid in every way tending to further the trials of the inventor. Mr. Marconi, not having an established station at St. Johns, chose a very simple installation, relying on kites for the suspension of the antennæ. He used the Lizard station for the transmission of the signals and the St. Johns station for receiving them. Mr. Marconi himself remained at St. Johns.

He had arranged in advance to have the letter S signals (Morse) sent out repeatedly during several days at the hour of six o'clock in the evening.

According to our information, the transmitter

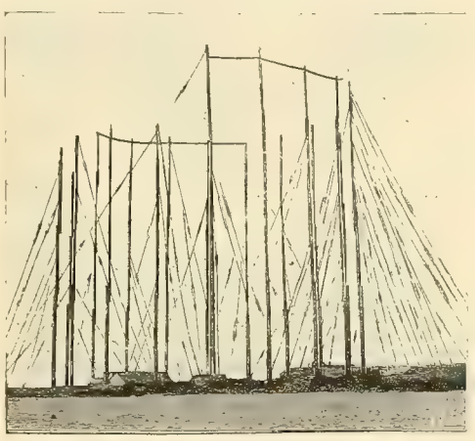


FIG 13. SPACE TELEGRAPHY.—MASTS AT POLDHU, ENGLAND

used at the Lizard was similar to that used between Biot and Calvi, only of larger size. The receiver was an electroradiophone, combined with the Marconi "jigger." Correctly speaking, this is simply using a telephone for a receiver, which compels one to accept the affirmation of Mr. Marconi with the greatest reserve, when he says that he received different S's at determined and equal intervals from the Lizard station and that it was practically, physically, and mathematically impossible for them to have come from any other place.

According to the opinions of competent authorities, the signals recorded by the Marconi apparatus at St. Johns, Newfoundland, may be attributed to any of the following causes:

First—Atmospheric electricity.

Second—Thunder.

Third—To some wireless-telegraph station on the American continent.

Fourth—To boats provided with wireless-telegraph apparatus and passing Newfoundland.

Fifth—To some practical joker.

Sixth—To signals from submarine cables.

Seventh—To opening or closing of a light circuit or other sounds, etc.

Eighth—To hallucinations of the watchmen.

Ninth—As Marconi contends, to the signals sent out from the Lizard.

Another opinion, coming from officers of the French army advances this hypothesis: Wireless telegraphy, according to its definition, dispenses with wires. It is none the less true that the Hertzian waves will follow conductors when exposed to them—witness the antennæ. Why, then, in the case at issue would they not follow the transatlantic cables, since at the two extremities of the cable "wire" and "wireless" stations were neighbors?

This explanation of the situation seems to me the most plausible and ingenious of any which has been advanced. I will add that I had already thought of it, and, if I have not insisted on this point, it is because at the extreme stations—if the report given out by Marconi was exact—sounds similar to those heard in cable stations during storms should have been heard at the receiving station. In fact during bad weather telegraph instruments are often crossed by instantaneous currents of very high potential, which act adversely on the electromagnets, and may be strong enough to burn out the coils of the galvanometers and receivers. It is not impossible nor improbable that the powerful transmitters of the Lizard station in this way—imitating the thunder on a small scale—induced currents in the cables which are stretched between England and Newfoundland; these currents arriving near St. Johns, would have inducted other currents in the antennæ of the Marconi station. This hypothesis is more admissible, since the Marconi antennæ, suspended by a kite, were considerably inclined. Again, it should be added that the cable employes have confounded

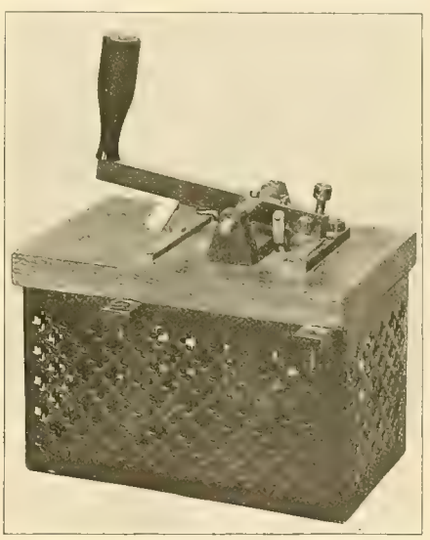


FIG. 20. SPACE TELEGRAPHY.—TRANSMITTER KEY (BRAUN).

Marconi signals with atmospheric disturbances and that the waves conducted by the cables might be very feeble in order to actuate siphon recorders, but still have sufficient power to work so sensitive an apparatus as the coherer by induction. Further, the waves may follow the armor of the cables, and in that case the cable apparatus at the extremities would not have received any perceptible signals.

If this hypothesis is good, there are two conclusions to be drawn from it: Although the waves are propagated in all directions (even over the cables), as in the Marconi system the solution of the problem would not be complete; second, since the waves traverse the water—which has already been proven by the fact that a receiver-coherer is acted upon under water and that the water waves produce effects on submarine cables even at a great depth—it can be drawn from this that the waves are transmitted through the water.

II. Space Telegraphy in Italy.

Italy, the country where William Marconi was born, was one of the first countries to adopt space telegraphy. Everybody remembers, without doubt, the remarkable experiments which were made there in 1897 (July), when Mr. Marconi was invited to make a demonstration by the authorities of his country, who have shown since then that they understand the importance of space telegraphy.

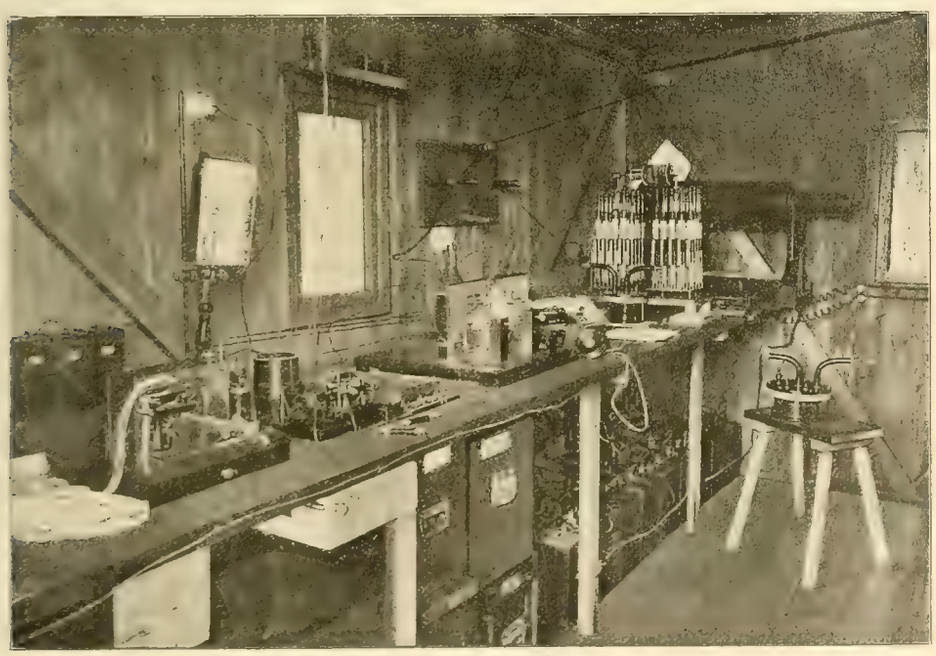


FIG 17 SPACE TELEGRAPHY.—BRAUN APPARATUS IN HELGOLAND STATION.

In the course of these experiments at Spezzia, the maximum distance of communication attained between a moving ship and the coast was 10 miles. Since then—Marconi having given the Italian government the right to make use of any and all of his patents—the experiments have been continued by the minister of war and more especially under the direction of the minister of marine. At first the experiments were under the direction of M. Pasqualini, chief electrician in the Navy Department, and his co-worker, Civita, then the officers themselves.

It is almost a year ago now since the Italian newspapers made note of the fact that signals from an Italian cruiser in Sicilian waters, had been received on board an English man-of-war, lying near the island of Malta, the distance between the two ships being 109 miles.

Toward the close of last October the officers of the Italian navy, after great trials, and after long and laborious researches, and without foreign aid, with the very limited means which the budget gave them, established a good wireless telegraphic connection between Mount Argentaro and Madelena Island, a distance of 124 miles. Communtcation, by wireless telegraphy between the Italian peninsula and the island of Sardinia is henceforth an established fact. Good results have been obtained in trials made between Rome and the island of Caprera. The station in Rome was located on Mount Mario, since it was only found possible to communicate any great distance over land by establishing oneself at a considerable distance above the land level. The distance between the two stations is something over 155 miles, a small part of which (8½ miles) is across land.

Italian newspapers make the statement that, thanks to wireless telegraphy, they will in all probability soon be independent of the submarine cable which joins the Italian peninsula with Sardinia.

The War Department will also adopt space teleg-

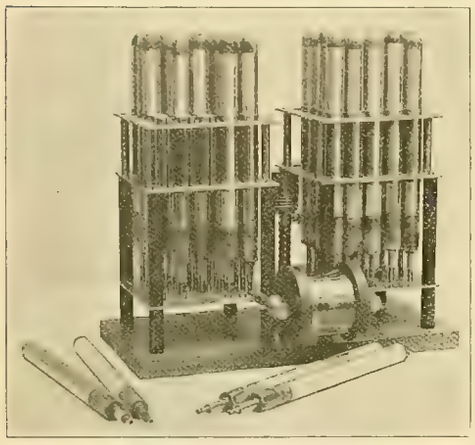


FIG. 21. SPACE TELEGRAPHY.—BRAUN TRANSMITTER, SHOWING LEYDEN-JAR TUBES.

raphy. It has made numerous trials with very satisfactory results and has ordered a great deal of apparatus from the electric factory at Spezzia.

III. The Braun System of Space Telegraphy.

It was in the latter part of the summer of 1898 that Dr. F. Braun, a professor in the University of Strasburg, Germany, commenced to occupy himself with the very interesting problems of space telegraphy in which domain he has since brought out some improvements which practice has shown to be of capital importance. As a proof of this, it may be mentioned that recent results obtained by Marconi have been attained with apparatus very similar to those of Braun.

Dr. Braun first made experiments through water, and then through air. After having made an experiment with the Marconi connections, for comparison, the illustrious professor obtained proofs with direct excitation (Fig. 14) and inductive excitation (Fig. 15) from Leyden jars, and he concluded that his apparatus by far surpassed that of the Anglo-Italian system of Mr. Marconi. At the same time, the influence of joining the antennæ to the earth was studied, and especially the apparatus shown in Fig. 16. Dr. Braun found from these experiments that there were some connections where the "ground" was advantageous, others where it was without influence, and others, finally, where it was even disadvantageous. But in the first experiments Dr. Braun perceived—and this was absolutely in accordance with his theory—that an arrangement with a Leyden jar was advantageous, and this fact constituted in substance a very important factor in his arrangements. It is for this reason, said Professor Braun, in a German article which he published later, that only this part of his connections (Leyden jars) was described in his patent of 1898, and not the junction with the earth. It results from this that Mr. Marconi alone has the right to use, in his transmitter—no matter what form he employs—a junction with the earth. In this case Dr. Braun would be able to make use of connections in which such a junction is not necessary. Later on Dr. Braun made the observation that in all cases, where a junction with the earth seemed to be necessary, it did not in reality represent the only way or the best way for obtaining communication over a great distance,

FIG. 22. SPACE TELEGRAPHY.—OIL-INSULATED COIL FOR BRAUN TRANSMITTER.

and that it could be replaced advantageously by other means.

The characteristic feature of the Braun apparatus is, that the oscillations which the transmitter emit are first created in the circuit of the Leyden jars. This circuit, like all the other arrangements, is constructed in a manner such that the sparks—which always represent an expenditure of energy—are reduced to the smallest number, and the only spark which exists is put into the main circuit with great intensity. Thus the strain on the apparatus can be easily diminished, as has been shown by practice.

In the summer of 1899 the place of experimentation of Professor Braun—who henceforth was the co-worker of Siemens & Halske, who, in fact, exploit the Braun system—was transferred from Strasburg to Cuxhaven. Here publicity was no longer to be avoided, and the daily papers spoke of the system as a scheme for utilizing great quantities of energy, and using them advantageously. From these experiments and from those made in his laboratory at Strasburg Professor Braun obtained the following results: "The method of inductive excitation requires the electrical characteristics of the antennæ to be exactly equal to those of the whole arrangement of the transmitter. Likewise the direct ex-

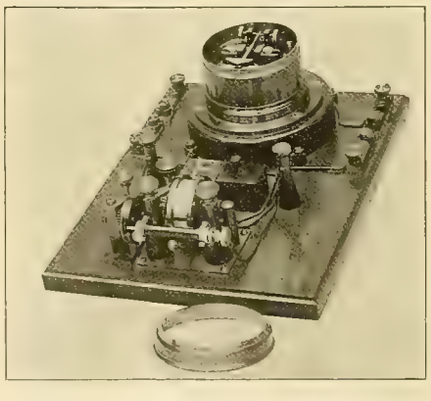


FIG. 23. SPACE TELEGRAPHY.—BRAUN RECEIVER.

citation requires a definite relation between the wire of the transmitter and the waves sent from it."

I quote this passage word for word from a statement made under the authority of the Telegraph Department of the Imperial German Marine, in which the direct connection with the earth junction of the antenna is described. This equalization is required if it is desired to increase the effects by joining the transformers either in series or in parallel.

Since then numerous experiments and installations have been made with the Braun-Siemens & Halske system, especially in Germany, between Helgoland and the continent. The interior of the Helgoland station is shown in Fig. 17.

The latest type of Braun-Siemens & Halske apparatus is shown in Figs. 18 and 19. The transmitter (Fig. 18) consists of a circuit supplied with a source of continuous current (either storage batteries or a dynamo) which a special key (Fig. 20) —made to suppress the sparks at the rupture—closes. This current is rendered intermittent by an electrolytic interrupter through which is charged the primary of an induction coil. This coil is made in a special manner in order to have very slight hysteresis and slight self-induction with a minimum heat loss. This at once becomes appropriate for a charge of great quantity. The secondary of this coil operates an oscillator, each ball of which is connected through Leyden-jar tubes (the number of which can be easily increased or diminished, as shown in Fig. 21), to the primary of a special coil, immersed in oil (Fig. 22). The completed receiver is seen in Fig. 23. The receiver is tested at short distances by a small test transmitter.

One of the antennæ (Fig. 19), in length equal to that of one-fourth wave, is joined to a metallic plate or to a wire equal electrically to the antennæ, through the primary of an induction coil, arranged to raise the difference of potential which is applied to the terminals of the coherer. The secondary of this small induction coil has one of its terminals joined directly, and the other indirectly, through a coherer, to a metallic plate or fully as well, to a wire equal in length to the antenna, which wire may be coiled up in the form of a helix. The coherer is placed, as ordinarily, in circuit with a battery and a relay which closes the circuit of a vibrator and of a Morse or other telegraphic registering device.

The Braun-Siemens & Halske people have also often made use of the telephonic receiver shown in Fig. 24. The coherer of this apparatus consists purely and simply of a carbon or steel point, which a screw presses more or less firmly against a steel

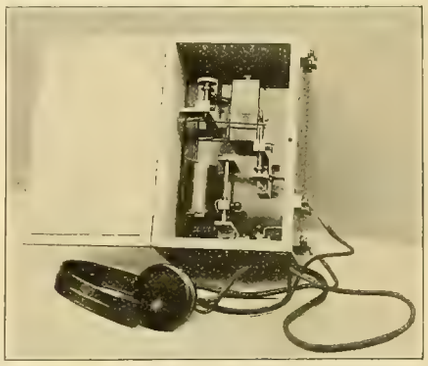


FIG. 24. SPACE TELEGRAPHY.—BRAUN TELEPHONE RECEIVER.

plate. This entire arrangement is put in series with a battery and telephone.

This receiver, say Siemens & Halske, is so sensitive that it foils all attempts at syntonization. With selective telephones (Mercadier type) multicommunication can be realized.

Electric Mining Locomotives.

The following paragraphs are taken from the United States Census Report on "Locomotives," prepared by Edward H. Sanborn of Philadelphia: "The number of electric locomotives built during the census year [1900] was 155, and their aggregate value, $288,071. Nearly all of these engines were built for use in mines, a field in which they have proved their utility and have met with much favor. A few electric locomotives of large capacity have been built for special service upon standard-gauge railroads, but for the most part this service has consisted of local switching and service in the yards of large manufacturing establishments. Thus far the substitution of electric locomotives for steam-propelled engines on long runs has not been undertaken.

"The distinction between an electric locomotive and a railway motor car is somewhat vague and indefinite, as a motor car often performs practically all the service required of an electric locomotive, not only propelling itself, but hauling other cars. The motor car has come into universal use for street, suburban, and interurban railways. Its work very closely approaches that of an independent electric locomotive. This report deals, however, only with detachable locomotives, not equipped to carry passengers or freight.

"A large proportion of the electric locomotives are constructed in shops which do not manufacture electrical equipment, but purchase the motors and their attachments. On this account their construction is not a distinct industry, not really belonging either to the locomotive-building or to the electrical-equipment industry. While most electric locomotives are built for operation by current transmitted from central power plants, a few have been equipped with storage batteries, being used chiefly for light work in manufacturing establishments."

Chicago's Messenger Girls.

The messenger-boy strike in Chicago is a thing of the past, apparently. After a short period of experiment, the Illinois District Telegraph Company decided to make general the employment of girls as messengers. Immediately upon reaching this decision, the company called the striking boys in, and, having given them their back pay, discharged them, and so put an end to their prolonged strike.

Superintendent Patterson says that, so long as he can prevent it, there will never be another boy messenger in the employment of the company. At present the messages are delivered by girls during the daytime and by men at night. The company has found the girls much more reliable and businesslike than the boys were, and much more courteous to patrons.

When a girl applies for a position on the staff the superintendent talks to her like a father. He tells her what to wear and what to avoid, points out the advantages and disadvantages of the work, and promises her immunity from unpleasant duties, such as delivering wires addressed to saloonkeepers and others who live in places a self-respecting girl might hesitate to enter. At the same time he does not hesitate to point out how tired she will be when she finishes running round or how essential it is to her comfort to abstain from long dresses and picture hats, which rain and splashing mud deface. Instead of such embellishments he recommends plain, serviceable skirts and shirtwaists and cheap straw hats, which will stand the buffeting of the elements for months. The company has decided not to ask the girls to wear uniforms, it being the idea to protect them from comment on the street as much as possible.

Nearly 200 girls have been put to work by the company, and have, it is said, more than equaled expectations. The girls seem to like the work, it being less monotonous than standing behind a department-store counter all day for four or five dollars a week. Besides, it is more profitable since the Illinois District Telegraph Company puts them to work at a dollar a day. No pretense is made that the pay offered is high for girls of 16 and over, such as are being put on, but it is claimed that the telegraph service offers more opportunities for advancement than almost any other career open to the young women. To start with each girl employed will be given an opportunity to learn operating and then it is said many business houses are in the habit of largely recruiting their office staff from the young people who bring their telegrams. That has been so in the past and is expected to be so still more now that, as one optimist puts it, "fleet-footed girls have once and for all deposed the dawdling boys."

Chicago cannot, however, claim credit for having originated the messenger girl. Colorado Springs has never had anything else and Omaha, as was mentioned in the last issue of the Western Electrician, has just decided to replace its boys with members of the fairer sex. At the same time there is no place where the experiment being tried in this city has ever been tried on so large a scale, and it was with much fear and trembling that the local management decided to attempt it. So far, however, it has found no reason to regret the step and hopes for nothing better than a continuance in the future of the good results experienced up to the present time.

A Floating Exposition for the Far East.

A unique means of stimulating trade is being carried out at Seattle, Wash., where a large ocean-going steamer, the Oregon, is being fitted up to take a party of American manufacturers with exhibits on a six months' cruise, commencing November 15th, to Russia, China, Japan, the Philippines, the Straits Settlements, India, Mauritius, South Africa, Australia, and the Hawaiian Islands. This, it is said, will be the forerunner of greater expansion to America's commerce, being a unique and practical opportunity for buyers and sellers to become personally acquainted and discuss the exhibits and methods of packing and preparing goods for the various markets, establishing agencies, effecting sales, and ascertaining the financial responsibility of interested parties. The exposition is under the auspices of the chambers of commerce, boards of trade, manufacturers' associations, and the consulates of the various points visited, and committees will discuss methods for the betterment of trade relations between the United States and the other countries.

As to Electric Headlights.

Writing on "Locomotives," in a report for the United States Census Department, Edward H. Sanborn of Philadelphia says: "The electric headlight is one of the minor accessories which have been developed in recent years. It consists of an arc light placed in the usual position upon the boiler front, and supplied with current from a small, direct-connected dynamo and engine, usually mounted upon the boiler just behind the stack. These headlights furnish light of intense brilliancy, illuminating the track for a long distance in advance of the locomotive, and their use has been quite general in recent years upon many railroads, particularly in the West."

Krieger Electric Automobile.

The Krieger electric automobile, produced in France, has been among the most successful in solving the problem of long-distance running for electric vehicles. Mr. Krieger is one of the pioneers in the construction of electric automobiles in France, and he has now developed a type which is noteworthy for its easy running and especially for the distance it can cover without recharging. A vehicle of this type lately made a remarkable run of 184 miles, which distanced all previous French records. This run was mainly due to the great simplicity of the mechanical parts and the careful calculation of the motor, besides the adoption of the system of placing the motors directly upon the front wheels; in this way the electrical and mechanical efficiency of the whole is considerably increased, and the expenditure of energy per mile approaches the lowest limit indicated by theory.

This vehicle, built in the shops of the Compagnie Parisienne des Voitures Electriques, is of the type known as "electrolette." It has seats for four persons, but its construction is considerably lighter than that of the ordinary four-place vehicle. The distance between axles is 80 inches and the gauge of the wheels 30 inches. The truck is 10 feet eight inches long. The diameter of the front wheels, provided with 5.2-inch pneumatic tires, is 33 inches, and the rear wheels, with 4.8-inch pneumatics, measure 43 inches.

KRIEGER ELECTRIC AUTOMOBILE.

It is the construction and arrangement of the motors that especially characterize the Krieger system. It has been several years since the inventor brought out the idea of placing the motors directly upon the front wheels, and although the different types of vehicles have been modified in various ways, this general principle, which proved so successful, has been always adhered to. The front axle has the form of a fixed cross-bar. At the end of the bar is a pivot, about which turns a short axle carrying the wheel. This pivot is provided with ball bearings for easy working. For the steering, each pivot carries a projecting arm, and the two arms are connected by a cross-rod, which allows the pair of wheels to be maneuvered from the steering wheel.

A motor is fixed to a support on the cross-bar and close to each of the wheels. The motor drives the wheel by a small pinion which engages in the large gear wheel fixed to the hub, just inside the main wheel. This gear wheel, with its pinion, will be noticed in the accompanying illustration. In this way each wheel is driven by its own motor, and, electrically, forms an independent system. One wheel may thus turn faster than the other, and this renders the use of a differential gear and its consequent mechanism unnecessary. This reduces the mechanical part of the vehicle to its simplest form and reduces the resulting losses.

The motor is of the four-pole enclosed type, with an aluminum cover, which makes it perfectly tight. The motor box has cast on one end a ring-shaped projection, which fits upon a collar on the journal, and the motor is thus supported and at the same time can take a certain angular displacement; this, however, is limited by a curved spring, which holds up the free end of the motor. In the present type the motor is supported at an angle of about 45 degrees, which brings the armature axis somewhat below the axle of the wheel. This has been found an improvement over the old arrangement in which the motor was simply fixed upright and above the cross-bar, without the spring suspension.

The capacity of the motors is 15 horsepower in all, with a voltage of 120. The batteries are of the Fulmen type, and are contained in a removable box placed in the front of the vehicle and protected by a cover. The total weight of the batteries is 2,640 pounds. The steering wheel and controller are combined in a single device, which will be observed in front of the conductor's seat, this arrangement being a characteristic point of the Krieger system. An upright column of aluminum contains the cylinder of the controller, which is operated by a small lever above. The shaft of the controller is hollow, and through it passes the steering wheel (a handle is also used), and the latter is just above the controller lever, both being within easy reach of the conductor. The controller drum carries a series of contacts which work against spring contacts at the side, as usual. It is arranged so as to allow the motor to act as a dynamo when descending grades, and thus charge the battery, and also to utilize the motor as an electric brake. A powerful mechanical brake acts upon the rear wheels.

The consumption of the vehicle per ton-mile is 85.9 watt-hours when running at 15 miles an hour on a level, and at a speed of 18 miles an hour it is 96 watt-hours. The weight of the vehicle without batteries is 2,330 pounds, and with the batteries (2,640 pounds) it is 4,970 pounds. The average speed on level grade is 16 miles an hour, with a maximum of 22.

As has been stated, this machine made a record for long distance in a remarkable run from Paris to Chatellerault, covering 184 miles. The vehicle shown in the picture is of somewhat smaller size, but of the same general build. The 184 miles was run (deducting stops) in 15 hours 15 minutes, or about 12 miles an hour, in spite of the fact that the 25 first miles of bad road were made at only eight miles an hour. The battery had a charge equivalent to 50 kilowatt-hours, and to recharge it (counting the efficiency of the accumulators at 80 per cent., on account of the slow charge) 62 kilowatt-hours are necessary. An idea of the expense will be useful. Counting the kilowatt-hour (in France) at $0.12, this makes $7.44 for the 184 miles, or about $0.040 a mile. To keep in order such a battery requires about one franc per 100 kilogrammes and per charge, which figures for this vehicle at $2.48 for the run, or $0.013 a mile. Adding this to the $0.040 above, the total cost is $0.053 a mile for the electrical energy.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE

A Notable Central-station Supply—Power and Lighting for Marshall Field & Co. Illustrated....165, 166, 167. 168
New Engineering Building at University of Michigan. Illustrated....168, 169
Alternating-current Interurban Railway between Washington and Baltimore. Illustrated.... 169
Arbitration of Street-railway Troubles in Chicago.... 169
Pickard Wireless-telegraph Apparatus. Illustrated.... 169
Electric Railways Affect Carriage Trade.... 169
Progress in Space Telegraphy. By Emile Guarini. Illustrated....170, 171, 172
Electric Mining Locomotives.... 172
Chicago's Messenger Girls.... 173
A Floating Exposition for the Far East.... 173
As to Electric Headlights.... 173
Krieger Electric Automobile. Illustrated.... 173
Editorial.... 174
Fall Business Prospects....175, 176
International Association of Municipal Electricians.... 176
Edison Men in the White Mountains.... 176
Power House and Cars of New York Subway System.... 176
Strikes of Electrical Workers.... 176
British Association.... 177
American Electrotherapeutic Association.... 177
National Association of Stationary Engineers.... 177
Aeronaut Falls on a Trolley Wire.... 177
Development of the Telephone Field.... 178
Ohio Telephone Notes.... 178
Indiana Telephone Items.... 178
Telephone News from the Northwest.... 178
Southern Telephone Developments.... 178
Indiana Telephone Toll-line Valuations.... 178
Work on Illinois Telephone Company's Tunnels.... 178
General Telephone News.... 178
Single-phase Electric Traction.... 179
G. I. Automatic Arc Regulator. Illustrated.... 179
Baird Dry-battery Gauge. Illustrated.... 179
Crookes' World-starvation Theory Combated....179, 180
Dicke Lineman's Cart. Illustrated.... 180
Edwards Carriage-call Annunciator. Illustrated.... 180
Freight Traffic on Electric Railways.... 180
A Survey of Electrical Patents Granted by the United States. By Story B. Ladd. Part I. (U. S. Census Bulletin.).181, 182
Elevated Roads Proposed in St. Louis.... 182

DEPARTMENTS.

Correspondence....182, 183, 184
New York Notes.... 182
Southern Developments.... 182
From the Buckeye State....182, 183
Information from Indiana.... 183
Northwestern Notations.... 183
Among the Rockies.... 183
On the Pacific Slope....183, 184
Personal.... 184
Electric Lighting.... 184
Electric Railways.... 184
Power Transmission.... 184
Societies and Schools.... 184
Publications.... 184
Miscellaneous.... 184
Trade News....184, 185
Business.... 185
Illustrated Electrical Patent Record....185, 186

CONVENTIONS AND EXPOSITIONS.

American Electrochemical Society, Niagara Falls, N. Y., September 15th, 16th and 17th.

Indiana Electrical Association, Indianapolis, September 17th and 18th.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

EMILE GUARINI'S article on space telegraphy in this issue is interesting as a resumé of the progress in this fascinating art and will be found to contain much valuable information. Mr. Guarini is a Belgian, or at least a resident in Belgium, and his own work in the wireless transmission of messages has attracted attention. In his incredulity as to Marconi and his leaning toward Braun, Mr. Guarini is, of course, speaking for himself alone.

RECENT railroad wrecks in which fire has greatly aggravated the horrors of the accidents have moved the New York World to lift up its voice in favor of universal electric train lighting. This reform is not now proposed for the first time, of course. Nevertheless, our contemporary is quite right in pressing for the abolition of all open-flame illuminants on railroad cars. No one can truthfully gainsay it when it makes these observations: "Efficient and economical electrical appliances for lighting the cars are being used on the finest and fastest railway trains. The explosive gas tank and the deadly oil lamp have been relegated to the scrap heap on many of the up-to-date railroads; and in the interest of the safety of the traveling public electric lighting should become universal." Let the good work go on!

THIS issue of the Western Electrician is the Third Annual Fall Trade Number, and considerable space in it is devoted to a consideration of the prospects for fall business. Like its predecessors of 1900 and 1901 this special number points to a continuation of the industrial prosperity of the country, particularly in the varied lines which go to make up the trade founded on applied electricity. The favorable predictions of the former fall trade numbers of this journal were amply fulfilled, and there is every reason to believe that those now presented will be followed by a continuance of the existing favorable conditions for many months to come. We congratulate the readers of the Western Electrician that the situation is so promising and trust that it may continue through the publication of an indefinite number of fall-trade numbers.

WHETHER the delivery of telegraph messages is an employment suitable for young women is a question deserving of very careful consideration; and we trust that the Illinois District Telegraph Company seriously considered the moral and sociological aspects of the proposition before substituting girls for the boy strikers, as it has done. The company promises that the night work and the carrying of messages to resorts where a young girl should not enter shall be done by men, but in the rush of business it will be difficult to enforce this rule. Of course, there is nothing in the least dangerous or degrading in the ordinary delivery of telegrams to business offices or residences in the daytime. It may be that the use of girl messengers is simply another outpost that has fallen to the army of women in the labor field—that it is a proper and rational evolutionary step in the march of progress. But we must confess our doubts of the desirability of the change, for certainly no mere business advantage should be suffered to rend the veil of protection rightfully thrown about the purer and physically weaker sex. At best the system is on a doubtful trial, and the company will do well to see that its promised exemptions are strictly enforced.

PROFESSOR GOLDSBOROUGH is meeting with excellent success in his missionary tour among the electrical and quasi-electrical conventions on behalf of the St. Louis World's Fair of 1904. Electrical men, particularly in the West, are greatly interested in the Louisiana Purchase Exposition and will help to make it a success. They receive the chief of the Department of Electricity, who is one of their number and well known to them, with cordiality, give him an attentive hearing and, in almost every case, promise not only their co-operation but their convention of 1904 for St. Louis. The latest instance of this sort of thing could have been witnessed last week in the Catskill Mountains at the convention of the electromedical specialists, or, in official phrase, the American Electrotherapeutic Association. The doctors passed a resolution commending the exposition authorities for their attention to electrotherapeutics and pledging their hearty support. A committee was appointed to co-operate with the chief of the electrical department, and it was also decided to hold the meeting of 1904 in St. Louis.

Such co-operation as this is gratifying. It is good for the exposition on the one hand, and, on the other, it will undoubtedly result in greatly assisting the universal dissemination of the knowledge of the value of electrotherapeutic methods by stimulating activity in the production of exhibits that will have a distinct educational value. It is high time that a more general appreciation should obtain of the great good that can be done by the proper and scientific use of electricity in the treatment of disease. The American Electrotherapeutic Association has done much in this direction, and the coming exposition should afford a fine opportunity for acquainting the public with the careful, legitimate work that has been accomplished.

IT is certainly to be regretted that it was a trolley car that collided with the president's carriage near Pittsfield, Mass., last week, killing a body attendant of Mr. Roosevelt and injuring the driver of the carriage. But the fault appears to have been that of the motorman. It was clearly the human equation that was inadequate and not any part of the mechanism of the electric-railway line. This self-evident truth would hardly be worth emphasizing were it not for the constantly recurring tendency to blame a system for the failures of men operating it. For instance, in conversation with visiting American generals a few days ago, the German emperor spoke of his admiration for President Roosevelt, and said that he fervently thanked God for having spared the life of the president at the time of the Pittsfield accident. "Electric cars," continued his majesty, according to the report, "are the enemies of humanity." The imperial speaker perhaps referred to the number of persons who have been killed or wounded by electric cars in the streets of Berlin, but one would have credited William II. with being too keen-witted a man to condemn all electric railways so unsparingly because the people of his capital have difficulty in adjusting themselves to the new order. The times demand rapid transit, and cars cannot be operated rapidly on surface lines without some danger to the sluggards. The electric cars are all right, but perhaps they and all other transportation systems should be placed under or over thronged city streets. It is surprising that the kaiser, who is reported to be progressive in his ideas, should have made such an inept generalization.

ARBITRATION has again demonstrated its eminent reasonableness in the case of the discontent of the street-railway employes in Chicago. There were differences between the Chicago City Railway Company and its men. After some discussion the matters in dispute were referred to a board of arbitration consisting of three members, the umpire or third man being a well-known and disinterested Chicago merchant. By the award of the arbiters the motormen and conductors on the South Side lines receive an increase of 10 per cent. in wages. The working hours of those employed in the company's shops are reduced from 12 and 15 to nine a day. A maximum number of hours for the car men will also be established. Shop or barn employes are to be paid "time and a half" for work overtime. The agreement thus formed will be binding for one year. Similar differences on the North and West Sides are to be referred to arbitration by the Chicago Union Traction Company and its men, the company and the men having already chosen their respective arbiters.

These agreements are certainly to be highly commended. In the case of the South Side arbitration the employes secure substantial concessions, the company has re-established amicable relations with its men—an especial advantage in the case of a public-transportation corporation—and the public is not put to the great loss and inconvenience of a strike. All that is needed in any labor dispute to secure the self-evident benefit of arbitration is the disposition to admit, publicly, that one wants no more than his rightful equities—precisely the feeling, indeed, that lies behind the jury system when disputes as to fact are adjusted in the law courts. It is strange indeed that in an age we call enlightened a fair but mandatory procedure cannot be devised to make the crude and out-of-date "strike" impossible.

FALL BUSINESS PROSPECTS.

The industrial prosperity of the United States continues in full tide, and the prospect for business in the electrical and allied lines of trade in this country for the fall of 1902 is most excellent. For five years the country has enjoyed unexampled prosperity, and there is yet no sign of diminution in the volume of business. Crop prospects are very good. It is estimated that the corn harvest alone will make 2,333,000 carloads of 30 tons each. With 50 cars in each train, this would load 46,600 trains. The railroads, which are large buyers in good times, are making huge purchases now. The Baltimore and Ohio Railroad Company will place orders for 100 locomotives in a short time. The same company bought 100 engines in June and ordered 50 some time ago, which are now being delivered. These large purchases are but a sample of the way in which managers are fortifying themselves with new engines and cars. In the last few days it has been announced that the Chesapeake and Ohio Railway Company has leased from a car trust 25 locomotives and 2,300 cars adapted to handling coal and coke. The Missouri Pacific and the St. Louis, Iron Mountain and Southern have received 95 new engines since January 1st and 50 more are contracted for delivery before the close of the year.

Turning to waterborne commerce, the upward tendency is the same. Total shipments from ports on the Great Lakes for the first seven months in 1901 were 19,653,334 tons, as compared with 26,876,004 tons for the same period of 1902, showing a gain of 7,222,670 tons, or 36.7 per cent. As much as 16,568,899 tons passed the Sault Ste. Marie canals for the first seven months of this year, against 11,548,192 tons in 1901, and 12,775,246 tons in 1900. Traffic in iron and steel originating in southern producing territory during the first seven months of this year amounted to 1,131,275 tons, compared with 857,760 tons for the corresponding period of 1901. In almost every avenue of industry there is great activity and an increasing volume of business. As the electrical business is interwoven with the manufacturing, mining and commercial enterprises of the country, there is no reason to doubt its continued prosperity for some time to come.

The anthracite-coal strike is the one depressing influence, but that has not seriously affected the electrical industry as yet, and a settlement is promised within two weeks.

After a slight backward tendency in the early part of the year the electrical exports in July showed a marked increase when compared with the corresponding month of last year. There is no reason why this increase should not be kept up during the fall and winter, especially as reports from Germany show an improvement in the commercial situation in that country, thus giving some prospect that the German electrical manufacturers will not be forced to bid for business on the ruinously low prices made in that country for the last two or three years.

It is a pleasure, in closing this very brief review of the business situation, to say that there is certainly every reason to anticipate good trade for the manufacturers and dealers of apparatus in electrical and allied lines during the closing months of 1902 and as far beyond that as one may venture to look. This is the opinion of the Western Electrician, and it is corroborated by the views of many electrical business men of prominence, as will be seen by the following expressions of opinion collected for this issue.

Boilers.

New York Safety Steam Power Company. (by J. Stewart Thomson), New York: Bearing on the present business situation, it will be of interest to state that up to the present time we have sold as many Worthington boilers as in the whole of last year (1901), and even then, we felt that we had done a fair business. The matter of delivery seems the vital point. If we could deliver, we could sell much more. The prospect for orders seems to-day as bright as earlier in the season, and we anticipate that our business this year will be at least 50 per cent. greater than in 1901.

Cables.

Standard Underground Cable Company (by J. W. Marsh), Pittsburg: I am pleased to say that I see no indications of a decline in the electrical business generally nor in our business in particular. I consider that there is every reason to expect a very large fall business in the electrical and allied trades, and for a considerable period beyond next fall.

Conduit.

Standard Vitrified Conduit Company (by B. S. Barnard), New York: We are sold up now for the next 60 days. Our factory at South River, N. J., is possibly one of the largest of its kind in the world, and we will soon have a capacity of 25,000,000 feet a year. The prospect for the fall and winter trade is very good. It is well known that none of the conduit manufacturers of this country can promise delivery until after December 1st. The number of railways changing from overhead to underground contact, the rapid strides of the Independent telephone business, and the continual use of conduit with the electric-light companies of the country, create a demand at the present time far greater than the production. This has been the condition of things in this line of business for the last two years.

Dynamos and Motors.

Bullock Electric Manufacturing Company (by Frank G. Bolles), Cincinnati: In so far as we are able to see, the prospects for fall business are quite as good as at any time during the year, and our business this year has been larger than ever before.

Elwell-Parker Electric Company of America (by F. C. Phillips), Cleveland, Ohio: As to the prospects of the fall business in the electrical line, we would state our opinion in a very few words. We have no hesitation in saying that we think the fall business will be good in everything but electric fans.

Fort Wayne Electric Works (by F. R. Davis), Fort Wayne, Ind.: From the point of view of the Fort Wayne Electric Works, the situation at present is very encouraging and indicates a flourishing fall business in almost all lines of its manufacture, but especially active are the transformer, arc-lamp and wattmeter departments. In the line of power plants and factory equipments the trade outlook is most encouraging. Large contracts for complete equipment of power plants of manufacturing industries are becoming an increasing factor in the business of our company. The conversion of belt-transmission and small isolated power units into concentrated units of larger capacity is being recognized as a necessity by a large proportion of up-to-date factories and plants of similar nature.

Sprague Electric Company (by H. M. Davis), New York: The indications for fall business in the electrical and allied trades are undoubtedly good. Power plants, machine shops, factories, etc., all over the country show a decided tendency to install electric equipments as rapidly as is consistent with good management. This means a continued demand for generators and motors. The general prosperity of the country is favorable to the building of new industries and the extension of present ones, and, from the standpoint of the Sprague Electric Company, the prospects were never better. This has been the busiest season in the history of the company, and not only are both the Watsessing factory and the New York conduit factory filling unusually large orders, but the orders are constantly increasing. We believe the increased demand for electrical goods is felt by the majority of manufacturers.

Triumph Electric Company (by W. H. Jacob), Cincinnati: It is our opinion that business this fall will surpass that of any previous year. We make this estimate not only from the number of inquiries and specifications that we receive daily asking us for quotations, but from the amount of business and number of contracts that we have on hand at this present time, for we might say that we are exceptionally busy and now have quite a number of large orders that will take us until late in the fall or the early winter to get out. In a word, we think that business this fall will be exceptionally good.

Wagner Electric Manufacturing Company (by W. A. Layman), St. Louis: The most important development in central-station practice, so far as our immediate lines of manufacture are involved, lies in the direction of an exceedingly active enlargement of our business. This is especially noticeable in the smaller cities, where day circuits are being rapidly introduced, and every possible effort being made to establish a large day load. This policy is resulting in materially improving the financial condition of a great many small companies. Every indication for fall business is even better than last year.

Fuse Wire.

Chicago Fuse Wire and Manufacturing Company (by W. R. Goodman), Chicago: We find business in our line steady and increasing somewhat. This we consider fully as satisfactory as a year or two ago, when the percentage of increase might have been greater, but more uncertain. We see no reason why the fall and winter trade should not continue good.

Gas Engines.

Marinette Iron Works Manufacturing Company (by T. C. Miller), Marinette, Wis.: We take pleasure in informing you that the prospects for the fall business in our line are extremely good. We now have many orders booked ahead for engines of all sizes for electrical work to be installed (both belted and direct-connected) in private, as well as municipal lighting plants. We shipped two engines to Portugal last month and one to Japan, direct-connected to generator for lighting purposes, and this week received two orders by cable from Portugal and Yukon Territory for direct-connected gas engines and generators.

Glassware (Electrical).

Century Glass Company (by D. W. Eyman), Bellaire, Ohio: From the orders now on our books and from the number of inquiries received daily we expect the coming fall and winter seasons will be the best in our history. We are at present spending $35,000 on improvements. We are erecting new lehrs and day tank, which will almost double our capacity. We are also putting in improved machinery for finishing our ware. At one time anything in the shape of glass "went" for the open-arc lamp, but, with the improved lamps now on the market, we find that the central-station man will pay a little more for the right article that saves him trouble and that will last until broken by accident.

Heating Appliances (Electrical).

Simplex Electric Heating Company (by James I. Ayer), Boston: If the business for the next three months equals the business we have experienced for all previous months of this year, we can only say that it will be more than satisfactory. The increase in the first seven months of this year over any previous year has been very substantial, and the summer trade has been equal to the best months preceding, therefore the outlook to us is certainly very flattering, and there is nothing to indicate anything but a continuance of our past experience.

Incandescent Lamps.

Banner Electric Company (by N. L. Norris), Youngstown, Ohio: We are pleased to say that, judging from present conditions, the demand for all kinds of electrical supplies and equipment will be very large indeed during the fall and winter. We are best able, of course, to report on our particular line, incandescent lamps, and will say that with us the prospects for large business this fall are exceedingly good. In fact, we are operating our plant to its entire capacity and are placing a large number of lamps in stock, in order to furnish promptly not only goods for which we have future-delivery orders, but those for which we are sure to receive orders later on in the winter season. The prices in our line are about the same as for the last year.

Shelby Electric Company (by J. C. Fish), Shelby, Ohio: Judging the prospect of the fall by the amount of business we are receiving during the month of August, we would say that the fall trade in the electrical and kindred lines will be exceptionally good. This appears to us to be the same old story. Unquestionably, all people who are making goods of high quality and are advertising them will continue to do a good business.

Poles.

Lindsley Brothers Company, Chicago: Judging from present indications, there will be a heavy demand from electrical companies for cedar products during the coming fall and early winter. We have been advised of many new projects, which are about ready to become realities, in addition to extensive improvements and extensions contemplated by existing companies.

Porter Cedar Company (by John L. Porter), Saginaw, Mich.: We look for a continued active trade in cedar poles and posts, as well as ties. The wet season which has prevailed over a large amount of the territory from which supplies are drawn has curtailed the product during the summer, while the continued reaching out over more territory of both telephone and electric-railroad lines has used the usual quantity of material. We look for shortages in certain sizes of poles and a general stiffening of prices during the fall. We believe that business prudence demands that orders for early consumption be placed promptly, on account of broken stocks later if not an increase in price.

Porcelain.

Akron Smoking Pipe Company (by C. Fenton), Mogadore, Ohio: Business is very good, and the prospects for fall trade are excellent. We cannot see anything that will bar this year from being an exceptional period for the insulator business in all its branches, as building has been very heavy throughout all sections of the country, and it is only natural that the electrical industry has shared to a greater extent than ever before in the general prosperity.

Specialties (Electrical).

Incandescent Electric Light Manipulator Company (by Frank W. Morse), Boston, Mass.: Commencing last fall we commenced to deal largely with the consumers, with the result that our business has increased so rapidly that we have twice had to enlarge our working capital and plant, and the prospects for trade this fall and winter look fine. Nine-tenths of our business is done through mail orders and by sales made by the writer. Of course, this brings in the largest percentage of profit to us—a good percentage of which, however, we shall be only too pleased to surrender to the supply dealers and contractors when they wake up to the fact that the goods we make are sellers. If we can increase our business the coming season the same percentage as we did that of last season over the year before we shall be more than satisfied; and if it continues as it has started in, we shall certainly do it.

K. McLennan & Co. (by M. J. Isaacs), Chicago: The prospects of an active and increased

business in the electrical and allied trades are already evident to us from the fact that supply houses have placed larger orders for our compound already for fall shipment than has previously been the case. I believe that the electrical supply and construction companies are in better condition financially than they have been for many years; that they have better and more profitable business, and that the coming fall will no doubt be the best in many years. With us the foreign business has materially increased of late, and we expect a still further increase this fall.

STEAM ENGINES.

Buffalo Forge Company (by Mr. Stuart), Buffalo: The present outlook and prospects for future business in the line of direct-connected generating sets and motor-driven fans and blowers for factory and public-building ventilation, mechanical draft and forge-shop service, are without question better than ever before. The development of the isolated electric plant, with the distribution of power to separate motor drives, has become almost universal for new construction, and the application to fan blowers and exhausters for various purposes has within the last two years been carried on very extensively. The electrical manufacturers are catering to the special requirements sometimes embodied in this class of work, and have on the market economical machines for direct connection with fans. We have never had so large a proportion of orders in our shops for fans to be electrically driven, and the prospective business under way maintains at least as high a proportion. This tendency also has quickened the demand for medium-size direct-connected generating units, and the high-speed engine builders are finding that more than two-thirds of their orders are of this nature, while four or five years ago the proportion was on the opposite side. Our engine department is working up to its full capacity and several new designs brought out within the last year are being regularly produced. We find the export business for England, South America, South Africa and our new possessions in the Atlantic and Pacific to be an important factor, and have a number of large orders on our books for foreign countries.

STORAGE BATTERIES.

Electric Storage Battery Company (by Charles Blizard), Philadelphia: Our business for the current year has been most satisfactory. The field for the profitable use of storage batteries is constantly broadening, and prospects indicate a growing demand.

SUPPLIES.

George William Hoffman, Indianapolis: Crops are going to be larger than ever in this section of the country. Business was never better. The question is, How are we going to get the goods out?

George A. McKinlock, president Central Electric Company, Chicago: I think my opinion of the situation will be in accord with public opinion, and that is that the business outlook is exceedingly favorable.

Western Electrical Supply Company (by William W. Ater), St. Louis: Our business in the last year has been better than ever before, and we consider the prospects for a heavy fall and winter business very good. All the departments have made a large increase this year, and the managers inform the writer that they have more quotations out at the present time than they ever had before. This is especially true of our telephone, electric-railway and apparatus departments. Our business in these departments has been more than gratifying, and we see no reason at the present time, with the good crop outlook and general business prosperity we have, why we should not have a very heavy fall business.

TELEPHONES.

International Telephone Manufacturing Company (by Henry Shafer), Chicago: From present indications we believe that while the supply and manufacturing output has been continually increasing in all branches, the demand seems to have a more rapid growth this season than in the past, and that the business in the higher class of electrical and telephone equipment will far surpass any previous year. Orders placed and in sight greatly exceed all past records for this time of the season. New inventions and improved devices have enlarged the field in many directions, and given a double reason for the marvelous increase being no more than a good healthy growth. The tendency this season, more than ever, is toward favoring the very best and most improved appliances. In our opinion, the coming season will show a great advancement in all directions in the telephone and electrical trade.

Kellogg Switchboard and Supply Company (by Joseph C. Belden), Chicago: We have been under a heavy pressure of business all this year and see nothing whatever to indicate a falling off of orders in the near future. The heavy rains throughout the country have delayed construction work all summer in a great many places. In consequence, much telephone work is being done now that is ordinarily done in the spring or earlier in the summer. The telephone industry is certainly receiving its full share of benefits from the general prosperity of the country.

TOOLS (ELECTRICAL).

W. H. Anderson & Sons (by W. R. Anderson), Detroit, Mich.: We have a number of good orders booked and the general outlook is favorable for a brisk fall trade. The class of orders we are securing shows there is considerable outside construction work of all kinds being pushed forward and to be completed this season. Prices continue low, but indications are for a slight advance, if present demands continue. The past season has shown us that a majority of buyers are not stocking as heavily as formerly, preferring to send in repeat orders for material as conditions might warrant. This has made it impossible for us to gauge our probable demands and has found us with depleted stocks of various materials and necessitating the making up of additional quantity before we had anticipated that this would have been necessary. The demands for such articles as we manufacture for use in underground construction has been larger this year than last year. The demand for overhead tools has been about on a par with last season. Altogether, we are well satisfied with what has already been accomplished this season, while the fall outlook is very satisfactory.

WATERWHEELS.

The James Leffel & Co., Springfield, Ohio: We certainly think the prospects very brilliant, if we are to judge from the number of orders for Samson turbines we are filling for driving electrical power plants. We see no reason why this should not continue until midwinter, unless the great advance in the raw materials which we use in our line of work should induce buyers to postpone some of their contemplated enterprises.

MISCELLANEOUS.

W. H. Schott, Chicago: Trade during the last summer, especially in the building and rebuilding of electric-light and power plants, and both hot-wat heating and steam plants, has been extremely good. At the present time I consider that next season will be better than this season, due to the fact that plants which are being established are being built and managed on different lines and making showings for themselves. A different type of construction is being used now than in former years. Purchasers of these properties are beginning to realize that the first requirement is to have a condition existing which justifies the expenditure of a given amount of money, and in expending this money they must put in the best that the market affords. From all indications I feel that the coming season will increase in volume in proportion to what this year has increased over last year.

International Association of Municipal Electricians.

The seventh annual convention of the International Association of Municipal Electricians is to be held in Richmond, Va., on October 7th, 8th and 9th. The papers to be presented are as follows: "Municipal Inspection and Control," by Walter M. Petty, superintendent Fire Telegraph, Rutherford, N. J.; "Relation of Electrical Interests to Other Branches of the Municipality," by Captain William Brophy, Boston, Mass.; "Classifying of Records of Electrical Departments and Standard Specifications for Supplies and Contracts," by Edward F. Schurig, city electrician, Omaha, Neb.; report of committee on rules for electrical inspection and control, especially with reference to the occupancy of streets, by Morris W. Mead, superintendent Bureau of Electricity, Pittsburg, Pa.; "The Telephone Service in Connection with Fire and Police-signal Systems," by Jerry Murphy, superintendent Police Telegraph, Cleveland, Ohio; "Electrical Government," by A. S. Hatch, assistant superintendent Public Lighting Commission, Detroit, Mich.; "Joint Use of Conduits," by Charles F. Hopewell, city electrician, Cambridge, Mass. Mr. Hopewell will also give his illustrated lecture on fire and police telegraph.

The headquarters of the association will be at Murphy's Hotel, where officers and committees will be in attendance to see to the welfare of the members and guests. Special railroad rates will be obtained by reason of the national encampment of the Grand Army of the Republic at Washington, D. C., during the week of the meeting. Frank P. Foster, Corning, N. Y., is secretary of the association.

Edison Men in the White Mountains.

The annual convention of the Association of Edison Illuminating Companies opened on Tuesday of this week at the Mount Washington Hotel, in the White Mountains, N. H., with a large and representative attendance of Edison central-station men. Mr. Louis A. Ferguson, president of the association, presided. A large delegation from the Chicago Edison Company left this city Sunday morning for the convention and will be gone all the week. Some of the party will stop over at the General Electric Company's works in Schenectady, N. Y., on the return trip. The Chicago Edison party was made up as follows: Samuel Insull, president; Louis A. Ferguson, second vice-president; William M. Anthony, comptroller; John F. Gilchrist, contract agent; R. C. P. Holmes, purchasing agent; H. G. Carleton, operating engineer, and P. Junkersfeld, assistant to mechanical engineer.

Power House and Cars of New York Subway System.

The subway rapid-transit railway system in New York, by its size and up-to-date features, is of unusual interest. The power house is to be located on the eastern portion of the block bounded by Fifty-eighth and Fifty-ninth Streets, and Eleventh and Twelfth Avenues. It will be 580 by 200 feet in ground dimensions and will be 115 feet high. The exterior work will be of brick, granite and terra-cotta. The roof will be covered with Spanish tiles. The generating plant was designed by J. Van Vleck and L. B. Stillwell, mechanical and electrical engineers, respectively. The building is divided into two parts, one to be used as a boiler room, and the other for the engines and generators. The power units will all be direct-connected, and will be made up of 8,000-horsepower engines and 5,000-kilowatt alternating-current generators. There will be eight of these units installed at first, but the building is so constructed that, in case of need, an additional section can be built and other machines set up. A coal bunker is provided off the boiler room, which will contain about 15,000 tons of coal. The work on the structure is well under way, and the building will be completed on or before the first of November, 1903.

The cars for the subway are to possess many interesting features. Two model cars built by the Wason Manufacturing Company of Springfield, Mass., were shipped to New York recently, and, after an inspection by the subway officials, will be sent on to Schenectady, N. Y., to be wired and tested by the General Electric Company. The cars are 42 feet long, which is two feet longer than those in use on the Manhattan elevated railroad. The most striking feature of these cars comprises the inclined sides, which are built to conform to the subway walls. The sides are perpendicular for 30 inches and then slant inward, so that the part of the car on which the roof rests is a foot inside of the perpendicular line from the base. The vestibules are of original design and are fitted with double folding doors on each side. On the outside of the car is a device by means of which a guard can open or close all the doors at the same time. The seating arrangements of the cars follow closely those of the Manhattan elevated road. The total seating capacity of a car is 52. The seats are upholstered with rattan. The interior of a car is finished in light stained mahogany, known as an empire finish.

The lighting for the cars is furnished by six groups of five lights each, each group being enclosed in a globe. The windows are made in two sections, the upper one of which alone can be raised. Ventilation is provided by a new scheme which has one-half the ventilators on a side opening in an opposite direction to the other half, thereby insuring a continuous current of air at all times. Sections of these ventilators can be opened by the turning of a hand-lever. The ordinary lines of hand straps are also provided. The cars will be painted a light yellow color.

Strikes of Electrical Workers.

Wiremen in Boston, Mass., are now insisting on a reduction of a working day from nine to eight hours. Mention was made in the last issue of the Western Electrician of a strike having been declared on August 25th. Several of the contracting firms have already granted the demands of the strikers and have recognized their union. Nearly half of the men who struck have gone back to work, having gained their point. A number of contractors and the Lord Electrical Company are seeking to obtain an injunction restraining the strikers from interfering with employes. The hearing went before Judge Hardy of the Superior Court, who referred the case to Francis Peabody, Jr., as a master. Boston Union, No. 103, is the defendant in the case.

The electrical workers have gone back to their work in Lynn, Mass., their demands having been acceded to by the contractors. The Lynn workers struck by order of the Boston union and made the same demands as the Boston strikers.

The Davenport (Ia.) electrical workers, who struck through sympathy with Des Moines linemen, have returned to their work, as the strike was making no progress. The Des Moines strike referred to is the strike against the Iowa Telephone Company. This strike has been in progress for some weeks, and has been dealt with before in the Western Electrician. A temporary injunction has been served upon the striking employes of the company. It was issued by the Federal Court in St. Paul.

Work is progressing rapidly on an electric railway between Oakland and Porta Costa, Cal.

British Association.

Inasmuch as the annual meeting of the British Association for the Advancement of Science is to be begun this week in Belfast, Ireland, some facts about the gathering, from a recent forecast in the London Times, will be of interest. The meeting will be held under the presidency of Professor Dewar. Prof. John Purser is president of the mathematical and physical-science section. Professor Purser's address will be in the main biographical, giving an account of the Irish school of mathematicians and physicists in the last century (not living). Lord Rayleigh will probably raise the question of the conservation of weight in chemical reaction; Professor Trouton may be able to show his experiments on the magnetic field due to the motion of a charged condenser; Professor Martin will communicate some results in electrical oscillation and some experimental work done by students under his direction; while Dr. Larmor will have something to say on the temperature of radiant energy. Mr. Petavel has promised a paper on radiation experiments with a view to the construction of a more trustworthy standard of light.

Section B (Chemistry) will be presided over by Professor Edward Divers, the subject of whose address will be "The Atomic Theory: What It Has Become in the Course of a Century." Dr. Cannan will preside over Section F (Economic Science and Statistics). The staple of this address will probably be the thesis that economic theory is useful in regard to practical questions such as protection, housing and other municipal enterprises (especially those connected with locomotion), the postoffice and various means of raising revenue. As in other sections, the general work of the branch will largely deal with Irish subjects. The Right Hon. Horace Plunkett will discuss technical instruction and industrial development. The effect of factory legislation is the subject of the work of a committee which will make a lengthy interim report. Other papers are on miscellaneous subjects, including "Municipal Trading," by the Hon. Robert P. Porter (director of the U. S. A. Eleventh Census), the "Position of Economics and the Applied Sciences" in the university training of men intended for a commercial life, which will be discussed by Dr. W. R. Scott, and a paper by Mr. P. A. Ashley on "Muncipal Policy and State Control."

Prof. John Perry, who presides over section G (Engineering) will have something very incisive to say in his address on the training of engineers. He does not think that German methods are at all suited for English boys, and he affirms, moreover, that such methods are unpractical. Being of opinion that the great technical colleges of England suffer because their pupils have had no good general education, he will urge that an endeavor should be made to instil into all boys—whatever profession they intend to enter—(1) A knowledge of English, as distinct from classical, subjects; (2) the power to compute—to achieve this the present methods employed in the teaching of mathematics must be completely revised; (3) a knowledge of the methods of study in experimental science. Professor Perry will contend that the average boy is not stupid, and that what is needed is a radical change in our educational systems. The great technical colleges themselves need reforming; for one thing every teacher at an engineering college, whatever his subject, ought to have engineering experience, and many more and better paid teachers are required. Among other points that will come under discussion are whether workshop experience ought to come before, or after, or during an engineering college course, and the reforms due to foreign competition going on in engineering shop management and methods.

In the general work of the section Professor Hele-Shaw is expected to present an important report embodying the result of the deliberations of the road-traction committee, while the report of the screw-gauge committee is likely to conclude a prolonged discussion of an important point of detail in small mechanisms. Among the papers that have been promised are the following: "The Combustion of Bituminous Coal," by Mr. W. H. Boots; "Waterpower in Ireland," by Mr. F. J. Dick; "Exhibition of Electrical Apparatus," by Mr. M. B. Field; "Recent Progress in Large Gas Engines," by Mr. H. A. Humphrey; and "The Importance of Minor Details in Engineering Work," by Mr. L. Holroyd-Smith, and papers on other electrical subjects have been promised by Mr. P. V. McMahon and Mr. F. Holden and Mr. J. E. Kingsbury.

Prof. H. E. Armstrong, F. R. S., who is president of section L (Educational Science), and to whose efforts the formation of this new section is largely due, will devote his address largely to a discussion of the educational outlook. He will consider the deficiences of the present curriculum and the directions in which it needs reform, and will also deal with the question of the training of teachers. Following the practice of last year, a definite programme has been arranged for the section, so that a number of important subjects may be debated. The first two days will be mainly devoted to the discussion of Irish educational problems. In a debate on technical instruction in relation to industrial development in Ireland, the Right Hon. Horace Plunkett has promised to take part. More general debates later in the meeting will be on the training of teachers, about which Professor Withers and Miss Walter will have something to say. Dr. Kimmins will discuss the subjects to be taught as "science" and the order in which they should be taken, and papers on educational experiments have also been promised. Reports will be presented on the teaching of mathematics, the teaching of science in elementary schools, and on examinations.

One evening's discourse will be by Prof. J. J. Thomson, F. R. S., on Becquerel rays and radioactivity.

American Electrotherapeutic Association.

The twelfth annual convention of the American Electrotherapeutic Association was held at Hotel Kaaterskill, Kaaterskill, N. Y., on September 2-4, 1902. Every circumstance seemed to conspire to make it one of the most successful meetings ever held by the society. Placed amidst surroundings which offered beautiful and extensive views, away from distractions usually interfering with the serious work of a convention, in an atmosphere stimulating and refreshing, the members were responsive and devoted an enthusiastic energy to the scientific details of the sessions, such as never before obtained at any of their meetings.

The address of the retiring president, Dr. Morse of Melrose, Mass., referred to the growing difference in the attitude of the medical profession, relative to the claims of the electric current in therapeusis, and declared that this was due, not only to the disinterested work of pioneers in this field, the world over, but even more to the energy of the members of this association in particular, who, selected for their attainment in this branch of medicine, sought to make their results of exact and scientific value, not only in practice, but also in the physical material with which they were compelled to work.

Though such results were brilliant, and manufacturers were, in general, in sympathy with the aim of the association, in securing uniformity in construction of apparatus in order to secure uniform and specific results, Dr. Morse cautioned the association to spare no endeavor in the construction of their committees appointed to study such methods as were approved by the society as scientific. While much had been done with coil and current modification, while brilliant progress in the use of the X-ray had been made, while results that were effective had been discovered in the use of galvanic and sinusoidal currents, still there remained discrepancies in the work of various observers, which only active and vigorous work of the various committees could settle. While this association had triumphed in effacing the arrogation of quackery in electrotherapeutics, through the work of the special committees appointed by the society on the construction and use of electromedical apparatus, the speaker felt that in the stress of their own private work much remained to be done for the association, and he would therefore caution the several committees appointed not to lose their enthusiasm.

Dr. Dickson of Toronto, Canada., reported progress in the work of his committee on electrodes. Referring to the work already done, he announced that he had sent a list of the members to every manufacturer of any prominence in the United States of America, Canada, Great Britain, France, Germany and Austria, together with the report of the committee, containing the conclusions as to the desirability of certain necessary points of construction and measurement of electrodes and stating that it was the desire of this association to secure uniformity of design in order to attain standards for correct conclusions. He reported little of novelty in discovery of electrodes for the last year, but would mention an electrode for ear work, constructed on the principle of the binaural stethoscope, of probable value in the electrotherapeusis of this special field.

Dr. Morton, chairman of the committee on static machines, reported difficulty in obtaining the requisite data for conclusions, somewhat due to the rivalry of manufacturers of static machines. He stated that up to the present time, it was difficult to define exactly what should form the fundamental constituents in the construction of the best static machine, but the question nowadays became of relative importance by reason of the greater multiplicity of work that all static machines were now called upon to perform. For instance, before the X-ray was discovered, perhaps the machine limited its field to gross electrotherapeutic work, but since that time it became a question as to whether it were not better to limit the use of one kind of a static machine to one field as X-ray work, and another to the other. He, himself, looked for a better machine for this multiplicity of work than can be evolved from any machine hitherto constructed. He noted the machine of Gaiffeé of Paris, which seemed to anticipate in a measure what he himself was seeking or expecting. He, so far as his own experience went, esteemed the Holtz as the best yet made for the usual therapeutic work and the Wimshurst for X-ray work. He thought for those who could attempt it that the one could be used for the one and the other for the other kind of work. Perhaps there yet would be constructed a machine which could offer both results in a single apparatus, which could be so made as to regulate the speed for one kind of work and change it for the other by suitable gearing.

The suggestions offered were of great interest to the association and the work of the chairman was especially commended. The work of the convention was largely in the line of static electricity, and the various papers thereon read, together with their full discussion, were of absorbing and practical interest. Several cures of malignant diseases, superficial and deep, were reported. In the various discussions the difference in the character of the tubes in X-ray work, giving rise to varied experience of the authors and members of the association with tube and machine, served to render prominent the conclusions of Dr. Morton expressed in his report on the work of his committee in the construction of a uniform static machine, capable of doing therapeutic work of any requirement. A full report of the various papers, with discussions thereon, will be found in the official organ of the society, the Journal of Advanced Therapeutics of New York city.

The association voted to meet in September, 1903, in Atlantic City, the exact time and place to be determined upon by the executive council and announced later.

By unanimous vote the association decided to appoint a committee to co-operate with the authorities of the exposition to be held at St. Louis in 1904, and to meet in that city in 1904. Prof. W. E. Goldsborough, chief of the Department of Electricity at St. Louis, was elected an associate fellow and forecasted the work to be done. He spoke earnestly of his desire that the work of the American Electrotherapeutic Association should be represented in an adequate manner. Accordingly the association voted that a committee should be appointed by the president which should co-operate with Professor Goldsborough.

The following-named officers were elected: President, Dr. D. R. Brower of Chicago; treasurer, Dr. R. J. Nunn of Savannah, Ga.; secretary, Dr. C. E. Skinner of New Haven, Conn.

National Association of Stationary Engineers.

The twenty-first annual convention of the National Association of Stationary Engineers was held in Boston, Mass., on September 2d to 5th. The opening session was held at the Massachusetts Institute of Technology, and there were about 3,000 delegates and visitors in attendance from all parts of the United States. Henry S. Pritchett, president of the Institute, sent to the convention a long letter eulogizing the work of the association. Charles W. Naylor of Chicago, chairman of the national educational committee and chief engineer for Marshall Field & Co., responded to the letter. The convention closed with a ball and banquet and the installation of the following-named newly elected officers: President, Robert G. Ingleson, Cleveland, Ohio; vice-president, P. J. Hogan, Boston, Mass.; secretary, F. W. Raven, Chicago, Ill.; treasurer, C. F. Wilson, Milwaukee, Wis.; trustee, George L. Geyer, Buffalo, N. Y.; conductor, J. H. Van Arsdale, St. Louis, Mo. Evansville, Ind., was chosen as the place for the next convention.

Aeronaut Falls on a Trolley Wire.

An aeronaut who exhibited nightly at a recent fair in Southport, Conn., narrowly escaped death one evening by striking a live trolley wire in his parachute descent. After making the ascension and reaching a height of several thousand feet, he cut himself loose and dropped with a parachute. In landing he struck the trolley wire. In what manner he received a shock is hard to determine, unless the current passed through the guys of his parachute, which may have fallen across another wire. He was severely burned about the left side, his arm and leg suffering particularly. He was enabled to extricate himself, and, landing on the ground, made his way back to the fair grounds, where he reported his mishap. He suffered somewhat, but was able to resume his occupation. During the night season, of course, it is impossible for the aeronaut to distinguish objects below him, and in order to permit of his landing in a safe place he is warned by those on the ground when to make his drop. The signal, a pistol shot, was given in this instance just after he had crossed over a river.

An experimental underground-rail electric railway has proved so successful in Paris, France, that two important branches will be added to it during the current year.

DEVELOPMENT OF THE TELEPHONE FIELD.

Ohio Telephone Notes.

Jesse Sloan has purchased the controlling interest in the Independent plant at Fostoria, which was built by the Federal Telephone Company, the consideration being about $80,000. The company has a capital stock of $50,000, and has issued bonds to the amount of $44,000. Part of the bonds were retained by the Federal company, however, although the exact amount has not been given out. J. F. Lanning of Norwalk has also purchased the controlling interest in the Mansfield Telephone Company, which he will probably make a part of the Huron County Telephone Company's property. The consideration in this case is said to be $225,000. This company had no capital stock issued, but there were $200,000 worth of bonds sold, of which the Federal company had about 92 per cent. Mr. Lanning is also negotiating for the purchase of the plant at Zanesville, which is an important one. It is capitalized at $200,000 and has a bond issue of $150,000 outstanding. The Federal company still has control of the plant at Detroit, but negotiations are pending for its disposal. It is the largest single plant undertaken by the company, and it seems to be the most difficult to handle, now that it is necessary to dispose of it.

It is said that Ed. L. Barber of Wauseon has made a definite offer for 60 per cent. of the stock of the United States Telephone Company and that it will more than likely be accepted within a short time. Mr. Barber is anxious to secure the property, as he is widely interested in the telephone business and in many of the local plants over the country. The lines of the United States company connect these plants with various sections of the country, and would place the Barber syndicate in a splendid position to extend its business. The assertion has been made that the Standard Oil Company is interested with Mr. Barber in the purchase of the system, and that there will be plenty of money to complete lines in any direction desired. Mr. Barber is a member of the firm of Barber & Braley, who are constructing the plant at Toledo, and who are also interested in the plants at St. Louis and Kansas City. It is intimated that he is interested in the consolidation of the Independent plants in Kansas, Nebraska and other western states and those in Texas. With such connections and with plenty of money behind it, the new syndicate will be in position to have connecting lines between the principal cities of the East and West and the North and South. Mr. Barber and Mr. Braley are men of long experience, and the interests of the United States Telephone Company will be in good hands if they should gain control of them. The company has a capital stock of $2,000,000, and $1,800,000 has been issued. It now has connections with 330 exchanges in this state.

The Bell Telephone Company has made an increase of 100 per cent. in the rates of residence telephones at Parkersburg, W. Va., and about 70 per cent. in business telephones. Citizens held a meeting and appointed a committee to induce subscribers to order their telephones out, and as a result about 500 of them have taken this action and 100 have subscribed for the Independent service.

Charles Richter, a real-estate broker of Cleveland, has sued the Cleveland Telephone Company for $10,000 damages, charging that the company omitted his name from the last telephone directory published and refused to correct it, notwithstanding the fact that he made a vigorous protest. He says that he has used the service for 13 years and that he has never before had any difficulty, but that this time he has lost a number of real-estate sales through the name being left out of the directory.

The Toledo Home Telephone Company has now connected about 3,800 telephones out of the 5,000 installed, and it has 7,000 contracts. The company began to charge for service on September 1st, and from now on the work of installing and connecting the telephones will be pushed with vigor.

The Hicksville Telephone Company, Hicksville, has filed notice with the secretary of state of an increase of capital stock from $10,000 to $25,000.

The Federal Telephone Company will in all probability sell its holdings in the Cuyahoga Telephone Company if the proper inducements are made. The Cuyahoga plant has been a good investment, but at this time needs extensions and enlargements to meet the demand for the service. The matter of an increase in rates stands in the way of this at the present time, but that will likely be cleared away. The Federal holds $1,500,000 of the stock of the company, and this has been listed at $20 a share. There is talk now that the property will be sold to a syndicate of Cleveland men, and Messrs. Everett and Moore will probably retain at least a portion of the stock personally. O. M. C.

Indiana Telephone Items.

The Hymera Telephone Company of Hymera, Sullivan County, has been incorporated, with a capital stock of $5,000. The company will construct a plant in Hymera and subsequently extend the service throughout Sullivan County. The directors are James M. Barnett, O. B. Kattman, H. T. James, J. G. Barnett and John Funkhouser.

The Royal Telephone Company of Kosciusko County was incorporated last week, with capital stock of $20,000. The company will construct and maintain a telephone system in Kosciusko County, with a central exchange and office at Milford. The company promises to extend its service to adjacent counties. John W. Whitehead, James Haller, G. G. Grady, M. P. Wright, C. F. Mills and W. B. Neff constitute the board of directors.

Gass City and Jonesboro are constructing jointly a new Independent telephone plant. The system is to be completed and in operation within 90 days.

The New Long-distance Telephone Company has filed a mortgage for $1,000,000 in favor of the Union Trust Company of Indianapolis to secure payment on 1,200 five per cent. bonds, payable in 20 years. The bonds numbered from one to 800, are for $1,000 each, and from 801 to 1,200 are for $500 each. The mortgage covers all the tangible property of the company in 32 counties. President A. H. Nordyke said the money will be used for the general improvement of the service. The greater amount of the funds will be used to purchase new copper wire for new circuits and additional lines over the leads already in use in various parts of the state. He said the company would expend $150,000 this year and an equal amount next year, as the service needs to be enlarged on account of the rapidly growing business. He said that it will be some time before it would be necessary to use the whole amount of the loan, but the officers of the company deemed it advisable to secure sufficient amount at one time rather than to make several mortgages to improve the system. The lines will be extended into other counties at once. F.

Telephone News from the Northwest.

The Duluth Telephone Company of Duluth, Minn., which has been barred from the city offices of Duluth for three years, has agreed to give one-half of one per cent. of its gross earnings to the city, the same as the Zenith Telephone Company does, in consideration of the city reinstating its instruments in the city offices. The city began suit against the company to oust it from the streets, after the expiration of its franchise, but the decision in the United States Court was in favor of the company. Then came a petition from city officials asking for the Duluth Telephone Company's connections, and the aldermen notified the company the terms on which it could come in again—the same gross-earnings tax that is paid by its competitor.

The Minnesota Valley Toll Line Company has been organized at Mankato, Minn., with a capital of $100,000, to build to the Twin Cities. E. H. Moulton, of the Twin City Telephone Company, is one of the directors.

Telephone operators at La Crosse, Wis., in the employment of the Wisconsin Telephone Company recently struck because of dislike of the chief operator, who is accused of being "stuck up."

The Northwestern Telephone Exchange Company has reached an agreement with the local company at Warren, Minn., and will, therefore, make toll-line connections with that company.

The Hutchinson Telephone Company of Hutchinson, Minn., has installed a new switchboard of 450 drops.

The Iowa Telephone Company complains at its assessment in Dubuque, by the city assessor, as it is over three times what it was the year previous. The city assessor declares that it is assessed for its full value and the same will be done again this year.

The county assessor at Sioux City, Ia., has increased the assessments upon telephone companies in the county. The Iowa gets a raise of $4 a mile, the New State Telephone Company of $10.70 and the Northwestern of $18. R.

Southern Telephone Items.

The Cumberland Telephone Company will establish a system in Coffeeville, Miss., the requisite number of subscribers having been obtained.

It is rumored that a new telephone company is being projected at Petersburg, Va. This, if successful, will be the third system in that town.

On October 1st the Southern States Telephone and Telegraph Company will apply for a charter. The capital stock will be $500,000. The company proposes to cover many hundred miles, connecting Jacksonville, Fla., with other towns in the state. W. S. West will be president of the new company.

The Diamond State Telephone Company is erecting a system which will be in working order in about four weeks. The system will cover Somerset County, Md. Harry Mayer is manager and McGee Riggin local manager.

The International Telephone Company has applied for a franchise to put in an underground telephone system in Charlotte, N. C. The company has headquarters in Washington.

The city attorney of Hazelhurst, Miss., is endeavoring to get the Cumberland Telephone Company to reduce its rates, which, he claims, are above the rate allowed in the franchise. The company claims that improved service justifies the increase.

The Bell company of Richmond, Va., it is said, does not contemplate any advance in rates, as was expected, but if any advance is made it will be in accordance with its franchise, so an official of the company states. L.

Indiana Telephone Toll-line Valuations.

Complete figures compiled from the record of the State Board of Tax Commissioners in Indiana show a large increase in the assessment of telephone property in that state over the previous year. In 1901 the telephone companies' property (exclusive of real estate, buildings, machinery, fixtures and appliances subject to local taxation) was valued at $4,436,666.00, and in 1902 at $5,065,323.30, an increase of $628,660.30.

Valuations of the more important companies for this year are as follows:

American Telephone and Telegraph Company.	$ 552,732.50
Central Union Telephone	2,333,731.50
Chicago Telephone	59,859.60
Citizens' of Columbus	26,250.00
Citizens' of Kokomo	38,500.00
City and Suburban Telegraph Association of Cincinnati	22,200.00
Cumberland Telephone and Telegraph	374,550.00
Decatur County Independent	27,040.00
Delaware and Madison County	36,360.00
Greensburg Telephone	25,470.00
Home of Crawfordsville	20,000.00
Home of Elkhart	67,050.00
Home of Wabash	20,790.00
Home of Fort Wayne	88,500.00
Lafayette Telephone	59,500.00
Mutual of Shelbyville	17,580.00
National Telephone and Telegraph	42,731.50
New Telephone of Indianapolis	330,498.00
New Long-distance	96,500.00
Richmond Home	76,440.00
United of Bluffton	189,300.00

In contrast to the telephone development, telegraph pole lines show a decrease in valuation, the figures being: 1901, $2,514,812; 1902, $2,478,183.50. Of the latter valuation $2,242,722 is assessed against the Western Union and $225,024.75 against the Postal.

Work on Illinois Telephone Company's Tunnels.

Although the Illinois Telephone and Telegraph Company is waiting action by the Chicago City Council on an amended ordinance that will permit the construction of its 14-foot trunk tunnel, it has steadily carried forward its work of building the seven-foot tunnels under the streets in the business section of Chicago. It is stated that the downtown conduits are to be completed in December, and that by next February the company will have in operation an automatic exchange of 10,000 instruments. The work of wiring the tunnels has been commenced and the construction of the telephone exchange is now under way. The district to be opened first to public use will extend west to Halsted Street, north to Chicago Avenue and south to Twelfth or Twenty-second Street. It will require fully two years to build the entire system to Sixty-third Street on the south and to the extreme western and northern boundaries of the city.

GENERAL TELEPHONE NEWS.

On August 29th the telephone exchange at Tuxedo Park, N. Y., was destroyed by fire. Henry Tomlins, wife and two children occupied part of the building as a living apartment and all were severely burned, being taken out unconscious.

The large exchange of the Toledo Home Telephone Company, with 3,000 telephones just put into operation and contracts for 4,000 more, was installed by the Sterling Electric Company of Lafayette, Ind. The exchange company is reported to be well pleased with its plant.

The Southern Massachusetts Telephone Company has paid $2,512 to the city of Brockton, Mass., for all the city's rights in the conduits laid in that city by the Massachusetts Telephone and Telegraph Company, which forfeited its Brockton franchise by not fulfilling the requirements. The Brockton aldermen have granted a franchise to the Southern Massachusetts company.

In San Francisco John I. Sabin was interviewed by the Examiner in relation to the possibility of his resigning the presidency of the Chicago Telephone Company. Mr. Sabin said that his relations with the Chicago company were never more cordial or agreeable than at the present time. "Instead of being relieved of any of his duties," says the Examiner, "Mr. Sabin has lately been appointed president of the Cleveland Telephone Company, and is at present deliberating as to whether he is physically able to care for this additional responsibility."

"It is generally the rule with corporations which issue new stock from time to time," says the Chicago Chronicle, "that if stockholders neglect to take advantage of any rights in connection with their stock holdings the company benefits by such neglect. The maxim that 'corporations have no souls' can hardly be applied to the American Telephone and Telegraph Company, for it has within a week sent a letter to stockholders who neglected to subscribe to the stock issue of June, 1901, or sell their rights, to the effect that the directors had authorized a payment of $15 per share to such stockholders, and checks were enclosed."

Single-phase Electric Traction.

In an Italian electrical journal Mr. Fumero, an engineer, states that at a recent meeting at Zurich Herr Huber, director of the Oerlikon Maschinenfabrik, gave an official confirmation of the reports that have been current from time to time to the effect that the Oerlikon company is engaged in a series of experiments to solve the problem of the use of single-phase alternating current for electric traction on railways. The fundamental point which forms the basis of the experiment is that of organizing a system which will not in any way necessitate any alteration in the formation of existing trains, that is to say, instead of employing self-moving passenger cars and freight cars, thus rendering the whole of the existing rolling stock useless, to employ electric locomotives in place of existing steam locomotives, the old passenger cars and freight cars being still retained.

The electric locomotive at present being constructed at the Oerlikon works is adapted to receive a single-phase alternating current at a pressure of 15,000 volts; presuming it to be intended for a train of 250 tons of the present type, and running at an average speed of 25 miles per hour on a line having a maximum gradient of one in 100, it was estimated that the engine should have a capacity of 575 horsepower.

Taking these data as a basis, it is easy to estimate the strength of the current which it would be best to adopt for a line working under normal conditions. In fact, presuming the total efficiency to be 75 per cent., and the load factor 90 per cent., with a voltage of 15,000, a current of 45 amperes would suffice to feed the motors. With such a current, it is possible that the efficiency of the transmitting conductor would be most satisfactory, as well on long lines as on sections on which trains follow one another at frequent intervals.

It might be asked whether limiting the pressure to 15,000 volts might not constitute a notable reduction in the radius of action of each generating station—a question, however, not justified by sufficient reason. It appears to us, says Mr. Fumero, that the question of the pressure should be dealt with in such a manner that it should not become excessive, but allow of the adoption of feeding stations sufficiently distant one from the other to reduce to a minimum the initial outlay. The pressure of 15,000 volts, which it is proposed to adopt, is quite within the range of that for which experience has taught us the applicability of insulating materials for safe working.

The working conductor would be arranged on the side of the track, and at a convenient height; it would be supported in a way similar to that adopted in electric-tramway practice, but the suspension should be at the side and somewhat lower than usual. The insulators used would necessarily have to be adapted for very high pressures.

The current would be taken from the overhead wire by means of a conducting bar, mobile in a plane perpendicular to the direction of the track, and consequently able to revolve around an axis parallel to the direction of the track itself. The contact between the conductor and the moving bar would be sustained by means of a pressure spring. The rails, which would be used as the return, would have to be duly bonded in such a way as to offer a low resistance.

To avoid any danger which might arise from a breakage of the feed conductor, and of contact of this with the cars, the latter would have to be provided with metallic guards, and care would have to be taken that the latter be connected with earth through the wheels. The distance between the sides of the guards should not be more than two meters.

In a case in which the necessary power is not so great, a system of electric locomotives fitted with transformers might advantageously be adopted, similar to self-moving cars. The additional weight would not be too great, as will be seen from the following estimate:

	Metric tons.
Vehicle	15
Transformers	16
Regulators, conductors and current receivers.	1
Brakes	1
Motors	11
	44 tons.

It is not possible to say that this would be excessive, and that it would be much more than that of vehicles using three-phase current and adapted for similar service. The electric locomotive in question, at a speed of from 20 to 25 miles per hour, would develop a tractive force of five tons.

It is, perhaps, hardly possible to judge from these data of the practical applicability of the system at present receiving the attention of the Oerlikon company. Herr Huber has promised a full description with drawings as soon as possible of a project for its application on the St. Gothard railway, in order to prove the practicability and advantage of the substitution of electric for steam traction, both from a technical and a financial point of view. We shall then be able to see, continues the Italian writer, whether the projected system responds to all the exigencies of a practicable and economical, and, at the same time, safe and simple service—and this without prejudice to the important question which might be asked as to whether it is really advantageous to preserve the present system of infrequent heavy-train service, comprising a large number of units, or whether it would not be preferable to adopt small units, traveling rapidly, and at frequent intervals of time, a service which would not be practicable if electric locomotives were adopted in place of self-moving cars. On this aspect of the question, we cannot, without further information, accept the ideas put forward by Herr Huber. Further discussion, however, may well be left until the publication of the promised particulars and drawings, which will afford a more concrete case for comment than mere hypothesis.

G. I. Automatic Arc Regulator.

The type L7 arc lamp which is made by the General Incandescent Arc Light Company of New York, is designed to operate on constant-current alternating series circuits, the only limitation to the number that can be connected in a series being that each lamp must not have less than 83 volts at the circuit terminals, including drop in the regulator and line. The G. I. automatic regulator or reactive coil that is used in series with the arc and incandescent lamps is shown in the illustration. The device is connected in series across constant-potential alternating circuits and is built in sizes of from 20 to 120-light capacity, for 5½ to 7½ amperes and for 60 to 133 cycles.

The regulator consists of a pair of reactive coils

G. I. AUTOMATIC ARC REGULATOR.

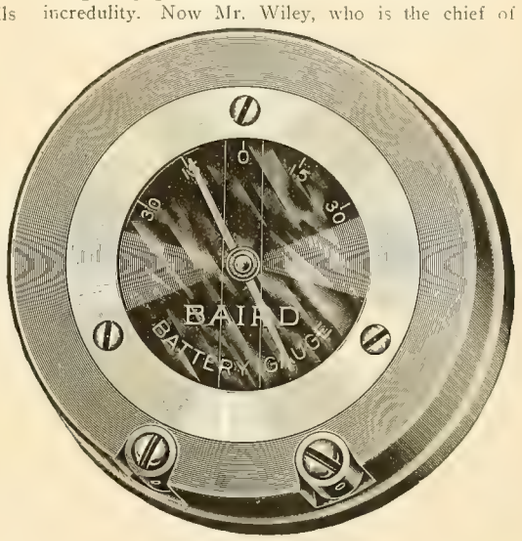
mounted in a metal frame and supported by spiral springs from a heavy marble top. This top is supported by an iron frame, which is secured to a similar marble base. A laminated iron core is suspended under the reactive coils in such a way that it can play up and down in the magnetic field of the coils. To the lower part of the core is fastened a metal strip which is attached to the upper face of the arc on one end of the lever which carries the adjustable counter-weight at its other end. Below the core, and fastened to it, is a large air-dash pot which prevents "pumping" of the system and aids the starting of the lamps.

When not in operation only a small portion of the legs of the laminated iron core are surrounded by the windings of the reactive coils. If the outside line is short-circuited and current turned on, the core is immediately drawn into the coils which then react against the line potential and keep the current constant at the value for which the regulator is adjusted. When the short-circuit is removed, causing the current on the circuit to fall, the core drops down; this decreases the reactance of the regulator and sufficient of the line potential is allowed on the lamp circuit to start and operate the lamps. If one or more of the lamps are switched off or cut out, causing the current on the circuit to increase, the regulator coils attract the core which when entering the coils further increases the reactance of the regulator and the current will again be brought to its given value.

Attention is called to the fact that the regulator has no moving wires or coils. The efficiency of a 50-light regulator is said to be about 98.6 per cent. Current regulation from no load to full load is within 0.2 ampere, while current adjustment by means of counter-weight is from six to seven amperes. The floor space occupied by such a regulator is 24 by 17 inches, while its maximum height is 42 inches, and its weight is about 450 pounds.

Baird Dry-battery Gauge.

The Baird battery gauge, shown in the accompanying illustration, has been brought out by the Baird Manufacturing Company of Chicago. Although it is a cheap instrument, the company asserts that it is more accurate than much more expensive instruments heretofore placed on the market. There is no gearing in the Baird battery gauge, as the only movable part is a compass needle, which, being extremely sensitive, is capable of detecting the exact condition of a dry-battery cell. These gauges are put out at popular prices, and as the Baird Manufacturing Company guarantees them to give satisfaction, they are apt to meet with a ready sale wherever dry batteries are used to any extent.



BAIRD DRY-BATTERY GAUGE.

Crookes' World-starvation Theory Combated.

Apropos of Sir William Crookes' sensational address a few years ago as president of the British Association, some paragraphs in a recent lecture before the Franklin Institute of Philadelphia by H. W. Wiley will be of interest. It will be remembered that Sir William contended that there was an appreciable danger of the starvation of the world's inhabitants within a half century or so unless something is done to replenish the wheat lands of the globe, which, he said, are rapidly becoming exhausted. This replenishment would naturally be done by nitrates, and the distinguished scientist suggested that the electric power of Niagara Falls might be used to fix the nitrogen of the atmosphere for this purpose, thus averting the appalling calamity. Since then a small plant for the electrical fixation of nitrogen has been actually established at Niagara Falls. At the time of Sir William's presidential address his gloomy predictions were received with amazed incredulity. Now Mr. Wiley, who is the chief of the Bureau of Chemistry of the United States Department of Agriculture, says that the English physicist's apprehensions are unfounded. These are the apposite paragraphs from Mr. Wiley's address:

To me it seems that a wise use of the resources which nature has placed at our disposal, together with a practical application of the principles of science, will serve to show how a properly managed soil can be increased in fertility instead of exhausted by continuous cropping, thus removing any fear of the fate of starvation.

The fields of the future, instead of becoming poorer will grow richer; the average yield of foods per acre will increase so that the coming increasing millions of the world's people will be better fed, better clothed and better taught than those that have gone before.

It is not the fear of starvation that confronts men in the remote future. If this planet, as is probable, is to live its day and die as others have done, it will not be because of the exhaustion of the earth's supply of plant food. The circuit of life is complete, and no item of matter which has once been available for plant food can ever be hopelessly lost for the same purpose. In the changes which come and go the vital molecule of matter will again live, even if it has been dead for thousands of years. Science and practice will add indefinitely to the stores of human food, and the scientific agriculture of the future years will be ready to feed the mouths which come into existence.

For every mouth, it must be remembered, nature provides two hands. The capacity of the mouth remains constant, while the ability of the hands to fabricate, to make and to earn is constantly increasing. The future, therefore, will bring more leisure, more ease, more culture and more food.

Should the races of men ever cease to exist upon the face of the earth, as is possible, it is evident, to my mind, that a cosmic and not any economic cause will bring about the result.

It seems more probable that the earth is gradually cooling. Paleontology finds evidence of tropical life, both plant and animal, far in the polar regions. It seems that all life is gradually approaching the equator. The armies of ice are slowly but surely advancing their lines, and the time may finally come when the last man will reach the equator. Far in the millions of years will this event take place. Dwarfed in stature, flat of head and hopeless of face will this last man be—the remnant of civilizations and of nations long extinct. Exhausted with his struggle for existence he will calmly and hopelessly await the end.

The future will not see the fulfillment of the

prophecy of Berthelot when all men will be fed food formed in the chemist's crucible. The future will not see the fulfillment of the prophecy of Crookes when all men shall starve for the lack of wheat which farmers can no longer grow. Only a future too remote to be finite can possibly see the fulfillment of the prophecy which sees the end of humanity in a universe of ice.

Dicke Lineman's Cart.

A handy lineman's cart, designed to take up and pay out telephone wires, is shown in the accompanying illustrations. The frame of the cart is made of pipe, to render it durable. The box is of wood, 34 by 19 by 10 inches in size, the edges being bound with band iron. It is provided with iron wheels, 36 inches in diameter. A small tool box is attached to the front of the cart to accommodate some of the tools which may be needed in repairing a line.

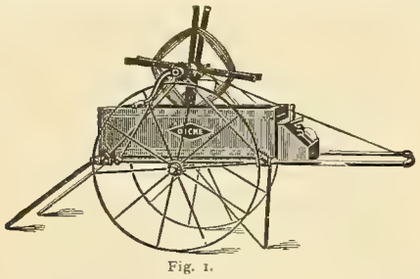


Fig. 1.

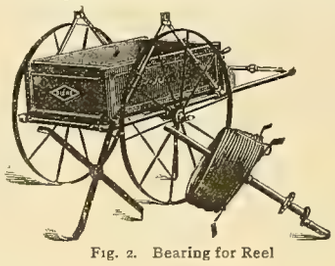


Fig. 2. Bearing for Reel

DICKE LINEMAN'S CART.

Fig. 1 shows the cart ready for use. In Fig. 2 the bearing for the reel is shown, the reel being designed to wind up or pay out wire, as the case may be. The entire cart is painted in suitable colors. It is pointed out, by the manufacturer, the Dicke Tool Company of Downer's Grove, Ill., that one of these carts at a station enables the station electrician to go immediately when a breakdown is reported, instead of being obliged to wait until some conveyance can be obtained to carry the wire and tools necessary to make the repair.

Edwards Carriage-call Annunciator.

A new type of electric carriage-call annunciator that possesses some interesting details of construction has recently been brought out by Edwards & Co. of New York city. A completed annunciator encased in an ornamental grill case is shown in Fig. 1, while Fig. 2 illustrates the same in a weatherproof case.

The device is constructed to show the numbers on both sides, and is composed of six five-sided lanterns, three on each side. The numbers are of opal glass, so as to be plainly visible in daytime. A 32-candlepower lamp is suspended in each lantern for night use. The annunciator is operated by a simple 15-section switchboard, consisting of three divisions of five numbers each, five for units, five for tens, and five for hundreds. These correspond with the numbers on the lanterns, viz., 0, 1, 2, 3, 4, on each, so that 125 different combinations can be made.

The operation of the annunciator is as follows:

Fig. 1. Annunciator in Ornamental Grill Case.

Fig. 2. Annunciator in Weatherproof Case.

When the desired combination of numbers is switched in, the lanterns of both sides revolve to the desired numbers, and are automatically cut out in the instrument. The movement is given by a small electric motor. Each section is provided with an electromagnetic clutch, which engages the lanterns the instant the circuit is established, and releases the same when the circuit is broken. The lanterns are connected by miter gears, so that each side will operate in unison with the other. The switchboard is provided with a main annunciator switch, also one for the light. Fig. 3 shows the arrangement of gears and magnetic clutches, and Fig. 4 illustrates the arrangement of shunt lamps and automatic switches.

The Metropolitan Street Railway Company of Kansas City, Mo., has purchased a piece of ground in that city, located at the northeast corner of Second and Walnut Streets. The purchase price was $15,000. The company now owns, with the exception of one lot, all of two blocks in the above district for which it has paid, all told, about $136,000. A new power house is to be built on the property, and the work on it is now in progress.

Freight Traffic on Electric Railways.[1]

One of the strong claims made by promoters of interurban and rural electric railways has been that they will greatly serve the farmers and the people of small communities by collecting and delivering freight along the roadside. To some extent these promises are being realized and a number of electric roads have added to the passenger service the carrying of package freight and express in combination cars, while some have also established a distinct freight service and haul cars to and from steam roads, carrying coal, merchandise and farm products in bulk. For example, the Chicago, Harvard and Geneva Lake electric road, 10½ miles long, running from Harvard, Ill., on the Chicago and Northwestern to Lake Geneva, and crossing the Chicago, Milwaukee and St. Paul, has six freight sidings, besides its own yards at terminals, and does quite a business in switching cars from both the steam roads named. Refrigerator cars for several creameries on the line, cars for ice in winter, and live stock through the year, are handled in connection with the steam roads. The latter make the same rate per carload to any point on the electric line as to their point of junction, and the electric road charges $5 per car for delivery, carrying piece freight at five cents per hundred, with a minimum charge of 10 cents. The electric road has established stock yards and has secured the favor of shippers by furnishing feed at moderate prices and requiring its conductors and motormen to assist in loading stock without charge.

The Cleveland and Eastern electric road, which operates nearly 100 miles of lines through a farming country and does not closely parallel any steam road, has developed freight business still more extensively, having also a package express, operated in connection with delivery wagons in all the towns. The freight is carried in combination cars, and conductors and motormen do the hauling, loading and unloading, no agents being employed, except in the largest towns. Milk forms a large item of traffic, cans being piled high on either side of the car interior. Rates are figured on weight according to the regular steam-railway classifications, and elaborate forms of waybills, shipping receipts and freight records are used. Steam cars are handled on all parts of the system except in the city of Cleveland, and wood, coal, grain, ice, etc., are transferred to and from steam roads. The freight schedules appear to be made on an arbitrary basis, with little regard to actual distance or to the comparative distance of stations. The following figures showing distances and classes are condensed from the table of freight rates by stations:

Miles.	1st.	2d.	3d.	4th.	5th.	6th.
9	9½	5½	8	7½	6½	5½
11 to 16	12	11	10½	8½	7½	6½
20 to 30	14½	13	12	10	7½	6½
32 to 39	15½	14	13	10	7½	6½

There are 22 stations on the three lines, and the most remote of them enjoy the same rates as the nearer, in numerous cases. In some instances there is apparent discrimination between localities. Thus to Hiram, which is 40 miles from Cleveland, the first-class rate is 13 cents, while it is 15 to Middlefield, 39 miles, on another branch; on second and third classes, Hiram has an advantage of two cents, and on fourth class of one cent. So far the Ohio Railroad Commission does not appear to have taken any steps to punish discrimination or to secure uniformity and equity in electric-railway charges, and the injured communities cannot appeal to the Interstate Commerce Commission for relief on purely local business.

The freight business of the Cleveland and Eastern is already reported to furnish one-third of the total receipts, while it is affirmed that it costs only seven per cent. of the gross freight receipts to operate the freight business. Some published figures of the road's receipts seem to show that the freight is a still more important element in the traffic than is claimed. For the month of March last, the passenger earnings, it is stated, were $8,700; while express earned $1,300, freight $1,300, milk $1,200 and mail $400, making a total of $4,200 for freight, or nearly half as much as the passenger receipts, besides nearly $1,500 in receipts from special cars, city companies and other incomes. Unfortunately, no statement of expenses is furnished, but the company could hardly have had time to demonstrate the profitableness or unprofitableness of the business before it was embarrassed by the troubles of the Everett-Moore syndicate, of which the Cleveland and Eastern furnishes a part.

The Detroit United Railway Company, which controls and operates some 500 miles of electric-railway track, composed of six different roads, has developed a very considerable freight business. It has a substantial brick freight house in Detroit, with doorways for each division, along which, on busy days, teams are drawn up awaiting their turn, quite after the fashion of the bigger steam-railway freight terminals. Every kind of package freight is carried, as well as larger quantities of merchandise, flour, lumber, coal, farm products, etc. Much of the freight is handled at night, when the passenger business is light, and the roads seem to be doing a freight business on the most favorable and profitable terms that could be expected for railways of this character. Yet the results do not appear to be altogether encouraging. The president says that the income is comparatively small, the freight earnings hardly forming more than two per cent. of the entire earnings, while in the case of steam roads the earnings from freight business may be 70 or 80 per cent. of the total. The president continues:

"The trouble is that we cannot run our freight cars in trains, as the steam railways do. When they have an extra amount of freight they may send out train after train, each one drawn by an engine, a distinct unit of power. Each train of 20 or 30 cars has its own crew. That crew, however, consists of no more men than would be required to run two or three of our cars. Each one of our cars must have its own crew. We get the same freight rates as they do, **though.**

"The suburban-freight business is an outgrowth of the passenger business, and it had its conception in a desire to accommodate the patrons of the passenger lines; nothing more or less. It began with people giving the conductors and motormen parcels to carry. The old suburban railways, before they passed under our management used to allow that and charge for it. They put a small compartment in the passenger cars for express business, and finally cars especially for freight and express business came to be used."

The Detroit company labors under a disadvantage, from which it evidently would like to have relief, in the fact that it is required to pay a specific tax of 50 cents a car to the city of Detroit for every car of freight hauled through the streets on its various electric lines. Over 10,000 cars having thus been handled within the last year, the tax was upward of $5,000, and as the president declares that "the city gets about all that is made out of the business in the 50 cents per car tax," it would appear that the freight business of this road is more beneficial to its patrons than to the company. So far as now appears, none of the electric roads has succeeded in developing a freight business which cuts any figure with the steam roads or which indicates that the trolley lines can expect any considerable profit out of freight traffic in the future. The rapid and frequent running of passenger cars at cheap rates is incompatible with the hauling and delivery of freight along the way, and the probabilities are that as the passenger business increases the less will be the effort to handle freight on suburban and rural electric roads.

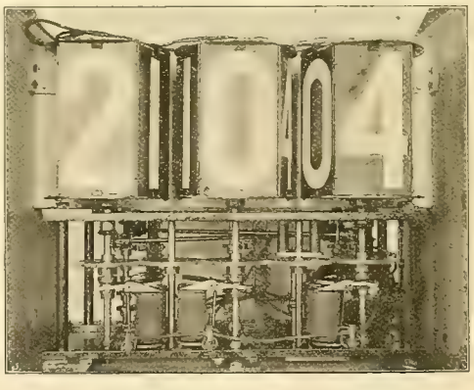


Fig. 3. Arrangement of Gears and Magnetic Clutches.

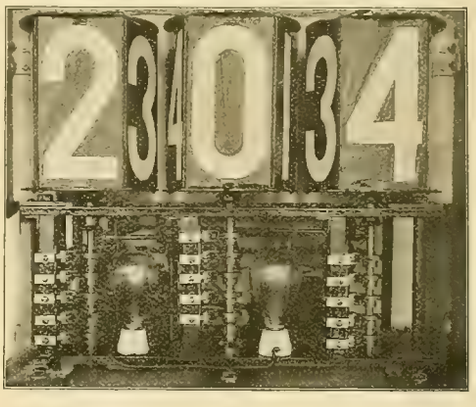


Fig. 4. Arrangement of Shunt Lamps and Automatic Switches.

EDWARDS CARRIAGE-CALL ANNUNCIATOR.

1. From the Railway Age.

A Survey of Electrical Patents Granted by the United States.[1]

By Story B. Ladd.

Part I.

Generation of Electricity.

In this class 3,688 patents have been issued. In 1871 the state of the art was as follows: Sonnenburg & Rechten had patented a machine for killing whales by electricity, patent 8,843, March 30, 1852, the earliest United States patent in this art. The so-called Alliance machine was in use to some extent for seaboard illumination and is represented in the patent to Shepard, 15,596, August 19, 1856. These machines were provided with permanent field magnets. Wilde had patented a machine that was intermediate between those having permanent field magnets and those which had electromagnets excited by the current of the machine itself. This is shown in patent 59,738, November 13, 1866.

Gramme and d'Ivernois had patented a machine having a continuous armature winding which, so far as the United States patents go, may be regarded as the progenitor of the modern dynamo-electric machine. This patent is 120,057, October 17, 1871. April 13, 1875, a patent, 161,874, was granted to Farmer embodying the principle announced in 1866 by Siemens, Wheatstone, and Varley of exciting the field magnets by the currents generated by the machine. Weston patented July 18, 1876, 180,082, a multipolar self-exciting machine. The first patented machine having the modern form with consequent poles was granted to Holcombe, December 5, 1876, 184,966. Brush, April 24, 1877, 189,997, patented a form of machine having an open-coil ring armature. Weston patented, October 29, 1878, 209,532, a machine which had all the essential features of the most modern machines, viz., consequent poles and cylindrical ventilated armature with continuous winding. Brush, July 22, 1879, 217,677, introduced the so-called teazer, which is a high-resistance winding upon the field magnets, connected in shunt to the work for the purpose of maintaining the magnetism of the field magnets when the machine is running, whether the external circuit is closed or open. Prior to this all machines had their field-magnet winding in series with the work, and had no excitation except when the working circuit was closed. Edison patented, December 23, 1879, 222,881, a special structure of cylindrical armature. Thomson & Houston, January 13, 1880, patented their three-coil armature, 223,557. Brush patented a regulator consisting of a shunt around the field magnets, including a variable resistance, February 17, 1880, 224,511. Seeley patented June 22, 1880, 229,191, an armature in the form of a disk, wherein the active wire was radial. Sawyer, July 20, 1880, 230,345, patented a regulator which varies the number of active sections of field-magnet winding. Von Hefner-Alteneck patented, November 9, 1880, 234,353, a multipolar alternating-current machine having a portion of its current commutated for exciting the field magnets. Edison, June 14, 1881, 242,898, patented an armature having its conducting parts formed of heavy copper bars. Van Depoele, May 16, 1882, 257,990, patented what is known as a motor-generator or rotary transformer, in which there are two armature windings, one taking current from a line and driving the machine as a motor, while the other winding acts as a generator. Irwin, August 8, 1882, 262,421, patented a machine in which regulation is effected by changing the inductive relation of field magnet and armature. Patent to Wenstrom, 292,079, January 15, 1884, shows the first of the iron-clad machines. An armature winding for drum armatures, in which the coils may be prepared in advance and placed on the core as desired, was patented to Eickemeyer, February 14, 1888, 377,996. The employment of carbon collector brushes is represented in the patent to Van Depoele, February 25, 1890, 422,265. A form of machine in which the armature wire is stationary and is affected by the closing and opening of the magnetic circuit is shown in the patent to Sawyer, February 8, 1881, 237,632, and in a more improved form in that to Stanley, Jr., and Kelly, June 13, 1893, 499,446. Machines on a vertical shaft are shown in the patent to Sellers, June 5, 1894, 520,940.

During the last few years there has been no startling innovation in this class, the attention of inventors having been directed to the improvement of minor details of known devices. The commutators have been improved, the collecting brushes have been better adapted to their purposes, variations made in the construction of coils, and the manner of applying them have received much attention. A dynamo of modern type includes in its construction a large number of patented improvements and its superiority does not rest on one any more than on another, and in many cases the improvement consists in some comparatively trivial change.

The first attempts at a commercial employment of transformers for purposes of distribution were based on the patent to Gaulard & Gibbs, October 26, 1886, 351,589. A transformer system for constant current is brought out in the patent to Thomson, April 2, 1889, 400,515. The relation of counter electromotive force to direct electromotive force, which renders transformers connected to line in parallel self-regulating, is found in the patent to Kennedy, July 16, 1889, 407,294, which was reissued September 24, 1889, 11,031. The monocyclic system is represented by Steinmetz, January 29, 1895, 533,248.

An electric meter for distributing electricity in proportion to the value of an inserted coin is shown by the patent to Phillips & Tilden, 626,298, June 6, 1899. This meter is arranged to be operated by coins of different denominations.

Electric Heaters.

An improvement in electrical heating is a woven fabric that is adapted to be uniformly heated throughout by an electric current. This is shown in patent 540,398, to Meek, June 4, 1895. This fabric is of great value in case of sickness, which reduces the temperature of the body and renders desirable the application of heat, and is also useful as a covering whenever a gentle heat is required. Gold, 638,236, December 5, 1899, strings a coil of bare resistance wire upon an insulated supporting rod and puts it under such strain as to cause the convolutions to impinge at one point only against said supporting rod.

Electric Lighting.

In this class 5,833 patents have been issued. Some of the more important inventions in this art are the now common type of ring clutch used in arc lamps, patented by Brush, 203,411, May 7, 1878; a main and shunt magnetic differential feed for arc lights, patented by Brush, 212,183, February 11, 1879; a main and shunt mechanical differential feed, patented by Weston, 285,451, September 25, 1883; the double-carbon arc lamp, with mechanism to separate the pairs successively, patented by Brush, 219,208, September 2, 1879; the high-resistance filament in an exhausted glass globe, the present incandescent lamp, patented by Edison, 223,898, January 27, 1880; the use of bamboo as a material for making incandescent filaments, patented by Edison, 251,540, December 27, 1881; the process of standardizing filaments by electrically heating them in the presence of hydrocarbon vapor, patented by Maxim, 405,170, June 11, 1889; a system of distribution employing three wires in multiple series, patented by Edison, 274,290, March 20, 1883; the process of producing currents of enormous frequency and excessively high potential, and utilizing them for the production of light, patented by Tesla, 454,622, June 23, 1891; the system for supplying electromotive force to a feed-wire system between the consumption circuit and source of supply of the main electromotive force, patented by Mailloux, 475,877, May 31, 1892; the process of producing Geissler-tube effects without the aid of induction coils by interrupting the current in a high vacuum, patented by Moore, 548,127, October 15, 1895; the socket detachable from an incandescent lamp, the parts being so arranged that the insertion of the lamp completes the circuit, patented by Edison, 251,554, December 27, 1881; a mechanical cut-out which will automatically take the current off the trolley wire in case it happens to break, and thus save danger of contact with live wires, patented by Morgan, 417,497, December 17, 1889; and a method of interrupting an electric arc by generating a non-conducting vapor within the path of the arc, patented by Wurts, 470,773, March 15, 1892.

Flexible metallic tubes for house wiring are shown in patent to Greenfield, 630,501, August 9, 1899. An outlet box for making working connections is shown in patent to Greenfield, 642,521, January 30, 1900.

Since 1895 four new types of electric light have been brought forward and perfected in commercial form. The first of these is the Jablochkoff candle, used and abandoned some twenty years ago. This form of lamp depends on the fact that numerous non-conductive oxides, such as kaolin, chalk, zirconia, etc., become electrolytic conductors when highly heated, the resistance decreasing with increase of temperature, so that the best light-producing condition is coincident with the best condition of conductivity. Mixtures of oxides capable of becoming conductive at lower heat have been substituted for the kaolin, a separate electric heater and automatic cut-out therefor have been devised, and a ballast resistance to balance the decrease of resistance in the glower have been supplied. This light, which is far more brilliant than the carbon filament and better than either the arc or filament light as to color, is now on the market in competition with the enclosed arc. This development of the art is illustrated by the new sub-class of lights, incandescent, second-class conductors, which contains some 53 patents, including the patents to Nernst, 623,811, 685,725, and 685,732; Potter, 685,486; and Van Vleck, 644,784.

The second is the mercury-vapor lamp, which comprises a tube of considerable length caused to glow by conduction of low-tension currents through rarefied pure mercury vapor contained therein. The entire mercury column gives off an intense and soft glowing light. The candlepower is great compared with the amount of current used. The patents for this invention, of which Hewitt, 682,690, is illustrative, constitute a new sub-class of lights—incandescent vapor conductors.

The third is the perfected McFarlan Moore vacuum lamp having no inleading wires, the energy being transferred from condenser surfaces on the ends of the tube to the extremely rarefied gas inside the same by electrostatic action. These lamps have been constructed in lengths of over 100 feet and have been made so as to be operated by commercial frequencies commonly employed for lighting purposes. See patents to McFarlan Moore, 702,315, 702,319, 702,320, and 702,321.

The fourth is the Bremer arc lamp, wherein the carbons approach each other at an acute angle. The principal feature of the light is the addition to the composition of the arc pencil of a large percentage of the salts of the alkaline metals. Such additions were known to increase greatly the efficiency of the light, but involved in practice great unsteadiness. Bremer discovered that the flickering caused by the addition of a desired amount of alkaline salts, instead of being made worse, is actually cured by still further increase in the proportion of such substance. See patents 658,423, 679,877, 679,878, 684,407, and 697,439.

Electric lighting of railroad trains by power derived from the motion of the train has been perfected to a point where it is entirely practical in particulars illustrated by Preston, 602,182; Guillott, 672,877; Moskowitz, 684,083; Bohm, 688,382; and Creveling, 688,394, and reissue 11,961.

Location of Metals.

The patents to Brown, 645,910, and 672,309, cover an apparatus and method for testing out and plotting the relative resistances of large areas of earth surface for the purpose of determining the location of underground veins of mineral, streams of water, and buried treasure. The scientific substitute for the witch-hazel fork and the divining rod has been extensively and successfully used both for discovering mineral ores and for determining the boundaries of veins already discovered.

Motive Power.

In this class 2,031 patents have been issued. Prior to 1871 there was nothing done in relation to the use of alternating currents for purposes of motive power. The growth of this art may be illustrated in the consecutive order of patents, as follows: Thomson, May 17, 1887, 363,186; Tesla, May 1, 1888, 381,968; Thomson & Wightman, March 19, 1889, 399,801; Zipernowsky & Deri, August 5, 1890, 433,758; Von Dolivo-Dobrowolsky, July 7, 1891, 455,683; Siemens, September 5, 1893, 504,630; Scott, June 5, 1894, 521,051; Hunting, February 20, 1894, 514,933.

Wireless transmission of electricity has been applied to the management of torpedo boats as presented in patents to Tesla, 613,809, November 8, 1898, and Fiske, 660,155, October 23, 1900.

A scheme for transmitting electric currents of different character (as continuous and alternating) over the same wire, is set forth in patent to Bedell, 647,741, April 17, 1900.

When two or more motors are employed they may be connected in series, in parallel, or in any relation of series and parallel. A simple scheme for this transition is shown in Knight, 587,442, August 3, 1897.

In the manufacture of insulators for high-tension currents, it has been found desirable to make them in sections, which are secured together by means of a fusible glaze. Patent to Boch, 600,475, March 8, 1898, shows one mode of making these insulators.

In starting electric motors from rest, it is desirable to apply an excess of power at first and diminish the power gradually as the motor acquires speed. One means for accomplishing this is shown in patent to Burke, 611,558, September 27, 1898.

The following patents are cited as illustrations of the growth of the art of operating elevators by electric power: A hydraulic elevator electrically controlled was patented by Smith, September 3, 1889, 410,212. Elevators in which the electric motor is carried on the car, with connected gearing engaging rack bars in shaft, was patented by Sheridan & Gorn, 259,593, June 13, 1882, and Blades & McKee, 462,527, November 3, 1891. Elevators having motor stationary and automatically controlled by switch mechanisms on car or landings, are shown in patents to Wheeler, 324,621, August 18, 1885, and Eickemeyer, 454,462, June 23, 1891. Safety devices to break motor circuit when elevator door is opened are shown in the patent to Ongley, 389,853, September 18, 1888.

The application of electricity to agricultural apparatus is set forth in Schimpf, 582,237, May 11, 1897, and Foerster, 610,350, September 6, 1898.

It has been found advisable to charge different rates for electric service at different periods of the day. To facilitate this, electric meters have been organized to give different readings in accordance with the rates of charge. Among these are Kapp, 595,985, January 25, 1898, and Cox, 585,257, June 29, 1897.

It is important to know the maximum of electric consumption during any given period. This is shown by Hoyt, 600,265, March 8, 1898.

A galvanometer having two indexes and scales for volts and amperes, respectively, has been patented by Weston, 600,981, March 22, 1898.

Under this general class 292 patents have been issued pertaining to the transmission of electric power.

Electric Railways.

In this class 2,947 patents have been issued. There was nothing in this art prior to 1871. Some of the most prominent features in the growth of the art are represented by the following patents:

1. This article is made up of portions of a report on "Patents in Relation to Manufactures" prepared by Mr. Ladd under the direction of S. N. D. North chief statistician for manufactures for the Twelfth Census, and published by the government as a census bulletin.

Overhead direct and return conductors with double trailing trolley, in the patent to Finney, January 2, 1883, 270,186; overhead conductor trailing trolley, ground return, in that to Finney, September 18, 1883, 285,353; overhead conductors, upward-pressed trolleys and double trolley, in that to Van Depoele, December 4, 1888, 394,038; overhead conductor with upward spring-pressed trolley broadly, in that to Van Depoele, January 19, 1892, 467,448; underground conductor with slotted conduit is shown in patent to Knight, September 23, 1884, 305,731; an underground conductor with contacts projecting above the surface of the ground is shown in that to Painter, June 23, 1885, 320,679; underground conductor, the circuit being closed by the action of a magnet carried by the car, in that to Wynne, January 7, 1890, 419,094; a railway system in which an alternating current is transformed to a direct current for driving the motor is shown in patent to Westinghouse, May 28, 1889, 404,139; a motor elastically mounted so as to be independent of the vibration of the car is represented by Field, April 10, 1888, 380,880; electric railways operated by polyphase currents are represented by Badt, January 10, 1893, 489,597.

For electric railways operated partly by overhead and partly by underground supply, King & Babendrier have several patents relating to the automatic removal from the conduit of the underground collector. One of these is 623,248, April 18, 1899.

To secure a satisfactory bond between the rails of electric railways, Daniels applies the heads to these bonds by hot pressure to secure a practically integral joint (see patent 582,849, May 18, 1899), and McTighe employs cold pressure of sufficient force to form a cold weld (see patent 650,861, June 5, 1900).

Attention has been directed to the prevention of collisions. Patent to Cooley, 573,645, December 22, 1896, shows means for depriving a following train or car of its propelling current, so that it cannot approach within a determined distance of the preceding car or train. Bentley, 658,336, September 25, 1900, illustrates means whereby the sections of a road are under the control of a signalman, who can cut out any section and stop a car at any point. Phillips, 631,491, August 22, 1899, provides for depriving a car of current on approaching an open drawbridge.

Westinghouse, 645,613, March 20, 1900, locates a gas-generating plant at some convenient point, from which he supplies gas for running engines at the different divisions of his road. These engines drive dynamos for supplying each its own division. Signaling and controlling devices are provided for the management of the local engines, which are started before a car enters the division. Somewhat in analogy to this is Heilmann, 622,466, April 4, 1899, in which there are local generators for the different sections driven by an electric current from a central source of power.

To provide additional power at high grades, Henry, 560,265, May 19, 1896, has two generators of, say, 400 and 600 volts, respectively. By a proper system of circuiting, these generators will deliver either 400, 600, or 1,000 volts, as occasion may require. Another mode of effecting the same purpose is to provide a propelling motor of somewhat more than sufficient capacity than is required for average work, using the excess of power when the requirements are the least for charging storage cells, from which additional power is drawn when required. An example of this plan is shown in Munson, 653,200, July 3, 1900.

Devices for the prevention of electrolysis of water and gas pipes by the vagrant currents from railway circuits are found in Kapp, 570,599, November 3, 1896; Jackson, 622,481, April 4, 1899; and Blake, 661,165, November 6, 1900.

In the operation of electric railways, trains may be made up of a number of cars, any number of which may be provided with apparatus for controlling the several motor equipments. See Sprague, 660,065, October 16, 1900; Rice, 608,301, August 2, 1898; and Entz, 619,287, February 14, 1899.

[*To be continued.*]

Elevated Roads Proposed in St. Louis.

The City Council of St. Louis is at present involved in solving a question of franchises to two different organizations desiring to build elevated railways through the city. The bills asking the franchises have been submitted to the council, and the point at issue is whether to allow the companies to erect the elevated structure over streets or to force them to build their roads over alleys. One bill was submitted by Charles Green, representing the Park Elevated Railway Company, and the other was submited by Charles Erb. The routes to be followed have not been made public.

The seventh session of the International Railway Congress will be held in Washington, D. C., in May, 1905. The section on electric traction will discuss the progress made on important electrical lines, the use of continuous current, alternating current, single and polyphase, experiments with high-tension currents, etc. The reporter for America will be W. D. Young, electrical engineer of the Baltimore and Ohio Railroad Company, Baltimore, Md. There will be three foreign reporters for this section, one for France, one for Great Britain and Belgium, and one for other countries.

CORRESPONDENCE.

New York Notes.

New York, September 6.—The anticipated settlement between the Board of Aldermen and the Pennsylvania Railroad Company in relation to the tunnel franchise is not forthcoming. On September 3d a joint meeting of the railroad directors and city committees was called and the tunnel franchise, which had been laid on the shelf during the vacation of the city officials, was taken up. The public looked forward to a settlement of the existing difficulties and the granting of the franchise, but its hopes were not to be realized. It will be remembered that the points at issue when the franchise was last discussed were concerning the "prevailing rate of wages" and the "eight-hour day." Both of these points are insisted on by the city officials, and the railroad company says it will not accept a franchise embodying them. The present outlook is bad for any immediate settlement, as both sides seem firm.

The Park Avenue tunnel is also attracting attention. The New York Central and Hudson River Railroad Company has petitioned the local board of the Murray Hill district of local improvements, in the Borough of Manhattan, asking it to start proceedings having for their object the changing of Park Avenue between Forty-fourth and Fifty-sixth Streets so as to permit the use of the present street by the company in connection with its proposed change of motive power and other tunnel improvements. The petition was accompanied by a letter from President Newman of the railroad company to the effect that it was understood distinctly that the improvements are to be effected without cost or expense to the city, and that it was the object of the railroad company to acquire title, by proper proceedings, to the discontinued portions of Park Avenue and intersecting streets. The railroad company proposes to vest in the city the titles to the land to be acquired for the new Park Avenue, and to bear all the expenses of opening, regulating, grading and paving the same. For the discontinued portions of the street the railroad is to pay the city full cash value.

A direct east-side subway is the new problem now. Ever since the creation of the Rapid Transit Commission, there has been a strong demand for a direct east-side railway into the Bronx. This demand, formerly made by individuals, has now been presented to the commission by an organization of prominent Bronx citizens known as the Rapid Transit League. This league is probably the strongest body of residents and taxpayers ever brought together for such an object, representing, as it does, about 15,000 men and 15 separate and distinct organizations, all working with one end in view. Considering the fact that the Rapid Transit Commission has already placed itself on record as favoring the construction of an east-side route, and that Mayor Low, in his recent talk on railway facilities, expressed similar views, the league now demands that the Rapid Transit Commission go a step further than simply favoring such a route and order that work be started upon it at once. If the east side of Manhattan and the Borough of the Bronx were provided for in the work now under construction, the forming of a Rapid Transit League would in all probability not have occurred. It is because the present subway does not provide that for which there is immediate necessity that the taxpayers have united their forces.

Last week the Manhattan Railway Company discharged 110 machinists, and considerable comment was caused by the act. The reason given for the act was the change of motive power from steam to electricity.

Just at present the stock of the Manhattan Railway Company is in good demand on the market. The cause is believed to be anticipated gains resulting from the improvements being made in the system. Some $18,000,000 has been expended on the property and returns from this are looked for. Brooklyn Rapid Transit is also strong and is being bought in by people in close touch with the management of the company. It is said that the business of the company is in far better shape than it has ever been or is thought to be by the public.

A new departure in space telegraphy is to be launched in Babylon, L. I., shortly. A school is to be opened there in which applicants may receive full courses of instruction in the handling of all the prevalent systems. The station at Babylon is the first of a series to be established along the Atlantic coast, extending from Maine to Florida. The men to handle these stations will first be taught at the Babylon school. The establishment of the school is in anticipation of a probable demand by space-telegraph companies for a great number of skilled operators. At present it is said there are very few capable "wireless" operators in the country. In order for a man to be proficient in the handling of wireless-telegraph apparatus, a considerable knowledge of electricity is required as it is applied to this use, consequently there is a good field for the school. The course of instruction for one familiar with the Morse key and alphabet will be about three weeks.

The New York Electric Headlight and Train Lighting Company of Yonkers has been incorporated with a capital of $1,000. H. D. Crippen is interested.

O.

New England News.

Boston, September 6.—Coleman Brothers of this city have been awarded the contract for building the first section of the new power transmission subway at the Charlestown navy yard. This section will be 1,500 feet long and the inside dimensions will be six feet by six feet. The contract price is $34,500. This is the result of the Navy Department's second call for bids. The first call brought only one bid, the tender being $55,000, or nearly double the estimated cost.

The Holden and Worcester Street Railway Company has let the contract of building its electric railway between Worcester and Jefferson, Mass., via Holden, a distance of some 10 miles. It is estimated that the road will cost $200,000. Boston men are planning to build a power house at Barre Falls, about 10 miles from Worcester, and the company will obtain its power from there. A dam 30 feet high will be built in the Ware River, and water will be carried through a steel penstock for 300 or 400 feet, until a fall of 70 feet is obtained.

The American Insulated Wire and Cable Company has leased the factory in Stamford, Conn., formerly occupied by the International Power Vehicle Company. The lease is for three years and the factory will be used for the manufacture of insulated wire and cable. Fifty persons will be employed.

The Norwell and Scituate Street Railway Company has been organized. It will have a capital of $150,000 and it proposes to build an electric railway between the terminus of the Old Colony street railway at Assinippi and Cohasset, Mass., a distance of 15 miles.

B.

Southern Developments.

Charlotte, N. C., September 6.—Roane County capitalists contemplate the building of an electric railway from Harriman, Tenn., to Rockwood and Kingston, also to Knoxville, by way of several intermediate points.

Articles of incorporation have been filed by the Salem (Ark.) and Eastern Railway Company. An electric freight and passenger line from Salem, Fulton County, to Mammoth Springs is proposed. The distance is 12 miles. R. A. Youngblood is president of the company, and Sheriff H. F. Northcutt, secretary.

The steamer Atlanta, built by W. E. Cole for the purpose of catching fish by electricity has proven a complete failure. The cost of the boat was $10,000. The plan was to attract fish by powerful electric lights and then to scoop them in.

The electric power plants of Portsmouth, Va., will be consolidated by the new management, the Williams Syndicate, and a big power house will be erected.

The Charlestown and Berryville Electric Railway Company has been organized at Charlestown, W. Va., to build an electric line from that city to Winchester, Va. Geo. Eyster, president of the Charlestown Gas, Light and Water Company, was elected president of the new company.

A new electric and steam railway, from Nashville, Tenn., to McMinnville, will be built. The new road, it is said, will be under the management of W. S. McKittrick, a Chicago railroad contractor. The cost will be over $750,000. The road will be 73 miles long and will pass through several prominent towns. Northern capital will operate the line, a survey for which has already been completed.

The lighting committee of the Memphis, Tenn., Council has agreed upon a plan permitting a merger of the Memphis Light and Power Company and the Equitable Gaslight Company. The ordinance, if adopted, will not, however, give exclusive rights for heating, lighting or power.

Negotiations for purchasing the Natchez (Miss.) Gas Light Company's plant have been on for some weeks. The object sought is a combination of all the electric light and street railway plants. The Light Power and Transit Company has recently sold out to the Electric Street Railway and Power Company for $75,000.

Dr. L. M. Able of St. Matthews, S. C., is installing an electric plant for lighting stores. Eventually, it is said, the town will be lighted by electricity.

Bids will be received until September 15th, at 3:30 p. m., for electrical fixtures for various offices in the new city building of Jacksonville, Fla., now being constructed. W. C. West is recording secretary of the board of public works.

L.

From the Buckeye State.

Cleveland, September 6.—It has been reported that Senator Hanna of Cleveland declared in favor of perpetual franchises for street railways in the new code bill which is now before the Legislature, and that Senator Foraker afterward sanctioned the idea, but now Senator Hanna has volunteered the statement that he did not declare in favor of any particular limit, but only said to another gentleman that he would be satisfied with an amendment of that kind. He further says that he is satisfied with the franchise portion of the code as it was presented in the original draft of the bill.

It has been reported that the Grand Trunk Railway Company has purchased the Detroit and Toledo Shore Line of the Everett-Moore syndicate and that it will be transformed into a steam line, but later on the report was denied. Members of the syndicate say that while the deal has not been actually com-

pleted, negotiations are under way for the property. The thing that stands in the way is the price, and until that is adjusted there will be no sale. The construction of the road so far has cost about $1,600,000, and the Grand Trunk has offered $1,400,000, which will hardly be accepted, as it is an excellent piece of property and is worth all it has cost.

George Dennison of the firm of Dennison, Prior & Co., Cleveland, and W. H. Park of Youngstown met the other promoters of the Havana street-railway system at the Hollenden Hotel, Cleveland, this week and made a report of their investigations as to the advisability of constructing the roads. The report was very favorable, and embodied not only their ideas of city lines, but lines across the island of Cuba, from Havana to Baraboa, on the south shore, and Sand Beach, which is only a short distance away. After hearing the reports, the gentlemen interested decided to go ahead with the construction of the roads, and work will probably be commenced within two or three weeks, with the idea of completing it by spring. The rights-of-way have been secured in the city and also for the cross-country lines. George F. Penhale of New York is interested with Mr. Park and Dennison, Prior & Co. in the proposed roads. A company has been incorporated, under the laws of Delaware, with a capital stock of $1,000,000 to build the roads.

The East Columbus Heating and Lighting Company of Columbus has selected a site at the corner of Mound and Seventeenth Streets for the plant it proposes to construct. The company has been granted a franchise to operate by the City Council.

The City Council of Canton has rejected W. H. Boyd's application for a franchise to operate a trolley system without fares, as well as all other bids, as they are considered irregular. It is believed by some that Mr. Boyd represents the Canton-Akron lines and that it was his object to keep the Alliance road out of the town.

The Bullock Electric Manufacturing Company of Cincinnati has been awarded the contract for furnishing all the electrical machinery for the battleship New Jersey and the cruiser Des Moines, the entire amount involved being something more than $100,000.

A resolution has been introduced in the council of Newport, Ky., to set aside next year $10,000 for the purpose of erecting an electric and gas plant and that the same amount shall be set aside each year until 1906. It provides that the plant shall be completed before March 1, 1906. A resolution directing the city engineer to advertise for bids for furnishing lights for the city has reached a second reading, but has been blocked for some reason.

A plan has been completed and accepted by the Cleveland banks for refinancing the Lake Shore Electric Railway Company. It was submitted to the banks forming the bond syndicate by the American Trust Company Tuesday, and later in the day representatives of all the banks interested met at the office of Henry A. Everett and the matter was discussed. The road will be taken out of the hands of the receiver within a short time and plans will be made to complete it and put it in good condition.

The Columbus, Marion, Tiffin and Toledo Electric Railway Company has filed notice with the secretary of state that the southern terminus of the road has been changed from Marion to Urbana, and that it will be extended through Marion, Delaware, Logan and Champaign Counties. O. M. C.

Information from Indiana.

Indianapolis, September 8.—The Fort Wayne Northern Railway Company has filed articles of incorporation with the secretary of state. The purpose of the company is to construct and operate an electric railway between Fort Wayne, Garrott, Auburn, Waterloo and Kendallville, and electric-light plants in towns along the line. The capital of $10,000 will be increased. Beeks Erick heads the board of directors.

An electric railway is projected to connect Louisville with Indianapolis. A company is being organized at Seymour, but Louisville capitalists are behind the scheme. The commissioners of Bartholomew County have granted rights-of-way and franchises to Morton Hall and others to build, maintain and operate an interurban from Columbus across the county to Seymour, Brownstown, Salem, West Baden and French Lick. Franchises have been granted other persons across Scott, Jackson, Washington and Orange Counties. These various persons will meet in Seymour this week to organize the company. The road, which is to be built as soon as possible, is to connect with the Indianapolis and Greenwood line at Columbus, making a line from Indianapolis to Louisville through West Baden, a distance of 163 miles.

A meeting of the promoters of the trunk line between Indianapolis and Cincinnati was held last week and the franchises granted to the promoters at Rushville and other cities were extended to January 1st. The progress of this enterprise has been retarded by the serious illness of J. K. Schouepf of Cincinnati, who has been representing the Widener-Elkins syndicate in the negotiations. The plan is to build from Hamilton, Ohio, through Liberty, Connersville, Rushville and Morristown to Indianapolis.

Construction work on several interurban lines in this vicinity made great progress last weel. Work began on the new Lima-Fort Wayne interurban at New Haven, on the Indianapolis Northern at Carmel and the Indianapolis-Greenwood extension at Edinburg. The Plainfield, the Martinsville and the Union Traction Company's Elwood-Tipton line are putting on the finishing touches.

The Fort Wayne and Southwestern Traction Company announces that it will build a line from Wabash to Marion, through Van Buren, thus completing the traction lines from Indianapolis to Fort Wayne by connecting with the Union Traction Company's line. Franchises are being secured for the proposed line.

The proposed extension of the Union Traction lines between Muncie and Alexandria will be begun next Monday, and will result in shortening the distance to 17 miles. The work will be done by Lamonte & Green of Anderson. The line, when completed, will form the connecting link between the extreme eastern terminal of the present Union Traction line and the new Indianapolis Northern at Tipton. It will parallel the Lake Erie and Western steam railroad through the gas belt.

The Muncie, Hartford City and Fort Wayne Traction Company completed its line from Eaton to Muncie last week. The poles are up and the wiring is progressing rapidly, as is also the building of the bridge over White River. Montpelier will be reached in two weeks.

The Town Council of Albany granted a 99-year franchise to the Muncie and Portland Traction Company in the principal street last week. This completes the right-of-way the entire distance.

Senator A. D. Ogburn holds a franchise for an electric line from Newcastle to Dunreith, and a visit to St. Louis last week is said to have made the building of the line a surety. The line, when built, will connect with the Greenfield and Richmond line, connecting Newcastle with both Richmond and Indianapolis.

The freight business on the interurban lines is increasing rapidly. The Greenfield and the Greenwood lines improved their freight service by adding a new freight car on each line, while the Union Traction Company has put on four new and additional freight cars between Indianapolis and the gas belt.

The Indiana Tax Board concluded its work last week. The board valued the electric railways in the state in 1901 at $7,746,452 and in 1902 at $9,639,312, making an increase of $1,892,860. This is exclusive of real estate, power houses, etc., simply on the mileage, right-of-way and rolling stock.

The Goshen Council has granted a 50-year franchise to the Hawkes Electric Company to operate an electric-light plant in Goshen. This brings the private concern to a position that is considered an advantage over the plant owned by the municipality, and may mean the absorption of the city plant by the Hawkes concern, as it is not on a paying basis and has long since been the subject of political discussion.

The electric-light commissioners of Richmond, in charge of the municipal plant, have notified the city that it will be charged for service the same as a private consumer, the rate being $75 a year for each arc light. The commissioners say that if the plant is to be placed on a money-making basis at the start the city should be in the same attitude toward it as a private patron. It has been the understanding that the city lights would be free. F.

Northwestern Notations.

Minneapolis, September 6.—It is understood that work is soon to be begun for the construction of an electric-railway line from Dubuque, Ia., to Cascade, thence south to Vinton and other points. A stock company is to be formed and it is understood that a franchise held by a company which is unlikely to build, will be secured for the new company to operate under.

The People's Gas and Electric Company of Burlington, Ia., has received wire for the new light system and trolley wires for the street-car system. New rails are also being received. Work will be begun at once to rebuild the entire system. New machinery is likewise to be installed for the power house.

Every telegraph, telephone and electrical company of St. Paul has had formal notice served by the city engineer that all wires and poles must be removed from the underground district. Ample time will be given and if they are not removed by the owners, the engineer's department will do so.

The Seattle Electric Company has asked the city of Seattle, Wash., that its assessment on personal property be cut in half. The company contends that $2,554,400 is altogether too much for its personal property and says it is willing to stand an increase over last year of over half a million dollars.

The Mankato (Minn.) Gas and Electric Light Company put a new schedule of prices for lighting and power into effect September 1st. The old price was 15 cents per thousand watts, with a discount of five to 15 per cent. The new rate is 12 cents per thousand with discounts of five to 25 per cent. The officials of the company claim that under the reduced prices, the city will enjoy the cheapest rates of any city in the state.

The Electrical Equipment Company of Chicago secured the contract to furnish a complete electric-light plant for the city of Washington, Ia., at $12,510.

Railway telegraphers on the railroads of the Northwest are quietly forming unions, preparatory to making demands for higher wages. A general convention is soon to be held in the Twin Cities, with that end in view.

Ulen, Minn., voted to establish a municipal electric-light plant.

J. M. Kirschbaum of St. Paul is now electrician in charge of the city lighting plant at Aitkin, Minn.

Eastern capitalists have made a proposition to the council of Grand Forks, N. D., for an automobile street-railway service for a year, to be succeeded by a regular street-railway system. The auto-coaches are to be operated by either gasoline motors or electric storage batteries. When the rails are laid, by changing the wheels the same coaches can be used. This will do away with any overhead wires. R.

Among the Rockies.

Salt Lake City, September 5.—The Three Forks Mining and Milling Company of Rawlins, Wyo., has a good silver and lead property just 60 feet north of the Colorado line. A fine stream—the North Fork of the Snake River—runs through the property. Here a large electric plant could be installed capable of running all the hoists of a busy camp, and it is reported that a plant which will prove adequate for all requirements is in contemplation by this company.

Pocatello, sometimes called the Gate City of Idaho, is the scene of a Democratic rally this week, and the principal feature of the demonstration is the electrical illuminations. A network of lights was stretched from the electric-light company's office to the railroad property at Harrison Avenue and east to the Pocatello House. There are several designs, including a large multi-colored "American Falls Power" sign and a large colored elk's head over the entrance to the Elk's Club. On the east side is suspended a sign with waving lights, spelling out the words, "Pocatello, the Gate City." A hand with disappearing colored lights points the way to the Democratic headquarters. The power is furnished from American Falls, 25 miles away from the city.

J. E. Durkee, president of the Consolidated Mines Company, operating in Hawthorne, Nevada, says his company will put $750,000 into a mill, cyanide plant, waterworks and electric plant in Tonopah mines, the work to commence immediately. This may turn out to be the largest electric enterprise ever installed in Nevada. G.

On the Pacific Slope.

San Francisco, September 2.—C. R. Ray, Gold Hill, Ore., has begun construction work on his electric-light and power plant on Rogue River, near Gold Hill. A dam, 419 feet in length and 27 feet high, is now being constructed. It is of timber crib, rock-filled construction. The hydraulic development of the plant will amount to 3,000 horsepower. Although the first generator installed will have a capacity of only 200 kilowatts, it will be a three-phase machine, generating about 2,300 volts. The head of water available at the dam is 20 feet. A five-mile transmission line from the plant to Gold Hill and a two-mile branch to the Perry and other mining properties will be built. A number of induction motors will be operated in the various mines of the district. Bids were received some time ago for electric apparatus. The Engineering Offices, 331 Pine Street, San Francisco, are consulting engineers.

The Redondo Electric Railway Company, Los Angeles, Cal., has let contracts for two new power houses, one to be situated at Hyde Park, and the other at Belvidere. The Redondo Electric Railway Company is now engaged in the work of converting the old steam line into an electric line. The first electric cars are to be run about December 1st.

The United Gas and Electric Company, which controls the distribution of the Standard Electric Company's power in the counties south of San Francisco, has cut its rates for electric current for lighting from 17½ cents to 10 cents a kilowatt-hour, to meet the rate now charged by the Palo Alto Town Electric Company. The company has offered to supply the city authorities of Palo Alto with electric power at 2½ cents a kilowatt-hour on a yearly contract. The town of Palo Alto is considering a $12,000 bond issue for the purpose of extending its lighting plant. Messrs. Poole, Crocker and Green, who are largely interested in the United Gas and Electric Company, have secured the control of the San Jose and Santa Clara Railway Company. It is given out that the new owners will construct an electric road on Market Street, San Jose, as a feeder to the present line.

City Engineer Thompson of Seattle, Wash., has returned to that city, after a thorough inspection of the work now in progress at the new municipal lighting and power plant on Cedar River. Mr. Thompson estimates that it will take until the middle of October to complete the preliminary work at the power site.

A directors' meeting of the newly incorporated Cloverdale Light and Power Company was held in this city a few days ago. The following-named officers were elected: President, A. Sbarboro; vice-president, P. C. Rossi; treasurer, A. E. Sbarboro. A. E. Sbarboro has been working for many months obtaining franchises, rights-of-way, and surveys, and has given these to the company without consideration. At the directors' meeting it was ordered that bids be advertised for for the building

of a dam on Sulphur Creek, for the construction of a flume with requisite machinery, and for the necessary poles and wires.

A number of seniors in the College of Mechanics at the University of California met at Berkeley on August 26th and organized an association of electrical and mechanical engineers. Bi-weekly sessions will be held, at which the students will discuss engineering topics or listen to outside speakers of note. At intervals the members will make tours of inspection to mechanical and electrical plants. On Thursday evening, September 25th, a banquet will be held in San Francisco, on which occasion members of the junior class will be initiated in the association. The officers of the organization are: President, Robert Sibley; vice-president, A. J. Turner; secretary, H. Phillips; treasurer, C. C. Murray; and F. Schwabacher and F. D. Lord, executive committee.

The Western Electric Machine Company has been incorporated to engage in business at Los Angeles, Cal. The directors of the company are M. P. Waite, L. C. Waite, W. H. Olmstead and C. E. Waite. The capital stock of the company is $50,000, of which amount $100 has been subscribed.

The Tonopah Light and Power Company has been incorporated for the purpose of constructing and operating an electric power plant in the Tonopah mining district in Nevada. The company has an authorized capital stock of $50,000, of which $500 has been subscribed. The directors are W. C. Watson, C. W. Waller, J. L. Joseph, E. S. Watson and C. E. Elliott. The principal office of the company will be in San Francisco.

The Lytle Creek Power Company filed articles of incorporation with the secretary of state on August 21st. The company has a capital stock of $300,000 and purposes to construct a power plant on Lytle Creek, near San Bernardino, Cal. The directors of the company are H. T. Hayes, S. B. Wright, C. L. Allison, J. L. Campbell and W. H. Miller. The principal office of the company will be in San Bernardino. A.

Seattle, Wash., September 4.—The Seattle Electric Company has taken preliminary steps toward the building of a car line to West Seattle, which lies on the opposite side of Elliot Bay from the city proper. Application was made to the City Council last night for the franchise.

The Yakima Valley Central Railway Company has filed with the county auditor of Yakima County articles of incorporation to form a company for the purpose of building an electric railway from North Yakima to Sunnyside, and to connect other points with the former city. It is expected that the company will begin actual work on construction by December 1st.

The Ballard City Council has passed a resolution declaring in favor of building a new $25,000 electric-light plant. The clerk has been instructed to advertise 10r bids.

The engineers engaged in placing the new underground conduits for the Seattle Electric Company are making good progress. The ducts have been laid on Post Street, between the power house and Columbia Street, and yesterday the work of installing ducts on Post Street, south of Yesler Way, commenced. Within a few days the company will apply to the board for permits to work along First and Second Avenues, Pike Street and Yesler Way.

The Interurban Company has about completed a list of its stations between Seattle and Tacoma. There are 19 stations along the 34 miles of track The track crossings have all been completed, and the Seattle Electric Company's machine shops are still kept busy finishing up an order of 190 whistle posts and two dozen station signs. L. E. C.

PERSONAL.

Arthur T. McElhiney, aged 58, who was the first telegraph operator in Bloomington, Ill., and for over 20 years agent for the Western Union Telegraph Company there, and later with the Postal company, died on September 5th, in Bloomington.

In connection with the centenary of the birth of Niels Henrik Abel, the Norwegian mathematician, which began at Christiania, Norway, on September 4th, honorary degrees of doctor of mathematics were conferred on twenty-nine foreign scientists, including Prof. Simon Newcomb of Johns Hopkins University, Prof. J. W. Gibbs of Yale University, and Lords Kelvin and Rayleigh.

Eugene N. Foss, the owner of the Norfolk (Mass.) and Suburban Street Railway Company previous to its absorption by the Massachusetts Electric Companies and a director of the latter corporation, has announced his intention of attempting to secure the Republican nomination in the Eleventh Massachusetts Congressional District. Mr. Foss is also principal stockholder of the B. F. Sturtevant Company, manufacturer of the Sturtevant blower, the Boston Blower Company, and the Detroit Blower Company, a director of the Manhattan Railway Company of New York, the Union Stock Yard Company of Chicago and several railroad companies.

ELECTRIC LIGHTING.

Colby, Wis., is to build an electric-light plant.

The Cape May (N. J.) Light and Power Company has been incorporated with a capital of $150,000.

E. C. Brainard of Chicago is among the incorporators.

The Pontiac (Ill.) Water and Light Company is building a new power house.

Castile, N. Y., has voted to issue $10,500 in bonds, the amount derived to be used in the erection of an electric-light plant.

The Berlin (Wis.) Lighting, Heating and Power Company certifies to an increase of capital stock from $65,000 to $100,000.

E. S. Harrison of Winnipeg, Man., has asked for a franchise in Carberry, Man., allowing him to build and operate an electric-light plant in that place.

Somerset, Ky., contemplates building an electric-light plant, but would rather sell a franchise and buy light. Mayor F. S. Griffin may be addressed.

The Minneapolis (Minn.) General Electric Company is going to build a brick addition to its plant and make extensive improvements. Eighteen thousand dollars will be expended by the company.

The Mystic Electric and Gas Light Company of Stonington, Conn., increased its rates on September 1st. The rate is advanced from 12 to 15 cents per kilowatt-hour, owing to the increased cost of coal.

It is reported that Chicago capitalists have become the owners of street railway, gas, light and power properties in Centralia, Ill. The idea reported is to affect a combination of the properties and operate them under one management.

The University of Illinois has taken advantage of the recent revision of the National Electrical Code of the Fire Underwriters permitting the use of 500-volt distribution within buildings by installing a 440-volt plant (220-volt lamps) for the lighting of the five new buildings at Champaign. Two phase alternating current will be used, and each phase will be treated as a single-phase circuit operated on the three-wire system, the neutral wire being supplied with current from an auto-transformer. The exhaust from the steam-engine plant operating the generators is to be used in heating the buildings. The generating station contains two belted two-phase generators, one of 50 kilowatts and one of 75 kilowatts, operated at 440 volts, to which will shortly be added an engine-type, revolving-field, 120-kilowatt Westinghouse alternator.

ELECTRIC RAILWAYS.

An electric railway is to be built between Winona and Warsaw, Ind. The road is to be in operation by winter.

The interurban electric railway, which is being built from Green Bay, Wis., to Duck Creek, and is owned by the Fox River Electric Street Railway Company, is nearing completion. The road will be in operation, it is said, within a few days.

Secretary Charles M. Lux of the Rochester, Syracuse and Eastern railroad (trolley) has announced that the capital stock of the company will at once be increased from $3,500,000 to $5,000,000. The company intends to build a branch from Clyde or Lyons to Sodus Bay.

A project is now on foot to build an electric railway from Negaunee to Marquette, both in the upper peninsula of Michigan. William K. Rhodes of Cleveland, Ohio, is interested. The power for the road will be derived from Dead River Falls, four miles northeast of Negaunee.

The Lafayette (Ind.) railway strike and boycott has been settled through an arbitration committee. The trouble was started through the discharge of a number of employes by the railway company. The men discharged were not taken back by the company, as the arbitration committee found that their discharge was merited.

The Allis-Chalmers Company has recently sold to the Milwaukee Electrical Railway and Light Company two vertical cross-compound, direct-coupled engines, having cylinders 28 and 60 inches in diameter, with 48-inch stroke. It has also sold to The New Orleans Railways engines of similar type, but larger, having cylinders 38 and 80 inches in diameter, with 60-inch stroke.

POWER TRANSMISSION.

The Oregon Electric Power Company will have its plant on Eagle Creek, in eastern Oregon, completed by April 1, 1903. The plant will develop about 5,000 horsepower.

The Red Boy Gold Mining Company of eastern Oregon has commenced work on the development of the waterpower of Olive Lake, situated near its mines in Grant County, Oregon, and a short distance from Baker City. Electric power will be developed and used to operate the company's mines.

An American company is said to have obtained a contract for the construction of a large hydro-electric power plant to be built on Mount Cenis Lake, Italy. Electric power is to be transmitted over a distance of about 40 miles to the city of Turin, Italy. The capacity of the plant will be about 5,000 horsepower.

While the Atlanta Electric Company has been awaiting a grant of power from the Atlanta (Ga.) council, the Atlanta Waterpower and Electric Company has been building a dam on the Chattahoochee River, six miles above the proposed site of the first-named company, which was also to be on this river. Both companies are attempting to deliver power to Atlanta, and each is taking its own way of accomplishing this end.

SOCIETIES AND SCHOOLS.

On August 29th two new buildings of the Michigan College of Mines at Houghton were dedicated. One is devoted to chemistry, and the dedicatory speech was delivered by Prof. Edward Ortem, Jr., dean of the College of Engineering of the Ohio State University, at Columbus. The other is a mining engineering building, and was dedicated by Prof. Calvin M. Woodward, dean of the College of Engineers of Washington University, at St. Louis, Mo.

PUBLICATIONS.

Recent publications issued by the Fort Wayne Electric Works of Fort Wayne, Ind., include bulletins describing their direct-current belted generators and motors of LB and MPL types, a bulletin descriptive of the firm's single-phase type WAL generators, a circular setting forth the merits of the Wood cut-out for arc circuits, and a September calendar card bearing a reproduction of a Wood automatic motor-starter. The Fort Wayne Works also issue a testimonial letter with photographic reproduction of one of its 30-light, type-A oil transformers, which was struck by lightning and not damaged beyond blowing the fuse and bursting the cast-iron cover.

A handsome set of bulletins has recently been issued by the Bullock Electric Manufacturing Company of Cincinnati, Ohio. One of them contains 32 pages and describes the Bullock type-N motors. Illustrations are given of the completed motors and various parts, and several shop and factory views illustrate a variety of applications of the motors to machine tools, etc. The company's marine-lighting and power sets are described in another bulletin and several pictures are given of yachts and steamships equipped with these sets. Two other Bullock bulletins are descriptive and illustrative of the company's direct-current multipolar type-H and H-I generators and type-H motors.

MISCELLANEOUS.

The International Brotherhood of Electrical Workers of Chicago has adopted resolutions indorsing municipal ownership and declaring themselves in favor of all candidates indorsed by the Public Ownership League. This move is looked upon as one of some importance politically.

Wireless telegraphy, as at present installed, was not as great a success in the recent naval maneuvers as was anticipated. Important information was obtained, however, in relation to the merits of different systems, which will materially aid the Navy Department in the selection of a system. Searchlights proved of great assistance in the coast defense.

Professor John Trowbridge of Harvard University has recently made a series of experiments tending to prove that lightning never strikes the surface of the ocean. His purpose was to volatilize water by electricity in order to obtain a strong spectrum of water vapor. He found that the sparks which he employed always refused to strike the surface of the water, and passed, instead, to the edges of the containing vessel. He employed a discharge of high-tension sparks, and drew the sparks from as great a distance as possible.

TRADE NEWS.

The Elliott Brothers' Electric Company of Cleveland, Ohio, has been incorporated with a capital of $25,000. The incorporators are J. E. Elliott and others.

The General Electric and Repair Company of Chicago certifies to a change of name to the Peerless Electrical Company and also to an increase of capital stock from $2,400 to $15,000.

The La Borteaux Compressed Air Electrical Company of Pierre, S. D., has been incorporated with a capital of $100,000. The incorporators are F. M. La Borteaux, John Schatzman and T. P. Estes.

The Mayer Engineering Company, 1561 Monadnock Building, Chicago, has been appointed agent for the Chicago pay-station apparatus, Eldredge battery voltmeter and O. S. Walker & Co.'s magnetic chucks.

The Electric Construction and Machinery Company, Davenport, Ia., has absorbed the Rock Island Electric Construction Company of Rock Island, Ill. The new company has been incorporated with a capital of $25,000. The incorporators are H. T. Schmidt of Davenport and J. T. Marron and W. H. Dickman of Rock Island. Hereafter the company will operate establishments in Davenport, Rock Island and Moline.

The Scientific Exchange of Chicago, which makes a specialty of supplying skilled electrical and mechanical workmen, has found it necessary to seek larger quarters, owing to the rapid increase in its

business. The company is now located in the Omaha Building, 134 Van Buren Street. Under the sole management of R. G. Wilson, it is entering upon what promises to be a very successful career.

Announcement has been made that Walter C. McKinlock has, by mutual consent, ceased to be a member of the Reliable Electrical Supply Company of Chicago. Otto Reeman and W. Irving Otis assume all liabilities and retain all assets of the company.

The Duncan Electric Manufacturing Company, Lafayette, Ind., is preparing to place on the market a line of new Duncan commutated meters for direct and alternating current. These meters are well designed and possess special features which are not found in other makes. The company has a well-equipped factory, containing the most modern tools and appliances for the manufacture of meters. The Duncan company expects to be able to fill a "long-felt want" in the meter line.

BUSINESS.

The Steam and Electrical Equipment Company of Pittsburg, Pa., reports the following sales for last week in the electrical line: One 190-kilowatt 60-cycle, two-phase Stanley alternator, 2,200 volts, to the Poughkeepsie (N. Y.) Light and Power Company, and one Babcock & Wilcox 108-horsepower steam boiler, to the Waynesburg (Pa.) Electric Company. The Steam and Electrical Equipment Company states that its business with electrical companies is very good and that inquiries are brisk.

Until October 31, 1902, second-class one-way colonist tickets will be sold by the Chicago, Milwaukee and St. Paul Railway from Chicago to all points in Montana, Idaho, Utah, California, Washington, Oregon, British Columbia and intermediate points at greatly reduced rates. The Chicago, Milwaukee and St. Paul Railway is the route of the United States Government fast mail trains between Chicago, St. Paul and Minneapolis, and of the Pioneer Limited, the famous train of the world. F. A. Miller of Chicago is the general passenger agent.

James S. Barron & Co., manufacturers of and wholesale dealers in general electrical supplies, of New York city, state that the following-named companies are using their Villard conduit rods: Manhattan (elevated) Railway Company, New York; Standard Underground Cable Company, Pittsburg, Pa.; Memphis Light and Power Company, Memphis, Tenn.; New York Telephone Company, New York; New York and New Jersey Telephone Company, Brooklyn, N. Y.; Chesapeake and Potomac Telephone Company, Washington, D. C., and Baltimore, Md.; Duchess County Telephone Company, Poughkeepsie, N. Y., etc.

The Gordon Battery Company of New York city, manufacturer of the well-known Gordon cell, reports an excellent trade. The battery is popular with telephone and gas-engine manufacturers, with whom the company's trade is steadily increasing. It is a well-known fact that several of the prominent railroad companies use Gordon cells exclusively for their signals. On account of its increasing business the Gordon company has had to enlarge, until at present it occupies the commodious premises at 439 to 445 East One-hundred-and-forty-fourth Street, New York, where it is well equipped with all necessary machinery to take orders of any magnitude and to make immediate shipment.

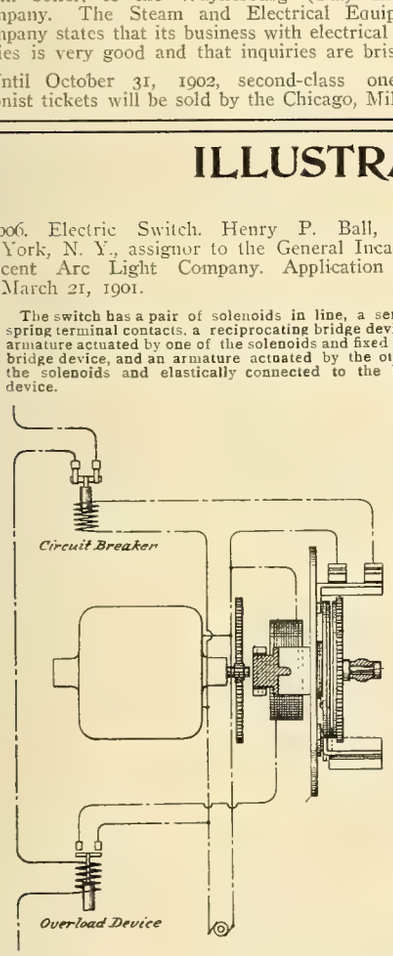
The Lindsley Brothers Company of Chicago and Menominee, Mich., has been a prominent factor in the development of the cedar-pole industry. This firm started with a small yard and supply store at Goll, Wis., and has gradually extended its business until now it has yards all over the best cedar-producing districts of Michigan and Northern Wisconsin, and general offices at 536 Tribune Building, Chicago. In 1899 the Lindsley Brothers Company took probably the largest contract ever let for long poles. It contracted with a Cleveland firm which was furnishing the Erie Telephone Company all its poles, to deliver 12,000 50-foot and longer poles. In order to secure this vast amount of material the company was obliged to establish yards in Idaho, and during that year it filled this immense order to the entire satisfaction of all concerned. In 1900 they organized the Lindsley Brothers Company and opened offices at Portland, Ore., and Spokane, Wash., where they have since built up an extensive and profitable trade and furnish nearly all the large telephone and telegraph companies of the west coast from Seattle, Wash., to the southwestern points of California, also in nearly every western and southwestern state. The western operations are under the direct supervision of C. P. Lindsley, whose headquarters are at Spokane, Wash. The Menominee end of the business is in charge of E. A. Lindsley, secretary and treasurer, while the Chicago office is under the direction of G. L. Lindsley, president of the company, and was opened for the purpose of looking after all the eastern business, for both Idaho and Michigan stock.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 2, 1902.

708,006. Electric Switch. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company. Application filed March 21, 1901.

The switch has a pair of solenoids in line, a series of spring terminal contacts, a reciprocating bridge device, an armature actuated by one of the solenoids and fixed to the bridge device, and an armature actuated by the other of the solenoids and elastically connected to the bridge device.



NO. 708,007.—TIME-LIMIT DEVICE FOR CIRCUIT-BREAKERS.

708,007. Time-limit Device for Circuit-breakers. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company. Application filed January 29, 1902.

The device is provided with a rotating member, a circuit-closing member, electroresponsive means for engaging the members upon the existence of an overload, means for returning the circuit-closing member to its original position upon the cessation of an overload, and means for limiting the degree of movement of the circuit-closing member. (See cut.)

708,008. Reverse-current Device for Circuit-breakers. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company. Application filed January 29, 1902.

A magnet with an armature comprising a fixed core and a pivoted oscillating coil and an auxiliary magnet are combined with means carried by the coil for closing a circuit through the auxiliary magnet when the direction of current through the first-named magnet is reversed.

708,016. Regulating Socket. Louis F. Bogia, Jr., Philadelphia, Pa. Application filed September 20, 1901.

In the socket are combined a frame of resistance material, comprising annular flanges connected by a hub of reduced diameter and forming an annular space, line terminals and local terminals connected to the frame, a resistance medium secured to the inner face of the frame at one side of the annular space, and a movable contact member mounted on the hub and arranged to contact with the resistance medium to vary the extent of the medium interposed between the line and local terminals.

708,024. Coupling for Electric Motors. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 15, 1901.

The coupling consists of a casing, a block of insulation, a metallic socket piece mounted therein and contact brushes screwed to the piece.

708,025. Rotary Transformer. Alexander Churchward, Chicago, Ill. Application filed June 12, 1899.

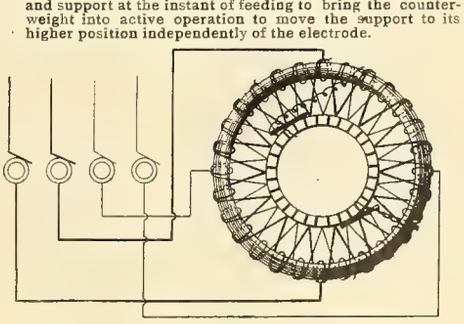
A rotary transformer for multiphase systems is described. It is provided with a number of armature windings corresponding in number to the number of phases in the system, a separate pair of collector rings connected with each winding, and a separate set of commutator bars connected with each winding, whereby the phases are maintained independent of each other. (See cut.)

708,026. Electric Controller. William H. Clarke, New York, N. Y. Application filed October 11, 1901.

An electric generator is operated by a fluid-pressure motor, and a reducing valve governs the admission of fluid pressure to the motor. An electromagnetic valve is connected with the generator with a rheostat in its field circuit. Another fluid-pressure motor is provided for the rheostat, and a port or passage is governed by the electromagnetic valve for admitting pressure to the rheostat motor and the reducing valve. (See cut.)

708,032. Electric Arc Lamp. Edgar A. Edwards, Cincinnati, Ohio. Application filed November 25, 1901.

In the lamp are combined a movable electrode, a movable support therefor, means for feeding the electrode downward independently of the support, a counterweight balancing the weight of the support and electrode, and means for releasing the connection between the electrode and support at the instant of feeding to bring the counterweight into active operation to move the support to its higher position independently of the electrode.



NO. 708,025.—ROTARY TRANSFORMER.

708,036. Mounting for Electric Heaters. Edward E. Gold, New York, N. Y. Application filed October 16, 1901.

Combined with a rotatable car seat are means for supporting a heater beneath the seat, and means for moving the heater to maintain it beneath the seat when the latter is moved.

708,048. Trolley Harp or Fork. Osro P. Johnson and Fred P. Crockett, Kalamazoo, Mich., assignors to the Star Brass Works, Kalamazoo, Mich. Application filed April 28, 1900.

In a contact device for trolley harps there are a spring forked at its upper end and a washer having suitable projections to engage between the forks of the spring to contact with a trolley wheel.

708,053. Apparatus for Distributing the Primary Current for Electric Ignition by Coils and Igniters in Explosive Engines. Arthur C. Krebs, Paris, France, assignor to Société Anonyme des Anciens Etablissements Panhard et Levassor, Paris, France. Application filed January 31, 1902.

In a gas engine or the like there are provided means for distributing a current to a number of igniters comprising brushes connected separately to the igniters, and means for revolving a terminal to contact with the brushes in succession.

708,055. Electric Controller. John B. Linn, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 15, 1901.

Combined with circuit-controlling devices for a number of motors, are a cut-out switch for the motors comprising two blades, and connections permitting each blade to move independently in one direction, but compelling one to actuate the other when moved in the other direction.

708,070. Coherer. Greenleaf W. Pickard, Boston, Mass., assignor to the Consolidated Wireless Telegraph and Telephone Company. Application filed October 18, 1901.

For this and two succeeding patents see page 169

708,071. Wireless-telegraph System. Greenleaf W. Pickard, Boston, Mass., assignor to the Consolidated Wireless Telegraph and Telephone Company. Application filed October 29, 1901.

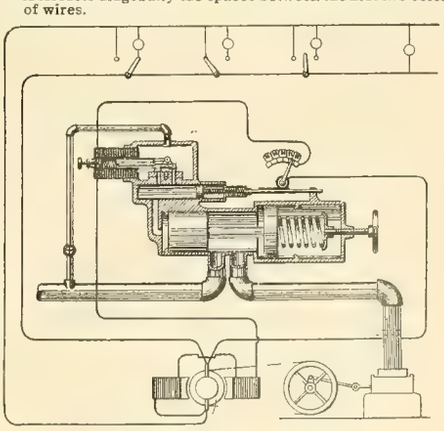
708,072. Wireless Telegraphy. Greenleaf W. Pickard, Boston, Mass., assignor to the Consolidated Wireless Telegraph and Telephone Company. Application filed November 4, 1901.

708,080. Revolving Electric Igniter. Anson G. Ronan, Toronto, Canada. Application filed June 5, 1901.

An electrode is centrally mounted within an adjustable electrode from which it is insulated and designed to turn therein.

708,093. Electrically Protected Structure. Henry M. Sutton, Walter L. Steele and Michael Coerver, Dallas, Texas. Original application filed May 25, 1901. Divided and this application filed August 19, 1901.

In an electrical alarm system there is provided a wiring for a protected structure, comprising a series of wires each composing an independent circuit. One of the series extends at a right angle to the other and the third series intersects diagonally the spaces between the first two series of wires.



NO. 708,026.—ELECTRIC CONTROLLER.

708,096. Controller for Electric Motors. Leonard A. Tirrill, Lynn, Mass., assignor to the General Electric Company. Application filed February 14, 1901.

Parts of the controller are a rotatable contact-carrying member, a handle for operating the member, an electromagnet concentric with the shaft on which the handle is mounted, an armature for the electromagnet operatively connected to the controller handle so as to be rotated therewith in a path concentric with the periphery of the electromagnet, and means controlled by the armature for locking the handle to the contact-carrying member.

708,105. Case for Fan Motors. Harold R. Wellman, New York, N. Y., assignor to the General Incandescent Arc Light Company of New York. Application filed November 16, 1901.

The motor case is formed of two parts, one of the parts substantially cylindrical in its vertical axis with a horizontal top and bottom and having on one cylindrical surface a circular opening, and the other part formed as a convex disk adapted to be inserted in the circular opening of the other part.

708,112. Electric Clock. Hjalmar E. Andersson, Stockholm, Sweden. Application filed December 1, 1900.

A circuit-closer in the circuit is operated by the armature lever of an electromagnet to close the electric circuit and rotate the ratchet wheel during the gravitating movement of the lever, and again to open the circuit when the lever is moved in an opposite direction by the closure of the electric circuit.

708,121. Device for Overcoming Alternating Currents in Direct-current Circuits. Hermann Brockelt, Berlin, German. Application filed March 28, 1902.

Means for destroying the disturbing alternating current in the conductors of electric railroads worked with direct current are described. They comprise a transformer, the primary winding of which is connected in the series circuit, and the secondary in a shunt circuit to the motor, in such manner that on the common path through the motor, the alternating current generated by the latter flows in opposite direction to the current produced in the secondary winding, for the purpose of removing the former.

708,132. Electric Arc Lamp. Richard Fleming, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 6, 1900. Renewed January 2, 1902.

The inventor describes a reactance coil composed of an open-work cage of magnetic material having central cores separated by an air gap, and a coil concentric with the cores and inside the cage.

708,138. Coin-controlled Telephone. Sylvester P. Grey, Fort Wayne, Ind., assignor of one-half to Franklin Howenstein, Fort Wayne, Ind. Application filed October 14, 1901.

A coin-chute having a longitudinal coin-channel is provided at its lower end with two discharge openings one of which is controlled by an adjustable slide. A coin-arresting disk is rotatably mounted in the chute in co-operative relation with an actuating receiver hook which engages the disk and is adapted to actuate the same automatically when the receiver is removed.

708,155. Electric Attachment. Jonathan C. Meloon, Providence, R. I., assignor to the General Fire Extinguisher Company, New York, N. Y. Application filed March 1, 1898.

One claim reads: The combination with a pressure chamber, a diaphragm therein, a plunger operated thereby, a block of insulating material, binding posts depending therefrom and supported thereby, an overhanging arm to which the block is secured, a contact blade pivoted to one of the posts and engaged by the plunger, and plates secured to the other post between which the blade passes.

708,157. Controller for Electric Motors. Frank A. Merrick and Emmett W. Stull, Johnstown, Pa., assignors to the Lorain Steel Company. Application filed January 2, 1902.

The controller combines a rheostatic switch, a series parallel switch, a lock for the series parallel switch temporarily released by the movement of the rheostatic switch to a predetermined running position, and a second lock for the series parallel switch released by the return of the rheostatic switch to its open-circuit position.

708,158. Controller for Electric Motors. Frank A. Merrick and Emmett W. Stull, Johnstown, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 2, 1902.

In the controller are combined a casing formed in part of magnetic material, a controller-drum whose body and shaft are also of magnetic material, a blow-out coil, a core supporting the coil, and a pole-piece carried by the core and carrying the bearings for the shaft.

708,159. Incandescent Lamp. Henry E. Meyers, Butte, Mont. Application filed August 19, 1901.

The lamp has filaments in the globe electrically connected at one end to the plug, and segmental contact strips embedded in and projecting upward from the lining and connected to the opposite ends of the filaments, each of which is adapted to engage, once in each revolution, one of the spring contacts.

708,166. Automatic Photographic Apparatus. George N. Pifer, Cleveland, Ohio, assignor to the American Automatic Photographic Company, Cleveland, Ohio. Application filed December 13, 1901.

The apparatus combines a photographic magazine, an electric motor, means for energizing the motor and means for feeding a plate from the magazine, such energizing and plate-feeding means being operatively connected whereby a plate may be fed simultaneously with the energizing of the motor.

708,167. Coin-controlled Photographic Apparatus. George N. Pifer, Cleveland, Ohio, assignor to the American Automatic Photographic Company, Cleveland, Ohio. Application filed March 8, 1902.

An operating lever is connected with the motor, and an electrical circuit-containing means is provided for controlling the operation of the motor. Two pairs of electrical contacts are arranged to open and close the circuit, a member of one pair being located in the coin path of the coin duct and a member of the other being located in the lever path.

708,168. Shutter for Automatic Photographic Apparatus. George N. Pifer, Cleveland, Ohio, assignor to the American Automatic Photographic Company, Cleveland, Ohio. Application filed March 11, 1902.

Means for discharging a plate from a focal plane are combined with a lens-controlling shutter, and a motor-operated angularly adjustable arm, one end of the arm being adapted to close the shutter and the other to engage and operate the discharging means.

708,170. Lubricating Device. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 23, 1901.

The rotatable member of a dynamo-electric machine is mounted on an upright shaft and has upper and lower bearings for the shaft, there being a passage or duct in the member joining the bearings, an oil cup for the upper bearing, a centrifugally operated oiling device secured to the rotating member beneath the lower bearing and arranged to receive the oil flowing therefrom, and a transfer pipe leading from the device out around the rotary member to the upper bearing.

708,182. Circuit-interrupter. Milo S. Walker, Chicago, Ill., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 6, 1899.

The described mode of maintaining electric vibration in a circuit consists of causing the current to traverse a narrow thread or film of conducting liquid, and maintaining at the sides at the film or thread a larger body of conducting liquid whereby the vibration is maintained by the sole action of the current. (See cut.)

708,185. Magnetic Separator. John P. Wetherill, South Bethlehem, Pa. Application filed August 26, 1901.

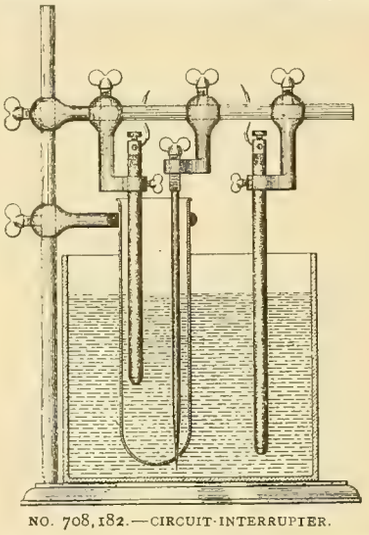
The separator comprises magnet poles spaced apart to form an intervening gap traversed by the magnetic lines of force, means for feeding into the gap the material to be separated, means for washing out the non-attracted particles from the particles detained by the magnetic attraction in the gap, and a scraper for removing the attracted particles, the scraper having projections which scrape both pole pieces.

708,186 and 708,187. Magnetic Separator. John P. Wetherill, South Bethlehem, Pa. Application filed August 26, 1901.

Devices similar to the above are described.

708,188. Lightning Rod. James O. Wilson, Canton, Mo. Application filed January 6, 1902.

The rod comprises a continuous conductor having a number of ground connections, loops connected continuously to the conductor and extending thereabove to form attractive points, and compound ground plates to which the terminals of the conductor are electrically connected.



NO. 708,182.—CIRCUIT-INTERRUPTER.

708,195. Controlling Device for Electric Generating Systems. John H. Bickford, Salem, Mass. Application filed December 18, 1900.

In the electric generating system described are combined a dynamo, a power-generating and converting apparatus for operating it, a starting device for starting the apparatus and a device for closing the dynamo circuit containing the translating devices, having an operating device by which it is operated.

708,198. Trolley. James W. Brooks, Indianapolis, Ind. Application filed January 16, 1901.

The trolley has a pivoted head part having the blades provided with openings therein, through which springs extend. The trolley wheel is mounted on the axle between the ends of the springs.

708,211. Electric Snap Switch. Louis W. Downes, Providence, R. I. Application filed May 3, 1902.

The switch has two circuit terminals, a switch-blade pivoted to one of the terminals, and adapted to be moved on its pivot into and out of engagement with the other terminal. A tooth or projection is on the pivoted end of the blade which a lug is adapted to engage after the actuating lever has been moved a predetermined distance and the spring thereby put under tension.

708,216. Electromedical Appliance. Jonathan O. Fowler, Jr., New York, N. Y., assignor to John W. Gibbs, New York, N. Y. Application filed March 30, 1901.

The device consists of a hollow roller shell, a handle therefor and means for generating a current of electricity within the roller shell, and also means for connecting the generator with the shell, and an induction coil located in the handle.

708,220. Means for Winding Converters or Like Articles. Edwin R. Gill, New York, N. Y., assignor to the Invention Developing Company. Application filed March 30, 1899.

An electrical apparatus is described with a virtually closed magnetic circuit having a practically straight portion, a divisible spool on the straight portion, and terminals for the conductors on the spool, the terminals serving also to fasten the parts of the spool together.

708,245. Target Apparatus. John L. McCullough, Brooklyn, N. Y., assignor to the Automatic Target Machine Company. Application filed April 30, 1900. Renewed December 31, 1901.

The apparatus has electrical means controlled by the trigger of the pistol for setting in operation the indicator-actuating means.

708,253. Electric Clock. Arthur F. Poole, Wheeling, W. Va. Application filed September 7, 1901.

In a synchronized clock system are provided a series of secondary clocks, a master clock having connections arranged to give electric impulses to them at determined intervals and for a determined period in one direction, and mechanism for sending out impulses for another period at determined intervals in the opposite direction.

708,277. Telephone or Telegraph Pole. Isaac M. Warner, Union City, Mich., assignor to Frank C. Boise, Union City, Mich. Application filed October 15, 1901.

A tubular pole has a bolt projecting vertically from the upper end thereof and having its lower end secured therein, a cross-arm provided with a series of wire supports on the bolt, bearing on the upper end of the pole, and means, independent of the bolt, to secure the cross-arm to the pole.

708,309. Manufacture of Glass by Means of Electricity. Jegor Bronn, Cologne, Germany, assignor to Gesellschaft zur Verwertung der Patente für Glaserzeugung auf Electrischem Wege Becker & Co., M. B. H., Cologne, Germany. Application filed September 21, 1901.

The process described of producing glass by electricity consists of mixing the raw materials together with water and a suitable binding agent, and conducting the mixture in plastic form between compressing rolls and thence in a continuous moving strip in close proximity to electrodes by which it is subjected to melting heat from an electric arc.

708,324. Lubricating Device. Frederick B. Duncan, Madison, Wis., assignor to the Northern Electrical Manufacturing Company, Madison, Wis. Application filed January 19, 1901.

A lubricating device for a vertical electric motor is described.

708,329. Lightning Arrester. Charles E. Egan, Durham, N. C., assignor to Julian S. Carr, Durham, N. C. Application filed March 11, 1901. Renewed April 22, 1902.

Parts of the arrester are a base, main-line terminals carried thereby, a ground normally insulated from the terminals, a conductor connected with one of the terminals, a series of fuses connected to the conductor, a closed circuit intermediate one of the fuses and the other line terminal, and means for cutting in each of the fuses in succession as the preceding fuse is blown.

708,334. Electric Accumulator Plate. Alexander Fischer, Berlin, Germany. Application filed June 21, 1902.

The plate comprises a plate of lead folded into serpentine form, tongues cut out of the plate at the apex of each fold and bent outward, and active mass disposed between the folds.

708,365. Electromedical Appliance. John H. Kliegl and Anton T. Kliegl, New York, N. Y. Application filed August 26, 1901.

In the apparatus are combined a source of light, means for absorbing heat rays from the light comprising a cell having transparent walls, ports in the cell, a receptacle for a heat-absorbing fluid, a flexible connection between such receptacle and one of the ports, a second receptacle, and a flexible connection between the second receptacle and another of the ports, the receptacles being adapted to be raised and lowered alternately above and below the cell, whereby a constant flow of the heat-absorbing fluid through the cell may be produced.

708,372. Automatic Engine Stop. Nathaniel C. Locke, Salem, Mass., assignor to Locke Regulator Company, Salem, Mass. Application filed January 2, 1902.

The device which is combined with an engine comprises means for shutting off steam to the engine consisting of electro-mechanical actuating mechanism and a circuit therefor, and a circuit-operating device for the circuit located close to the engine and arranged to be operated by contact with a distorted part thereof.

708,398. Electrical Gas-lighter. Jesse G. Poppert, Milwaukee, Wis. Application filed January 7, 1902.

The igniter comprises a handle, a laterally extending push-button, a fixed electrode projecting from the handle, an axially oscillating electrode, and an arm projecting from the oscillating electrode into the path of the push-button.

708,432. Incandescent Electric Lamp. Glenn C. Webster, Warren, Ohio, assignor to the Sterling Electrical Manufacturing Company, Warren, Ohio. Application filed December 30, 1901.

The lamp comprises the glass bulb, a central, pendent, translucent anchor and a double spiral filament having a bottom loop attached to the anchor and a series of convolutions symmetrically arranged opposite each other and placed at different distances from the anchor.

708,451. Trolley Wheel. Warren W. Annable, Grand Rapids, Mich., assignor to the Appliance Company, Limited, Grand Rapids, Mich. Application filed January 7, 1902.

The wheel has a tubular axle fixed in the wheel and projecting therefrom, and bearings engaging both the interior and exterior surfaces of the axle.

708,462. Vehicle to be Used in Electric Traction on Railways. George Cawley, Westminster, England. Application filed June 3, 1902.

The vehicle has a supporting bogie at each end thereof and carries a boiler, water tanks above and below the boiler, and fuel bunkers at one end of the boiler with engines and dynamos on the other side of the fuel bunkers.

708,478. Electrical Position-indicator. Albert S. Hubbard, Greenwich, Conn. Application filed February 20, 1902.

The device comprises a ring armature provided with a winding and with energizing-circuit connections, an index device connected to the armature, an annular field magnet with a ring winding, and a switch device connected to the object whose position is to be indicated and having a number of contacts electrically connected to different parts of the winding and to an energizing circuit.

708,496. Burglar Alarm. Freeman C. Robinson and James E. Green, Council Bluffs, Iowa. Application filed November 26, 1901.

The alarm is provided with a suitable gong located outside of the vault, safe or other receptacle or apartment to be protected. A shield incloses the gong and means are arranged for closing an electric circuit that causes the gong to be sounded upon the moving of the shield.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, SEPTEMBER 20, 1902. No. 12

New Electrically Operated Bascule Bridge over Chicago River.

Within a month a new type of bascule bridge will be in operation over the south branch of the Chicago River at Ashland Avenue. This bridge—of a new and interesting type—is the invention of Mr. J. W. Page, Chicago. It is the first of its particular kind ever built, and was constructed for the Sanitary District of Chicago. When completed it will have cost in round figures $133,000. The sub-structure, masonry, etc., cost $41,000, the remainder being expended on the steel work and operating machinery.

A general idea of the construction and operation of the bridge, which is supported on four stone piers, may be obtained from Figs. 1 and 2. The drawing (next page) shows the bridge closed and (in dotted section) opened. The main or center span is 168 feet long, with a clear waterway of 140 feet. The two side spans are each 48 feet in length. The total width of the bridge is 60 feet, divided into a central roadway, with sidewalks on each side. The roadway is 38 feet wide in the clear. Two street-car tracks occupy the central portion of this roadway, and the delay in getting rails for these tracks has considerably hindered the completion of the bridge. Of each of the two side sections 8½ feet is left clear for a sidewalk.

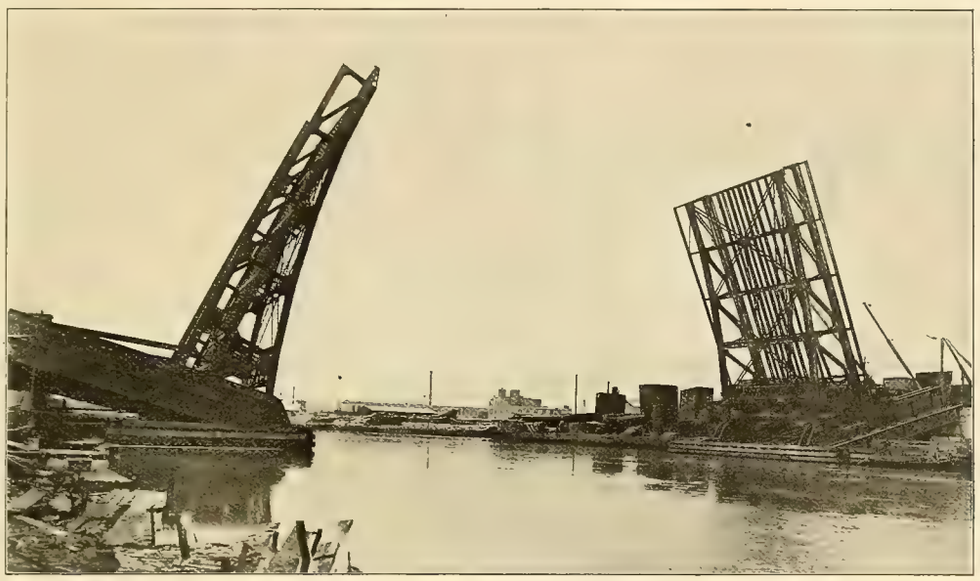


Fig. 1. View of the Bridge Opened.

The lift portion of the roadway and walks, 84 feet in length, is fitted with plank for walk and pavement. The roadway of the two back or side sections is to be paved with vitrified brick, four inches deep, and the sidewalks here will be of cement.

The operating features of the bridge are of unusual interest. Electricity is used for power. There are four 38-horsepower, direct-current, 500-volt motors, two on a side. The two halves of the bridge being alike, one only will be described.

When current is turned into these motors to open the bridge the outer end of the forward section rises while the forward end of the back section falls. In other words, the forward section tilts up and the back section tilts down. The position thus assumed by both sections is shown in Fig. 1 and in the dotted lines in Fig. 2. Just above the forward stone pier a reverse curve is shown (Fig. 2). This curve, which is built in the forward section, is made of steel and is about 18 inches wide. It can be seen at the bottom of Fig. 3. It serves as a sort of track along which a four-foot roller travels. This roller is pinned into the back section near its forward end, as shown in Fig. 2. When the bridge opens, this roller follows the curve, the weight of the back section nearly counterbalancing that of the forward one. In designing the bridge the weights of the two sections (forward and back) were determined in such a ratio to each other that a practical balance is maintained between them no matter in what relative positions they stand. A heavy I-beam connects the base plates on the two (forward and back) piers, and prevents any forward or backward movement taking place on them. If it were not for this compression member, the tendency would be for the back section to drop, the roller following the above-mentioned curve, the forward section being pulled backward in a parallel position, leaving an opening at the center of the bridge.

The motors which operate the bridge are shown in Fig. 3. There are two of them to each half of the bridge, and each motor, as before stated, is of 38-horsepower capacity. They operate on a 550-volt direct-current street-railway circuit, the power being supplied by the Chicago Union Traction Company. The motors are of the General Electric Company's make (67 A) and are ordinary enclosed-type street-railway motors. Figs. 2 and 3 show the positions of the motors as they are installed underneath the back section of the bridge directly under the roadway. These motors are geared by means of pinions to a steel shaft extending crosswise from side to side, one end of which is indicated at (A) in Fig. 2. The ends of the motor shaft are fitted with bevel gears, as shown in Fig. 3. These gears engage with others upon the ends of intermediate steel shafts shown in the drawing (Fig. 2) at (AB). These intermediate shafts extend backward and diagonally upward through the side girders of the bridge, and terminate in bevel gears at (B), Fig. 2. One of these last-mentioned gears, at the end of an intermediate shaft, is shown in Fig. 4 (p. 189). In turn these gears mesh with gear wheels set on the back ends of steel screws, shown (from different directions) in Figs. 4 and 5, and indicated by (BC) in Fig. 2. These screws are double, square-threaded steel ones 7½ inches in diameter and 30 feet long, and are threaded their entire length. On these screws travel sliding blocks or nuts (Fig. 4) to which the back ends of the operating struts (Figs. 1, 4 and 5 and indicated by (CD) in Fig. 2) are attached. The forward ends of these operating struts are attached to the forward section of the bridge, as can be seen by inspection of Figs. 1, 2 and 4.

The struts are 12 inches square, each being built up of two 12-inch steel channel irons riveted together by means of plates with the channel turned toward each other. These struts are one of the important features of the mechanism, for it is upon them, together with the screws, that the opening and closing of the bridge depend.

Fig. 4, looking from the street, shows the bridge partially opened, the screws, in this instance, being revolved toward the right and the sliding nuts being drawn toward the large bevel gears, one set of which is seen in the illustration. Fig. 5 shows the bridge in the same position, seen from a point out on the forward section. When the bridge has been opened to the position shown in Fig. 1, the forward end of the back section has dropped 16 feet.

The southern half of the bridge is now practically finished and has been operated for the passage of boats for two or three weeks. The brick flooring has not been placed on the back section as yet, and hence a great deal more power is required to raise the forward section than would be if the added weight was in place. At present to open the bridge 84 horsepower is required on starting. As the forward section gets into motion this drops down to nine horsepower. After the section has reached its upright position 57 horsepower is required to start it on its downward travel. Once set moving very little power is required to keep the sections in motion. The bridge can be stopped at any point, either in its upward or downward travel, and the current shut off, owing to the fact that the large driving screws act as a perfect brake. The upward or downward movement is attended with very slight vibration, considering the very heavy weights that are in motion.

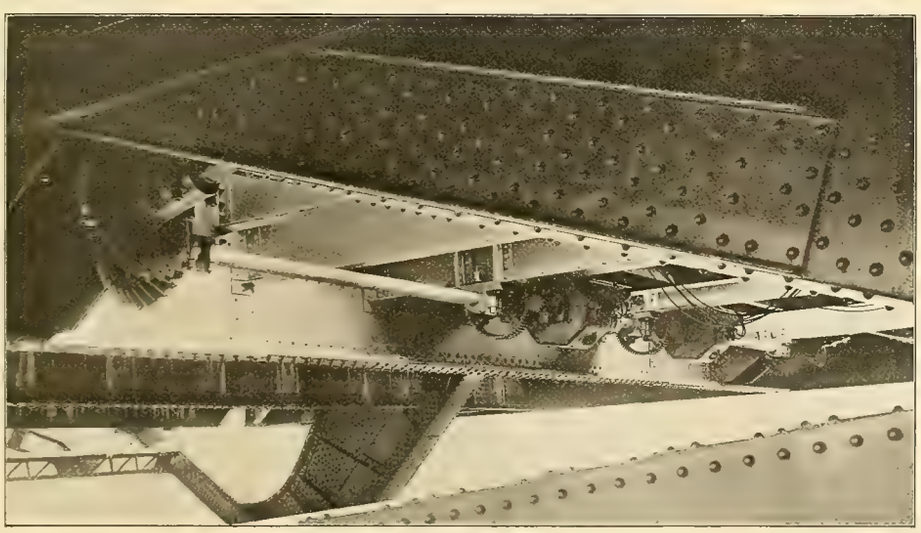


Fig. 3. Motors and Motor Shaft under Bridge.

NEW ELECTRICALLY OPERATED BASCULE BRIDGE OVER CHICAGO RIVER.

To insure safety traffic gates are provided; bridge locks are also installed at the junction of the forward and back sections on each side. These locks are automatically set the instant the bridge is closed. This is done by means of a pneumatic system which works automatically, pressure being on at all times. Whenever this pressure drops below 50 pounds motor-driven pumps are set in motion, and operate until the pressure is restored, when they are automatically thrown out of circuit. These air compressors were built by Christensen & Co. of Milwaukee, and are of four horsepower each. There are two air-receiving tanks, one located on each side

of the river, and each supplied with its own compressor. They are, however, connected by pipes placed underneath the river so that, in case of a breakdown of either compressor, the other would take care of the system. The traffic gates are also operated by the pneumatic system.

All the machinery, both pneumatic and electric, is controlled from two cabs located at the ends of the bridge. One of these cabs is seen in Fig. 5. The cabs are two-story structures eight by 12 feet in ground dimensions and built of wood. The floor of the upper story is three feet above the street level, thereby giving the bridge operator a good view of the river on both sides. The lower story contains resistances for the bridge motors and an air compressor and tank. The upper story contains a switchboard, an air controller and a controller for the bridge motors. The switchboard, which is a small one—about two by 2½ feet—is of marble, and is fitted with the following: Circuit-breaker, main-line, single-pole, double-throw switch, ammeter reading up to 500, voltmeter reading up to 600, double-pole, single-throw switch for the air-compressor motor, four small snap switches operating two night signal lights, the cab lights and the lamps placed near the bridge motors. The main-line, single-pole, double-throw switch is installed to be a protection against a possible breakdown in the source of current supply. Two power-house circuit connections are provided, so that in the event of the failure of one the switch can be thrown over to the other circuit. The bridge-motor controllers are of the ordinary street-railway type and have eight points of control, four for the go-ahead motion and four for the reverse motion. The last piece of apparatus to be described is one of the most unique of the whole installation. It is the air-system controller. This controller has five pipes leading to it and has four points on it. The main air pipe enters the controller between points 4 and 1. When the operator is desirous of opening the bridge he turns the controller to the first point, which closes down the traffic gates. Then he moves on to the second point, which opens the locking mechanism of the bridge, which is then ready to be opened. Now allowing the air controller to stand as it is, he opens and closes the bridge by means of the motor controller. He then returns to the air controller and, by moving it to the third point, locks the bridge down. The fourth point opens the traffic gates and the operations are completed. Having the pneumatic system to control the bridge locks obviates all chance of an operator opening his bridge before the gates are down, for he cannot unlock the bridge without passing over point 1 on the air controller which immediately drops the traffic gates. Having closed the bridge, he cannot open the traffic gates without passing over point 3 to point 4. Point 3 immediately locks the bridge down and hence makes it safe before the gates open at point 4 to allow traffic.

The two cabs and their apparatus are exactly alike with the one exception that the cab on the north side of the river contains two motor controllers instead of one. This extra controller is installed with the idea of operating both sides of the bridge from this cab, whereas only the south side can be operated from the other one. Either side, however, can be raised entirely independent of the other.

Page & Schnable built the piers and other masonry work of the bridge, and the Chicago Bridge and Iron Company placed the steel superstructure. The operating machinery was installed by George P. Nichols & Bro. William M. Hughes of Chicago was the consulting bridge engineer for the Sanitary District.

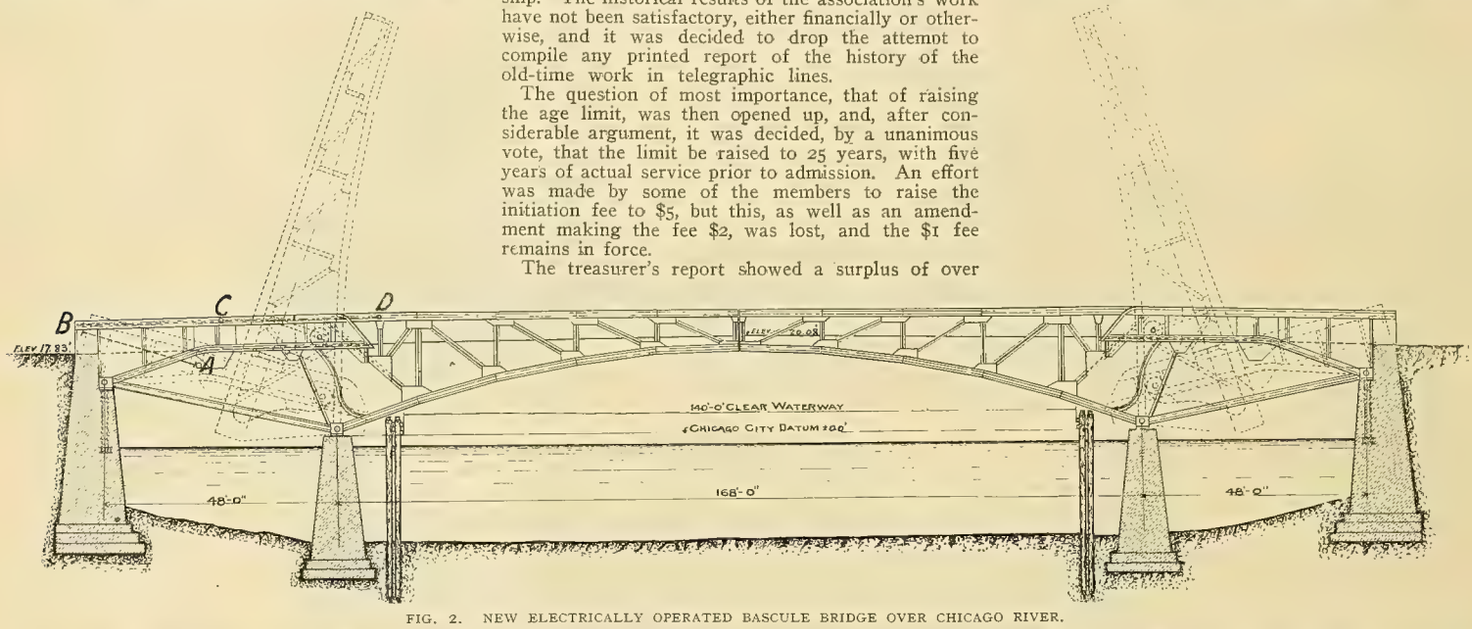


FIG. 2. NEW ELECTRICALLY OPERATED BASCULE BRIDGE OVER CHICAGO RIVER.

Old Time Telegraphers.

The twenty-second annual reunion of the Old Time Telegraphers and Historical Association and the Society of the United States Military Corps was held Wednesday, Thursday and Friday, September 10th, 11th and 12th, at the Kenyon Hotel in Salt Lake City, Utah.

There were exactly 100 names registered on the visitors' book when the meeting was called to order by Temporary Chairman Burton. Nearly 100 other members of the association, 40 of them from Chicago, did not arrive until five o'clock in the afternoon, their trains being some hours behind time. George H. Corse of Ogden, Utah, president of the association, took the chair and was decorated with a beautiful medallion with the face of Professor S. F. B. Morse ornamenting it. An address of welcome was delivered by the Rev. Mr. Simpkins, pastor of the Phillips Congregational Church. It was fittingly responded to by Mr. Cochrane of Milwaukee.

The regular business of the meeting was then taken up. The report of Secretary-treasurer John Brant showed a membership of 1,070 up to date, with a large number of applications for future membership. The historical results of the association's work have not been satisfactory, either financially or otherwise, and it was decided to drop the attempt to compile any printed report of the history of the old-time work in telegraphic lines.

The question of most importance, that of raising the age limit, was then opened up, and, after considerable argument, it was decided, by a unanimous vote, that the limit be raised to 25 years, with five years of actual service prior to admission. An effort was made by some of the members to raise the initiation fee to $5, but this, as well as an amendment making the fee $2, was lost, and the $1 fee remains in force.

The treasurer's report showed a surplus of over $800 in the treasury, and the attempt of Secretary-treasurer Brant to place his salary at $200 was met with a storm of "No's" from the members, and the gentleman was forced to accept $300 as the inadequate compensation for his highly satisfactory dual services.

The selection of Milwaukee as the next meeting place for the convention to be held in September, 1903, met with universal favor, and it was so ordered, after the reading of letters of invitation from the mayor and Board of Trade of the Cream City.

The officers nominated and elected for the ensuing year were: President, U. J. Fry of Milwaukee; vice-president, W. J. Lloyd of Chicago; secretary-treasurer, John Brant of New York; executive committee, George H. Corse, L. B. McFarlane, H. C. Hope and H. J. Pettingill.

A resolution of thanks for courtesies rendered was ordered wired to Colonel R. C. Clowry, president and general manager of the Western Union, at New York, and a suitable resolution of condolence for the loss of his son was sent to Colonel J. J. Dickey of Omaha. A resolution was also forwarded to the Rocky Mountain Telegraph and Telephone Company for courtesies extended to the association during its visit to Salt Lake. A telegram from Mayor David S. Rose of Milwaukee was received, reading as follows: "Congratulations of Milwaukee. Sincerely trust we shall have the pleasure of meeting you next year."

After the meeting of the Old Time Telegraphers adjourned, the United States Military Telegraph Corps, of which but half a score of members were present, held a short meeting, with Senator William J. Ives, vice-president, in the chair. No business of importance was transacted. The afternoon was spent in a trolley ride to all points of interest near the city.

At 10 a. m. on Thursday, September 11th, the visitors enjoyed a trip to Saltair, the beautiful watering-place and scenic attraction, 18 miles from the city. In the afternoon everybody and his wife made a flying trip to Lagoon, a pretty little pleasure resort about 16 miles from Salt Lake. At 8:30 p. m. a banquet was spread at the Kenyon, and until the big clock on the county building warned the feasters that another day had nearly dawned there was a feast of good things and ceaseless flow of reminiscences, with brilliant toasts moistened, but not dampened, by sparkling wines.

Friday, the last day of the reunion, was spent in a visit during the forenoon to the famous Mormon Tabernacle, where the guests were delightfully entertained by a recital on the great organ; and in the afternoon a majority of the visitors enjoyed a trip to Ogden, where carriages were in waiting to convey the pilgrims up through the picturesque Ogden Canyon, returning to Salt Lake in the early evening.

The reunion called together members from the Atlantic to the Pacific, and from the Great Lakes to the Gulf, and a finer appearing or more intelligent body of ladies and gentlemen never visited Salt Lake City than the members of the Old Time Telegraphers' and Historical Association and the Society of the United States Millitary Telegraph Corps and their ladies.

Electricity as a Factor in Automobilism.

Automobiles or "motor vehicles" appear to be considered by the United States Census Department, under the general head of "Locomotives." In the report bearing the latter title the expert special agent—Edward H. Sanborn of Philadelphia—says that the 4,192 motor vehicles constructed during the census year [1900] were divided as follows: Steam carriages, 1,681, valued at $1,147,927; electric vehicles, 1,575, valued at $2,873,464; automobiles using hydrocarbon motors, 936, valued at $878,052. As between steam, gasoline and electric vehicles, Mr. Sanborn is careful to maintain a strict neutrality as to superiority. Here is what he says that is especially interesting to the readers of the Western Electrician:

"The possibilities of the electrical propulsion of motor vehicles have received a very large share of the attention which has been centered on the various problems of the automobile, and some of the earliest successful American motor carriages were driven by electricity. Safety, freedom from noise and odor, ease of control, great flexibility of the power, and simplicity of the mechanical features of the electric automobile are recognized advantages over other methods of propulsion; but the limited range of travel, due to dependence upon charging stations, has tended to restrict the use of electric vehicles to strictly local service. Where only short runs are to be made and high speed is not a consideration, or where the service is intermittent, electricity has proved to be an ideal power for automobiles, but their limitations have practically excluded this class of vehicles from the touring field, where the use of the automobile is becoming more and more popular.

"The storage battery, which is the sole dependence of the electric vehicle, has been much improved since its first application to this work, and recent developments point to even more marked advancement in the direction of lessened weight and cost, greater capacity within the limits of the vehicle, and decreased cost of operation, all of which promise a wider field and larger use for this power. If the increasing use of electric vehicles shall lead to the multiplication of charging stations, the limits of their usefulness will be still further extended."

According to newspaper report, there is now being tested in Berlin, Germany, a system of automatically lighting and extinguishing gas street lamps from a central point by means of electricity.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

Undoubtedly the best attended and certainly one of the most enjoyable of the conventions of the Association of Edison Illuminating Companies was that held last week in the White Mountains, N. H. It was the twenty-third convention of the Edison Association and was attended by about 170 Edison men and their ladies. The place of meeting and headquarters of the convention was the Mount Washington Hotel, and the hotel accommations were excellent. Many of the delegates and visitors, principally from the East, arrived on Saturday and Sunday, September 7th and 8th, but the great majority came on Monday, and all were in attendance when the opening session was called to order on Tuesday morning, September 9th, by President L. A. Ferguson of Chicago.

The proceedings began with an address by President Ferguson. In the course of his remarks Mr. Ferguson paid a deserved compliment to the work done by the various standing committees, particularly the lamp and meter committees, and also the storage-battery committee, which was appointed last year for the first time. He advocated an extension of the work done by the appointment of additional standing committees to collect data and formulate opinions for the use of the members of the association. Among these should be standing committees on other kinds of illumination which compete with electricity; on steam turbines; on rates; on relations with kindred societies and associations, and on theft of current. He spoke strongly on the importance of devoting more time than had hitherto been spent upon mechanical and theoretical problems which arose in connection with the practice of the electrical art. He also referred to the proposed action of the National Board of Fire Underwriters in reference to high-potential currents, and urged upon the members the importance of giving their closest attention to the proposed changes in the rules of the National Board, so that the electrical industry would not be prejudiced thereby.

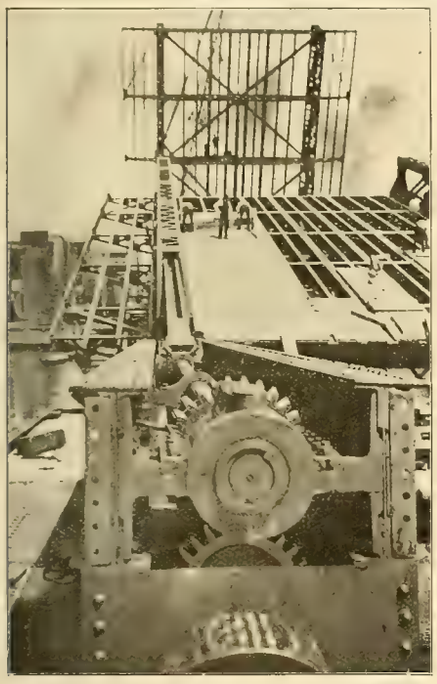


Fig. 4. Gears on Intermediate Shaft and Driving Screw.

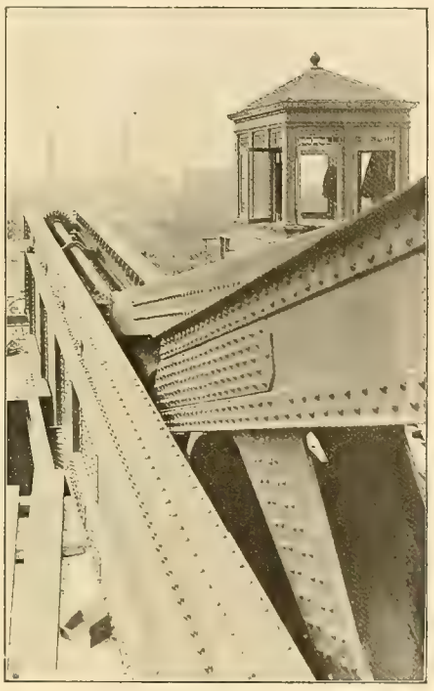


Fig. 5. Driving Screw and Operating Strut.

NEW ELECTRICALLY OPERATED BASCULE BRIDGE OVER CHICAGO RIVER.

In submitting the report of the committee on high-potential conductors, the chairman, J. W. Lieb, Jr., of New York, spoke of the proposed action of the National Board of Fire Underwriters in limiting the use of high-potential conductors in the vicinity of buildings, and of the desire of the various representative electrical bodies to secure harmonious co-operation with the National Board of Fire Underwriters without sacrificing the interests of the electrical industry. In conclusion Mr. Lieb proposed that the name of the committee should be changed to that of the committee on the National Code, in order more clearly to define its functions.

A long list of papers was provided on the programme, and it was presented practically as scheduled. The list of papers and authors is as follows:

"Recent Developments in Distribution System in Boston," by Sidney Hosmer, Boston; "Aspects of Safety and Reliability in High-tension Transmission and Distribution of Current from Annex Stations in Large Cities," by Philip Torchio, New York; "Construction and Operation of Underground High-tension Transmission," by H. J. Gille, St. Paul, Minn., and H. G. Carlton, Chicago; "High-tension Work in the Far West," by George H. Lukes, Chicago; "Development of New Forms of Illumination and Their Possible Influence on Central Stations (Nernst Lamps, Hewitt Lamp and Welsbach Arc Lamp)," by George Eastman, Chicago; "The Effect of the Nernst Lamp Upon Methods of Illumination," by Murray C. Beebe, chemist, Nernst Lamp Company, Pittsburg; "The Distribution of Light from Incandescent Lamps as Affected by Shades Commonly in Use," by John W. Howell, engineer, Edison Lamp Works, Harrison, N. J.; "The Order System and Its Influences Upon Cost," by Walter M. Anthony, Chicago; "Campaigning for Business," by John F. Gilchrist, Chicago; "Advertising and Canvassing," by Arthur Williams, New York; "Commercial Conditions with Customers," by J. T. Maxwell, Philadelphia; "Some Problems in the Design, Development and Operation of Large Central-station Systems," by P. Junkersfeld, Chicago; "Utilization of Waste Energy of Central Stations," by W. H. Schott, Chicago; "Steam-pipe Covering and Its Relation to Station Economy," by Henry G. Stott, superintendent motive power, Manhattan Railway Company, New York; "Coal," by Robert Lindsay, Cleveland, and W. L. Abbott, Chicago; "Storage Batteries," by Gerhard Goettling, Boston; "Integrating Electric Meters and the Meter Department," by George Ross Green and P. H. Bartlett, Philadelphia; "Checking Electrical Instruments," by Dr. C. H. Sharp, test officer, Lamp Testing Bureau, New York; "Automatic Voltage Regulators," by W. S. Andrews, Schenectady; "The Use of Superheated Steam," by Charles H. Parker, Boston.

Charles P. Steinmetz of the General Electric Company, Schenectady, N. Y., was to have presented a paper on "Original Researches in Electrical and Chemical Laboratory." He was unable to be present, however, and his paper was not given.

The selection of officers for the ensuing year resulted in the re-election, without exception, of the old officers, as follows: President, Louis A. Ferguson, Chicago; vice-president, A. W. Field, Columbus, Ohio; treasurer, Alex Dow, Detroit, Mich.; secretary, Walter H. Johnson, Philadelphia, Pa.; assistant secretary, Wilson S. Howell, New York city; executive committee, Louis A. Ferguson (chairman) of Chicago, Charles L. Edgar of Boston, John W. Lieb, Jr., of New York, W. C. L. Eglin of Philadelphia, Thomas E. Murray of New York, Samuel Insull of Chicago, and A. W. Field, Alex Dow and Walter H. Johnson, ex officio.

The sessions of the convention were held each morning from 9:30 to 1:00, and each evening from 8:00 until 10:30. This allowed the whole of the afternoons for excursions and for golf playing. A little rain fell the first day, but beyond that the weather was beautiful during the entire week, none of the cold weather being experienced that was prevalent throughout the western and central sections of the country. The pleasant weather, the natural scenic features of the region and the presence of a large number of ladies were factors which combined in making the social and entertainment features of the convention very enjoyable. The ladies themselves were entertained during the business sessions by a varied programme, which included golfing, driving, dancing, and a trip to the summit of Mount Washington.

The general entertainment programme opened on Tuesday, when a large party of ladies and members drove to the base of Mount Washington. On Wednesday no formal programme was set, but in the afternoon a large party walked to the Upper Falls of the Ammonoosuc, and thence through the woods to the new road, returning to the Mount Washington. On Thursday two golf tournaments took place, one for the ladies and one for the members. The ladies' tournament occupied the forenoon. Two trophies were presented as prizes by Louis A. Ferguson, the president of the association. The first was a handsome pitcher of Bohemian glass with a beautiful design of deposited silver. The second prize was a flask of similar material. These prizes, which were awarded for the lowest net scores, were won by Mrs. Walter C. Fish of Lynn and Mrs. Alex Dow of Detroit. The members' tournament, which was a handicap event, took place the same afternoon, the prizes for which were presented by the Boston Edison Company, consisting of a handsome oxidized-silver tankard and an oxidized-silver pitcher. The first prize in this contest was won by C. L. Edgar of Boston, and for the second prize H. W. Hillman and W. L. R. Emmet, both of Schenectady, were tied. Mr. Hillman defaulted, as he had to leave before the tie could be played, and the prize was awarded to Mr. Emmet. The General Electric Company offered a handsome silver cup as a prize for the lowest gross score, and this was won by President Ferguson with a score of 100.

The General Electric Company acted as host on Friday, and invited the members of the association and those who accompanied them to luncheon at the Summit House, Mount Washington. About 130 members and ladies accepted this invitation and were taken up on the Mount Washington railway on specially reserved cars. After luncheon about 50 members of the party took the stage to Glen Station, while some 30 others walked across the mountains to the Crawford House, the remainder returning by train.

In the evening there was a ping-pong tournament, for which prizes were presented by Mrs. C. L. Edgar of Boston. The winner of the first prize was Mrs. W. C. Fish of Lynn, and of the second Miss Duclos of Boston. The convention adjourned early in order to allow the members to join in an informal dance, which lasted until midnight. This ended the convention, which was pronounced one of the most enjoyable and profitable conventions ever held by the association.

Following is an alphabetically arranged list of the names of those in attendance at the convention:

W. S. Andrews, electrical engineer, General Electric Company, Schenectady, N. Y.; Walter M. Anthony, comptroller, Chicago Edison Company, Chicago, Ill.; A. H. Ackermann, engineer meter department, New York Edison Company, New York; Oliver J. Bushnell, engineer meter department, Chicago Edison Company, Chicago, Ill.; Byron T. Burt, secretary and superintendent, Chattanooga Light and Power Company, Chattanooga, Tenn.; F. E. Barker, chairman Massachusetts Board of Gas and Electric Light Commission, Boston; H. J. Buddy, General Electric Company, Philadelphia; E. J. Bechtel, electrical engineer and superintendent of lighting, The Toledo Railways and Light Company, Toledo, Ohio; Frank P. Cox, General Electric Company, Lynn, Mass.; W. G. Carlton, assistant to chief operating engineer, Chicago Edison Company, Chicago; George W. Cato, electrician and superintendent Edison Illuminating Company, Detroit, Mich.; Robert Charles Petyt Holmes, purchasing agent, Chicago Edison Company, Chicago; C. A. Coffin, president General Electric Company of New York, New York; Charles B. Davis, General Electric Company, Boston; Alexander Dow, general manager, Edison Illuminating Company of Detroit, Detroit, Mich.; A. J. De Camp, vice-president, Edison Electric Light Company of Philadelphia, Philadelphia, Pa.; Ernest H. Davis, treasurer, Edison Electric Illuminating Company of Williamsport, Williamsport, Pa.; W. L. R. Emmet, engineer lighting department, General Electric Company, Schenectady, N. Y.; Charles L. Edgar, president, Edison Electric Illuminating Company of Boston, Boston, Mass.; H. M. Edwards, auditor, The New York Edison Company, New York; Leonard L. Elden, chief electrician, Edison Electric Illuminating Company of Boston, Boston, Mass.; William C. L. Eglin, electrical engineer, Edison Electric Light Company, Philadelphia, Pa.; Louis A. Ferguson, second vice-president, Chicago Edison Company, Chicago; Richard Fleming, General Electric Company, Lynn, Mass.; W. C. Fish, manager Lynn works, General Electric Company, Lynn, Mass.; A. W. Field, secretary and manager, The Columbus Edison Company, Columbus, Ohio; W. W. Freeman, secretary, Edison Electric Illuminating Company of Brooklyn, Brooklyn, N. Y.; E. E. Gilbert, General Electric Company, Schenectady; Gerhard Goettling, Edison Electric Illuminating Company of Boston, Boston, Mass.; Edgar B. Greene, superintendent, The Edison Electric Illuminating Company of Altoona, Altoona, Pa.; George Ross Green, engineer meter department, Philadelphia Edison Company, Philadelphia; John F. Gilchrist, contract agent, Chicago Edison Company, Chicago, Ill.; Charles T. Hughes, New York manager, General Electric Company, New York city; John W. Howell, engineer lamp works, General Electric Company, Harrison, N. J.; Caryl D. Haskins, General Electric Company, Schenectady, N. Y.; R. S. Hale, The Edison Electric Illuminating Company of Boston, Boston, Mass.; George H. Harries, vice-president, United States Electric Light Company of Washington, Washington, D. C.; H. W. Hillman, General Electric Company, Schenectady, N. Y.; D. L. Huntington, general manager, The Washington Water Power Company, Spokane, Wash.; Joseph D. Israel, secretary, The Edison Electric Light Company of Philadelphia, Philadelphia, Pa.; Samuel Insull, president, Chicago Edison Company, Chicago, Ill.; W. H. Johnson, president, Edison Electric Light Company of Philadelphia, Philadelphia, Pa.; P. Junkersfeld, Chicago Edison Company, Chicago, Ill.; Fred M. Kimball, small motors, General Electric Company, Boston, Mass.; P. O. Keilholtz, consulting engineer, United Electric Light and Power Company, Baltimore, Md.; Henry Swift Kimball, superintendent distribution department, Edison Electric Illuminating Company of Boston, Boston; A. S. Knight, comptroller, The Edison Electric Illuminating Company of Boston, Boston; J. W. Lieb, Jr., third vice-president and associate general manager, The New York Edison Company, New York; J. R. Lovejoy, manager light department, General Electric Company, Schenectady, N. Y.; Robert Lindsay, general superintendent, The Cleveland Electric Illuminating Company, Cleveland, Ohio; George F. Morrison, manager lamp works, General Electric Company, Harrison, N. J.; R. H. MacMullan, vice-president and general manager, Des Moines Edison Light Company, Des Moines, Iowa; Thomas E. Murray, second vice-president and general manager, The New York Edison Company, New York; George P. Magner, division superintendent, Old Colony Street Railway Company, Newport Illuminating Company, Newport, R. I.; James T. Maxwell, general agent, The Edison Electric Light Company of Philadelphia, Philadelphia; E. H. Mullin,

General Electric Company, New York city; Thomas G. O'Dea, general manager, Edison Electric Light and Power Company, Erie, Pa.; C. C. Perry, secretary and treasurer, Indianapolis Light and Power Company, Indianapolis, Ind.; Charles H. Parker, assistant superintendent generating department, Edison Electric Illuminating Company, Boston; Charles R. Price, treasurer, New Bedford Gas and Edison Light Company, New Bedford; Hoyt Post, director, Edison Illuminating Company of Detroit, Detroit, Mich.; James G. Roseman, vice-president, Edison Electric Illuminating Company of Atlanta, Atlanta, Ga.; George A. Redman, general superintendent and director, Rochester Gas and Electric Company, Rochester, N. Y.; A. L. Rohrer, electrical superintendent, Schenectady works, General Electric Company, Schenectady, N. Y.; H. G. Stott, constructing engineer, Buffalo General Electric Company, Manhattan Railway Company, New York; Clayton H. Sharp, test officer, Lamp Testing Bureau, New York city; George R. Stetson, president and general manager, New Bedford Gas and Electric Light Company, New Bedford; L. E. Sinclair, general superintendent, United States Electric Light Company, Washington, D. C.; Luther Stieringer, Commonwealth Electric Company, Chicago, Ill.; B. E. Sunny, western manager, General Electric Company, Chicago, Ill.; Elihu Thomson, General Electric Company of New York, Lynn, Mass.; Philip Torchio, engineer of district, New York Edison Company, New York; Mathias E. Turner, The Cleveland Electric Illuminating Company, Cleveland, Ohio; Thomas W. Varley, engineer test department, New York Edison Company, New York; Francis W. Willcox, General Electric Company, Edison Lamp Works, Harrison, N. J.; Philip D. Wagoner, General Electric Company, Schenectady, N. Y.; Arthur Williams, general inspector, New York Edison Company, New York; Herbert A. Wagner, consulting engineer, Edison Electric Illuminating Company of Boston, Boston.

LADIES.

Mrs. Thomas E. Murray, Mrs. John W. Howell, Mrs. Frank W. Lund, Mrs. C. A. Coffin, Miss Coffin, Miss Alice S. Coffin, Mrs. Samuel Insull, Miss Bird, Mrs. L. E. Sinclaire, Mrs. A. L. Rohrer, Mrs. J. T. Maxwell, Mrs. W. S. Andrews, Mrs. E. Marden, Mrs. E. B. Greene, Mrs. Charles T. Hughes, Mrs. H. W. Hillman, Mrs. Alexander Dow, Mrs. J. F. Gilchrist, Mrs. Hoyt Post, Mrs. C. B. Davis, Mrs. F. W. Willcox, Mrs. R. Fleming, Mrs. C. R. Price, Mrs. George R. Stetson, Mrs. H. C. Wirt, Mrs. L. L. Elden, Mrs. C. D. Haskins, Mrs. F. T. Cox, Mrs. T. E. Hughes, Mrs. C. C. Perry, Mrs. H. M. Edwards, Mrs. J. W. Lieb, Jr., Mrs. W. W. Freeman, Mrs. C. L. Edgar, Mrs. W. S. Barstow, Miss Duclos, Mrs. A. S. Knight, Miss Howell, Mrs. J. R. Lovejoy, Mrs. Fred M. Kimball, Miss N. L. Kimball, Mrs. B. E. Sunny, Miss Sunny, Mrs. Louis A. Ferguson, Mrs. Philip Torchio, Miss Eglin, Mrs. A. J. De Camp, Miss De Camp, Mrs. W. H. Johnston, Miss Huntington, Mrs. E. H. Mullin.

Testing the Magnetic Qualities of Materials in Bulk.[1]

By C. V. Drysdale.

During a recent session of the Institution of Electrical Engineers a permeability bridge, by Lamb and Walker, was introduced, and in the discussion which followed Messrs. Evershed, Esson and Hammond drew the attention of the audience to the want which was felt by manufacturers of an instrument which would enable them to determine the magnetic quality of any casting or forging before a large amount of time and expense had been spent in machining it.

If such castings or forgings could be tested and accepted or rejected immediately on delivery, a much greater certainty in the design of machines might be attained.

Hitherto the numerous instruments that have been

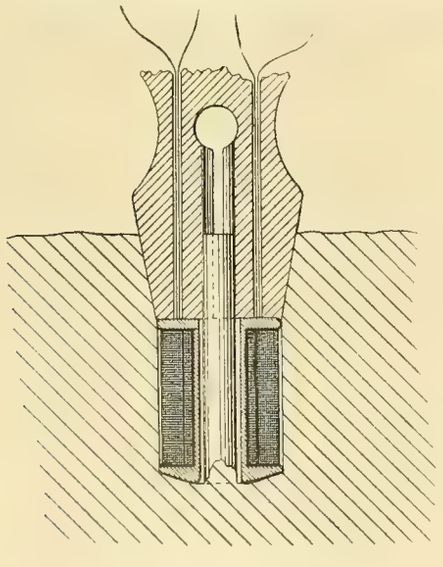


FIG. 1. TESTING MAGNETIC QUALITIES OF MATERIALS.—TESTING PLUG.

devised for the testing of the magnetic quality of material have all been open to the objection that, from the point of view of the electrical engineer, specially prepared specimens—usually in the shape of rods of some inches in length, which have to be accurately turned and perhaps faced—have been necessary. Not only is the preparation of these specimens troublesome, but it is very rarely that tests made on them are of practical value, as they cannot be prepared from the bulk of a casting or forging.

Again, the different specimens of iron, however carefully prepared, may show considerable differences in their magnetic qualities.

The importance of the subject of testing in bulk, and of the references made by Messrs. Evershed, Esson and Hammond at the meeting referred to, so impressed the author of this paper, that he set to work immediately afterwards to devise a piece of apparatus with which permeability tests could be made directly on the castings or forgings. The following text, which is substantially reproduced from the paper read before the same institution, describes in detail the apparatus and various tests made with it. Some of the latter were repeated at the meeting, and served to demonstrate the complete success and utility of the permeameter.

A permeameter for commercially testing iron or steel for engineering purposes should, as far as possible, fulfill the following requirements:

(a) It should be capable of testing specimens, either in the form of large or small castings or forgings, or in the form of rods or plates.

(b) The test should be rapidly effected.

(c) The apparatus should be self-contained and portable.

(d) The instruments should be direct-reading, and the test should not require experimental skill.

(e) It should be capable of testing either the permeability, the retentivity, or the complete hysteresis cycle.

(f) It should be simple and strongly made, and should be capable of being easily checked or recalibrated if deranged. It should not depend on previously standardized specimens.

The above list contains practically all the most important points, and it will be seen from what follows, how far the apparatus satisfies these requirements.

A few preliminary remarks on the principles which led to the design of the instrument may not be out of place, as they may lead to other solutions of the problem.

The various methods of testing the permeability of iron may be divided into three principal classes.

1. Magnetometer Methods.—In these the specimen is usually in the form of a long thin rod, and its magnetization is measured by the external force it produces at some point.

2. Ring Methods, in which the specimen is made up into a complete or split ring, the magnetization being measured by search coil or by the attraction between the two halves of the ring.

3. Yoke Methods.—The specimen is here in the form of a uniform rod, and is provided with a heavy

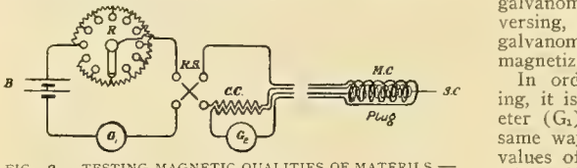


FIG. 2. TESTING MAGNETIC QUALITIES OF MATERILS.—DIAGRAM OF CONNECTIONS.

iron yoke or return path. Numerous devices are employed to determine the magnetization.

At first sight one would look for some form of magnetometer test as being the most promising, but the difficulty is, first, that in irregularly shaped bodies the connection between the external forces and the intensity of magnetization cannot easily be arrived at; and, secondly, that unless the specimen is very long in comparison with its transverse dimensions, its quality has very little effect on the field produced. It does not seem likely that any universal method can be devised which depends upon this principle.

The objection to either of the latter methods, from a practical point of view, is that if the ring or bar is of any great size, it cannot be prepared from the casting or forging. If, however, it can be arranged to use very small rings or rods, there is no reason why they should not be drilled from the bulk of the metal to be tested. The rods could be drilled out by some form of hollow drill, while the rings could be easily cut out of the solid by a properly designed expanding drill.

The ring method, however, suffers from the further objection that the magnetizing and search coils have to be wound through the center of the ring, which would be exceedingly troublesome. Moreover, it would be somewhat difficult to ensure the exact dimensions of the ring. We are thus thrown on the yoke method, and this may be carried out by drilling out a straight cylindrical specimen from the bulk, and inserting it in a yoke as in a Hopkinson permeameter.

The writer has adopted the plan in commercial testing of making both the specimen and the greater part of the return path from the bulk of the material tested. A drill of a special form is employed, which cuts a circular hole in the specimen, conical at the top, leaving a pin in center of it. In the instrument usually made this hole is three-eighths inch in diameter and five-eighths inch deep, and the diameter of the pin is one-tenth inch, but these dimensions could be considerably reduced if necessary.

The testing arrangement consists simply of a soft-iron plug, carrying a bobbin, on which are wound two circuits, a magnetizing coil and a search coil. The plug is split, and is turned slightly conical on its outside surface, while the drill cuts the cone of the same angle as that of the plug. It will thus be seen (Fig. 1) that on drilling the hole and inserting the plug a perfect miniature permeameter is produced, having an exceedingly good magnetic circuit, and in which either the permeability, retentivity, or hysteresis can be determined by ordinary methods.

Before going further into the details of the apparatus it will be well to say a few words about the drilling of the specimen. There are very few castings or forgings in which a hole of the size mentioned would not be admissible probably in the places reserved for bolt holes; but in the event of its not being allowable, there is no objection to a boss being left on the casting in any convenient position for the purpose of test, and which could be cut off before drilling. This is analogous to the procedure adopted in optical work, where for large telescopes the discs of glass are cast for small projections, from which the prisms can be cut for testing. For small castings, as above mentioned, it would be possible to reduce the drill and plug to half the dimensions above stated, if necessary. The time of drilling appears to be about ten minutes in the case of cast iron, and about fifteen minutes in the case of wrought iron; but this appears to be a

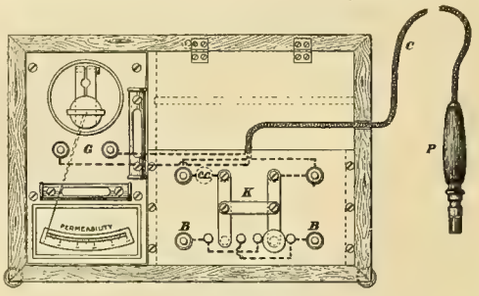


FIG. 3. TESTING MAGNETIC QUALITIES OF MATERIALS.—TESTING SET.

small consideration in comparison with the importance of the information obtained, and it may be possible to reduce this time considerably.

Fig. 2 shows the connections which are most simply employed. The magnetizing coil (MC) of the plug is supplied with current from a battery (B), through a regulating resistance (R) and ammeter (G), and reversing switch (RS). Connection is also made from the search coil (SC) to a ballistic galvanometer (G_2). On making, breaking and reversing, the switch deflections are obtained on the galvanometer (G_2), which are proportional to the magnetization of the specimen.

In order to make the instruments direct reading, it is easy to provide a scale for the galvanometer (G_1), so that it reads the value of H. In the same way a scale is provided for (G_2) reading the values of B directly. The permeability is then obtained, if necessary, by dividing the value of B by that of H; but it is generally sufficient to compare the values of B obtained with the curve of some satisfactory specimen.

In ordinary commercial testing of castings, etc., it would probably be sufficient to know the value of the permeability for one value of the magnetizing force. In this case the arrangement may be further simplified by withdrawing the resistance (R) and galvanometer (G), and simply arranging for the cells to give one definite current. The divisions on the galvanometer (G_2) may then be marked directly with values of the permeability.

There are, of course, other methods of taking the observations, but notwithstanding the attractions which they offer, I have preferred, up to the present, to adhere to the simple ballistic test, as it requires only slightly more skill to read the ballistic throw, and the connections are more simple. Moreover, the handle-turning methods do not lend themselves well to determining the retentivity of the specimens or their B-H cycles, but simply give the mean B-H curve.

The apparatus is at present made in two forms—the simplex, which allows of the permeability and retentivity being directly read off, and the second, in which the magnetization curve and the B-H cycle can also be arranged.

Fig. 3 shows the former of these arrangements. It simply consists of a wooden case, 11 by 7½ by 11½ inches high, containing a battery of two large dry cells, a reversing key (K), the plug (P) which is connected by a long quadruple flexible conductor (C) to the key (K), and to a d'Arsonval ballistic galvanometer (G), which is marked directly in values of the permeability. Space is provided under a flap for the plug and drills.

In order to obtain a test, all that is necessary is to drill the specimen, insert the plug and reverse the key. The pointer then swings to the value of the permeability, and if the circuit is then broken and twice the second reading taken from the first, the value of the retentivity is given.

The complete set differs from the last only in the addition of a milliammeter and a resistance dial, increasing the length of the case to 16½ inches. The galvanometer (G) is then arranged to read the values of B and also the values of μ when H = 100. The total and residual magnetization curves are obtained as before, while the cycles are determined by observing the throws corresponding to successive variations of the resistance and summing them in the well-known manner. Fig. 4 shows total and residual magnetization curves for three specimens of mild steel, wrought iron and

1. From Feilden's Magazine.

cast iron, while Fig. 5 represents the corresponding B-H cycle obtained in this way from a specimen of wrought iron. The annexed tables contain some of the readings actually obtained:

TABLE I.

Tests of Magnetization and Retentivity of Mild Steel Specimen.

H	B	Deflection on Break.	Residual Magnetization.
5	3,600	750	2,100
7.5	5,700	1,200	3,300
13.5	8,900	1,900	5,100
22	11,400	2,700	6,000
35	13,500	3,450	6,700
44	14,600	3,800	7,000
58.7	15,400	4,100	7,200
76.5	16,200	4,500	7,200
98.2	16,850	4,800	7,300
140	17,600	5,100	7,300
188.5	18,400	5,400	7,600

TABLE II.

Magnetization Cycle of Cast-iron Specimen.

H	D	B=ΣD
− 35.7	+ 4,300	+ 4,300
+ 25.5	− 400	+ 3,900
− 19.6	− 220	+ 3,680
− 5.5	− 800	+ 2,880
+ 3.0	− 230	+ 2,650
0	− 360	+ 2,290
− 3.0	− 380	+ 1,910
− 4.5	− 350	+ 1,560
− 7.0	− 650	+ 910
− 18.0	− 3,150	− 2,240
− 23.2	− 870	− 3,110
− 31.8	− 980	− 4,090
− 34.3	− 320	− 4,410
− 23.8	+ 350	− 4,060
− 17.7	+ 320	− 3,740
− 5.3	+ 700	− 3,040
− 3.3	+ 220	− 2,820
0	+ 320	− 2,500
+ 3.2	+ 400	− 2,100
+ 5.4	+ 400	− 1,700
+ 9.8	+ 1,350	− 350
+ 16.6	+ 2,000	+ 1,650
+ 21.2	+ 880	+ 2,530
+ 26.0	+ 750	+ 3,280
+ 34.1	+ 720	+ 4,000

It will be necessary to say a few words about the construction of some of the parts of the apparatus in order to show what amount of confidence may be placed in the results.

About the drills little need be said, except that they must all be made accurately to gauge, so as to be interchangeable. In order to make them more easy to center truly in drilling they are now made with a certain amount of relief in the bottom cutting edges. The form used did not seem to be truly in conformity with the best principles as to cutting edges, and it is probable that improvements may be effected whereby the time of drilling may be considerably reduced. It is, however, the best of some two or three forms that have been tried.

The plug demands a little more attention. To

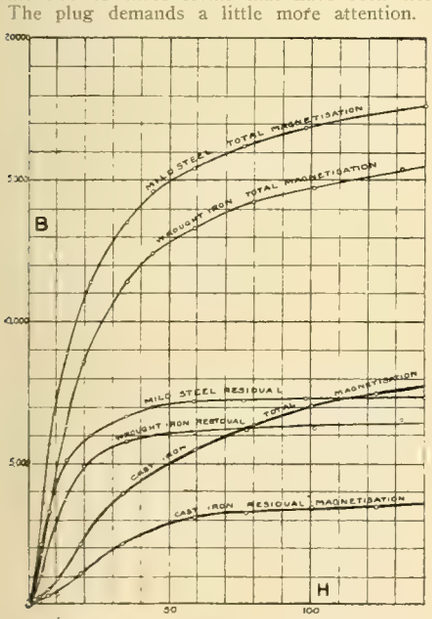


FIG. 4. TESTING MAGNETIC QUALITIES OF MATERALS.—TOTAL AND RESIDUAL MAGNETIZATION CURVES.

make the magnetic joints as perfect as possible the plug is very carefully turned to have the same angle as the drill, and the central hole the same diameter as that of the pin. In order, however, to ensure perfect contact the plug is split longitudinally, as will be seen on looking back at Fig. 1, so that on pushing it into place it grips tightly on the pin. Great care is taken to have the bottom edge of the aperture in the plug quite sharp, so as to give certainty in the length of the pin used.

The magnetizing and search coils are wound on an insulated brass bobbin split longitudinally to prevent eddy currents. This bobbin is screwed to the end of the plug in such a manner as to still allow of the yielding due to the slit, and the ends of the coils are brought up through the plug as shown.

In order to arrange for a perfectly definite length of specimen a standard piece of steel is kept which has been drilled in the ordinary manner and afterward cut through near the edge of the cavity, so as to expose the interior. The plugs are then turned or ground down until, when they are pushed home in this specimen, the length of the pin exposed is exactly one-half inch. Since the value of H is $\frac{4\pi}{10}$ the ampere-turns per centimeter length, the number of turns required for the current in milliamperes to equal H in gausses is

$$\frac{10}{4\pi \times 30.37 \times 2} = 1{,}010 \text{ turns.}$$

In calibrating the ballistic galvanometer it must not be forgotten that, being a moving-coil instrument on a small external resistance, the damping is considerable—as, indeed, is necessary in a commercial instrument. Standardization of the galvanometer by condenser is therefore unsatisfactory, and the best procedure is to obtain the throw corresponding to a known current and a known coefficient of mutual induction, or with a search coil and magnet previously measured on some other galvanometer.[1] If the search coil is of low resist-

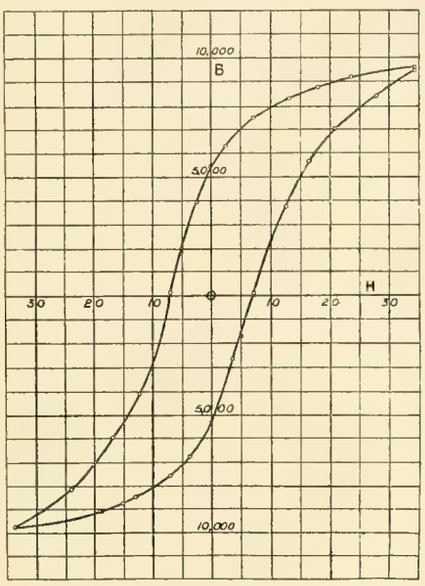


FIG. 5. TESTING MAGNETIC QUALITIES OF MATERIALS.—B-H CYCLE OF WROUGHT IRON.

ance and is interposed in the galvanometer circuit the damping will be unaffected. Terminals are provided on the instrument which will allow of this test being made should it be necessary.

One other matter should not be forgotten. The small size of the pin makes the gap between it and the search coil of some influence on the results, as the coil not only cuts the lines passing through the pin, but those in the annular space between it and the search coil. The effect is not large, but it can easily be allowed for by the simple expedient of winding a few turns of wire in the magnetizing and search-coil circuits together round a bobbin. A reading is first taken by reversing the current without the iron core. Then if D is this deflection, d_1 and d_2 the diameters of the pin and search coil, the deflection due to the space may be approximately taken as $\frac{d_2^2 - d_1^2}{d_2^2} D$. The number of turns in the compensating coil is adjusted to give this deflection, in the opposite direction, and thus eliminates the effect entirely. The compensating coil is shown in Figs. 1 and 3, marked (CC).

The highest value of H employed is 100, which corresponds to 100 milliamperes of current from the cells. As this is only on for the time of making and throwing over, there should not be much trouble with deterioration of the cells.

The readings appear to reproduce themselves with the most perfect accuracy. In a deflection of 230 divisions, obtained with a certain value of the current in a cast-iron specimen, a variation of one division in the deflection was very rare, although the plug was taken out and reinserted between the readings, and no particular care was used in replacing it. The perfection of the magnetic joint obtained by the conical fit appears to be all that can be desired, and is certainly better than can be obtained by any ordinary faced joints.

The sole point upon which experience is required is in the drilling of the specimens. No trouble has yet been found in drilling specimens of metal, such as can be put on a lathe, but for larger castings, etc., some form of portable drilling machine would be necessary. Should any difficulty be found in getting the drill properly centered, it would probably be well to drill a shallow hole first, with an ordinary twist-drill or rose-cutter, and any trouble as to wearing of the drills could be avoided by keeping a standard drill for a finishing cut. There is, however, no reason at present to suppose that such expedients would be necessary, and in any case all trouble would be avoided if small projections were left on the castings or forging and cut off before drilling.

1. The Hibbert standard inductor may be conveniently employed.

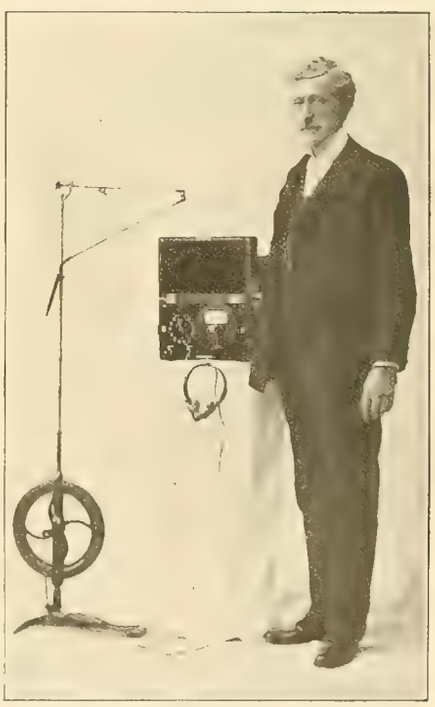
Electrical Anæsthesia in Dental Surgery.

During the last few months several announcements have been made of the use of electricity as an aid to dental surgery in the way of producing anæsthesia, deadening live nerves, etc. One of these methods has been brought out by Regnier & Didsbury of Paris, France, and consists in replacing the ordinary anæsthetics used by the action of high-frequency currents. In the case of extraction the system worked quite successfully.

A d'Arsonval-Gaiffe apparatus was employed, having a coil which gave a 1.2-inch spark, with a rotary interrupter and an oil condenser. The apparatus was connected to an Oudin resonator, one of whose terminals was joined by a flexible cord to an electrode fixed upon the jaw. The electrode was molded in plastic material and covered inside by metallic powder and a layer of tinfoil. Under these conditions the current is said to have given the patient no sensation other than a slight heating in the region covered by the electrodes. It was found that a tooth with one root was made completely insensible by the application of a current of 150 milliamperes for three to five minutes, while the larger teeth needed 200 to 250 milliamperes for six to eight minutes. As to the use of the method for more prolonged operations, the experiments are not as yet conclusive, although they are favorable on the whole.

A somewhat similar system has been devised by Thomas W. McCue, an inventor of Akron, Ohio. The apparatus used and its inventor are shown in the accompanying illustration. The negative side of the circuit is connected to a head piece which has terminals that are placed in contact with each side of the face and held in position by means of a hard-rubber band. The positive side of the circuit is attached to an ordinary dental engine and the current passes through the burr of the drill to the patient.

By means of the apparatus, the inventor says (these statements are given entirely on Mr. McCue's authority) that he short-circuits the pain, or, in other words, succeeds in the removal of exposed nerves by preventing the transmission of the sensation impulses to the brain by short-circuit. This is



ELECTRICAL ANÆSTHESIA IN DENTAL SURGERY.—M'CUE APPARATUS.

done by low voltage and high resistance. The storage battery used is made especially for the purpose and consists of 12 cells. All the cells are used in starting, but while operating only one cell producing one volt of electromotive force is used. The current from this cell is cut down to less than one three-hundred-thousandth of its strength by means of a resistance of 300,000 to 400,000 ohms. The current is reduced so fine that Mr. McCue says, as well he may, that he has found no instrument capable of measuring it. Sufficient current is produced, however—perhaps on the homeopathic principle—to enable one to operate on the most sensitive teeth without pain. The inventor himself was the first one to submit to an operation by means of which a live nerve was painlessly removed. Since then many similar operations have been performed, he says, by dentists in Akron with great success. No shock is felt, and it is said that the effect is that of a tonic, the patients getting out of the chair recuperated and refreshed.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

New Electrically Operated Bascule Bridge over Chicago River. Illustrated ... 187, 188, 189
Old Time Telegraphers ... 188
Electricity as a Factor in Automobilism ... 188
Association of Edison Illuminating Companies.—Convention in the White Mountains, September 9–11, 1902 ... 189, 190
Testing the Magnetic Qualities of Materials in Bulk. By C. V. Drysdale. Illustrated ... 190, 191
Electrical Anæsthesia in Dental Surgery. Illustrated. ... 191
Editorial ... 192
British Association ... 193
Death of Sir Frederick Abel ... 193
American Electrochemical Society ... 193
Incandescent Lamps Made in the Netherlands ... 193
Home-made Electrical Apparatus. (Communication) ... 193
Pennsylvania Street Railway Association ... 194
New York Street Railway Association ... 194
Special Train to Detroit Convention ... 194
Manhattan Third-rail Insulator. Illustrated ... 194
Another Great Power Project in California ... 194
Dispute over Central-station Heating in Evanston ... 194
Searchlights in Mimic Warfare ... 194
Matters Telegraphic ... 194
Space Telegraphy ... 195
Disappointing Results in Naval Tests ... 195
Operations by Signal Corps During Recent War Maneuvers ... 195
In Foreign Navies ... 195
German War Maneuvers ... 195
Marconi Confident ... 195
Telephonic Experiments ... 195
Big Electric-railway Consolidation Proposed in Michigan ... 195
Indiana Electrical Association ... 195
Electric Intramural Railway for St. Louis World's Fair ... 195
Development of the Telephone Field ... 196
Independent Telephone Men in Conference ... 196
Kansas Independent Telephone Association ... 196
Indiana Telephone Items ... 196
Telephone News from the Northwest ... 196
Ohio Telephone Notes ... 196
Interstate Telephone Convention ... 196
Telephone Men ... 196
Manufacturers and Dealers ... 196
Checking Electrical Instruments. By Clayton H. Sharp. Illustrated. (Association of Edison Illuminating Companies) ... 197
Armour Institute Evening Classes ... 197
Electrical Power Possibilities of Mountain Streams in France ... 197
A Survey of Electrical Patents Granted by the United States. By Story B. Ladd. Part II ... 198
Jackson Portable Electric Hammer. Illustrated ... 198, 199
High-tension Work in the Far West By George H. Lukes. (Association of Edison Illuminating Companies) ... 199, 200
Durability Tests of Storage Batteries ... 200
Blast-furnace Gases for Factory Power Plant ... 200
High-speed Electric Mail Delivery ... 200

DEPARTMENTS.

Correspondence ... 201, 202
New York Notes ... 201
New England News ... 201
Southern Developments ... 201
From the Buckeye State ... 201
Information from Indiana ... 201
Northwestern Notations ... 202
Personal ... 202
Electric Lighting ... 202
Electric Railways ... 202, 203
Automobiles ... 203
Publications ... 203
Societies and Schools ... 203
Telegraph ... 203
Miscellaneous ... 203
Trade News ... 203
Business ... 203, 204
Illustrated Electrical Patent Record ... 204

CONVENTIONS AND EXPOSITIONS.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

GERMANY was foremost among foreign nations in the electrical display at the Chicago World's Fair of 1893. Indeed, the great 60-inch Schuckert searchlight on the roof of Manufactures Building, with its beam sometimes visible 80 miles away, was one of the most spectacular features of the exposition. And now it appears likely that the German electrical exhibit at St. Louis in 1904 will likewise be large and carefully selected. The emperor is reported to be taking a personal interest in the representation of his country at the Louisiana Purchase Exposition, and it is said that the electrical part of it will be especially fine. But what will be the chef-d'œuvre, comparable to the giant projector that excited so much attention nine years ago?

ALTHOUGH the exports from the United States to Africa show a greater relative increase than those from the United Kingdom to the erstwhile Dark Continent, they are still comparatively small. In 1901 the figures were: From the United States, $29,652,093; from the United Kingdom, $157,130,000. Of course, Great Britain has the advantage of its colonies and of favoring ocean freight rates, but it would seem that American exporters should bestir themselves to secure a greater proportion of the trade of this important market. Much has been done in the way of introducing American mining machinery, particularly in South Africa, but it seems likely that with greater effort electrical and other manufacturers in the United States could ship more of their products to Africa, which is bound to offer a field for active development for many years.

HAVING ventured to praise the performance of the American Allis engines in the street-railway plant in Glasgow, Engineering of London—a journal of the highest reputation—is berated by some of the electrical and other journals of England with the noisy energy of fishwives. Professor Barr, an eminent English expert, after making exhaustive tests, is reported to have found the efficiency of the Allis engines to be 96 per cent. and the efficiency of the engines and generators together to be 92 per cent. Engineering published these facts in a fair-minded article, and in so doing excited some of the lesser technical journals to a pitiable degree. The state of mind of some of these rabid anti-American publications is really amazing, and gives the lie to all British traditions of fair play. It is reassuring, however, to observe that the really important technical journals do not join in this noisy abuse, but state the case of the American machinery with common decency and fairness.

MEDICAL men, in their zeal for the public health, have provided a new argument for the use of electric lighting. They show that the purity of the air in cities is especially affected by leakage in gas mains, which is much greater than is commonly realized, and also that the resulting injury to the public health has been increased by recent changes in processes of gas manufacture. At a recent meeting of the New York County Medical Society the subject was discussed. Some of the facts in the alarming recital may be thus summarized:

There is an immense amount of gas leakage in our large cities. Millions of cubic feet per day are reported to gas-company directors as lost from the mains. The impermeable sidewalk and pavement of asphalt make the ready diffusion of escaped gas into the atmosphere an impossibility in many places. The consequence is the imprisonment of the gas beneath the streets, to find an exit wherever it can into subways, sewers and through the cellar walls of neighboring houses. This produces a condition of affairs that is eminently undesirable. The illuminating gas of the present time is a dangerous poison. Modern "improvements" in its manufacture have added to its toxic qualities and have rendered it more insidious in its effects. The introduction of the so-called water-gas, now practically exclusively used as the basis of illuminating gas, has cheapened the cost of production, but has greatly added to the amount of carbon monoxide present in gas. This gas is perhaps the most poisonous that human beings may be brought in contact with in ordinary life. There is, therefore, reason for serious concern in relation to the present gas leakage.

Of course, the remedy is an obvious one. It is, use the electric light, eliminating from consideration, naturally, the primitive candle and malodorous oil-lamp. Electric-light wires may have their faults, but they do not leak a subtle poison; they are guiltless of the deadly carbon monoxide. Even in the case of fuel gas it may prove to be better to discard it resolutely. Instead of it, those who want the very best may install electric heating and cooking apparatus, and thus banish the possibly dangerous furnace or stove as well as the health-sapping gas pipe.

IN OHIO the special session of the Legislature is exciting a great deal of attention, and particular interest seems to be centered in that portion of the new code which deals with the franchise question in the large cities and towns. It is said that the stockholders of some of the large street-railway systems are favorable to a perpetual franchise, with a provision for a readjustment every 10 years, and Senator Hanna has been quoted as in favor of this, but he has denied the report, and says he is satisfied with the law the way it stands. However, it appears to be pretty generally agreed among the members of both houses of the Legislature that the franchise question will be dropped, the existing laws being allowed to stand for the present. Mayor Tom L. Johnson of Cleveland has, nevertheless, urged the Legislature to take up the question, saying that it should at least require that no ordinance renewing a grant should be effective until it has been approved by a majority vote of the people. The Hon. Tom is an effective manufacturer of campaign issues, but his political ambitions are such that he fails to concede to public-service corporations the rights that are legitimately theirs.

ELECTROCHEMISTS are endowed with great energy. In this country they were rather behind their European brethren in getting together, but once the bond of cohesiveness was found they exploited their organization with great vim and enthusiasm. They formed the American Electrochemical Society in Philadelphia last April, and now, scarcely five months later, they are holding their second general meeting in Niagara Falls, the gathering being scheduled for four days. The society has been very successful from the start, both in point of numbers and character of membership, and it is holding meetings with the prodigality and zest of lusty youth. After a time, perhaps, like the National Electric Light Association and other electrical bodies that have undergone a similar experience, it will discover that it can compare notes sufficiently well by a getting-together once a year. But the field is certainly wide, with very great possibilities, and it is not strange that the new organization, which has the best wishes of all electrical men, and no doubt of all the chemists also, finds plenty to discuss at its frequent meetings. A report of the proceedings of the first day at the Niagara Falls convention is given on another page in this issue, and an account of the remaining sessions will be given in this journal next week.

WHAT is, we believe, an unusual, but nevertheless well deserved, compliment was paid to the officers of the Association of Edison Illuminating Companies by their re-election in a body last week at the convention in the White Mountains. Mr. L. A. Ferguson, the president, is one of the most alert and progressive central-station men in the country, particularly well fitted to discharge the duties of an executive office, and the other gentlemen thus honored are also worthy of their respective distinctions. This association accomplishes much useful work for its members, but has from the outset pursued a policy of exclusiveness, which might now be relaxed with advantage, perhaps, in view of the change in the electric-lighting situation that has taken place since its organization. However, while regretting that more of the results of its deliberations are not made public for the good of the fraternity at large, one must recognize the right of the organization to rule its own household as it sees fit. The association follows the sensible custom of meeting, not in large cities, but in some resort where the members can be easily kept together and yet find means for rational enjoyment during the portions of the day when no business sessions are held. Very likely some attractive place of this character in the West will be selected for the meeting of next year. Lake Geneva, in Wisconsin, has been suggested. This is a charming summer retreat, 86 miles from Chicago, and if the hotel problem could be arranged no better selection could be made.

British Association.

The seventy-second annual meeting of the British Association for the Advancement of Science, forecasted in the Western Electrician last week, was commenced at Belfast, Ireland, on September 10th. The attendance was larger than at any former gathering of the association, with the exception of that of 1901 at Glasgow. The address of James R. Dewar, president elect, was largely devoted to a review of progress of physical chemistry. In the course of his remarks President Dewar referred to recent munificent benefactions to science and education, and especially to the gifts of Andrew Carnegie and the late Cecil Rhodes. He deplored Great Britain's backwardness in relation to applied chemistry, and said that the country's loss of valuable industries and its precarious hold upon others was due to "want of education."

At the sectional meetings of the association the respective presidents delivered their annual addresses to large audiences. Many of these contained complimentary references to the United States, which was held up as the model which Great Britain ought to follow.

Professor H. E. Armstrong of the educational section made a strong plea for the injection of some American life and energy into the British educational system and paid a high tribute to the imaginative insight and foresight of "Our American cousin, Captain Mahan," who had taught the nation the true meaning and value of sea power. Professor Armstrong contended that what British education to-day needed was to appreciate the value of a scrap heap.

Professor W. D. Halliburton of the physiological section spoke highly of the work of Professor Loeb and his colleagues of the University of Chicago in the new field of physical chemistry.

A great variety of subjects were discussed by the different sections. In the economic section Robert P. Porter, ex-supervisor of the United States Census, spoke on "Municipal Ownership," devoting special attention to the progress made in that direction in Europe.

The engineering section has been much interested in the model of an electric express train, which, paradoxically, stops at all stations. The idea is that a simple train composed of several corridor carriages as it passes each station, drops off behind one carriage containing passengers who want to alight there, and picks up in front another from that station, all this being done while the train is traveling at full speed. The carriage to be attached has to start in advance and get well under way by the time the train catches it, and is coupled by a patent automatic arrangement. The scheme is only possible where each carriage has its own motors on the multiple-unit system.

Death of Sir Frederick Abel.

Sir Frederick Augustus Abel, Bart., honorary secretary of the Imperial Institute, and one of the leading men of science in England, is dead. Sir Frederick Abel was born in London, England, on July 17, 1827, and during his life held many prominent positions under the English government and with different scientific societies. He was known principally through his work in chemistry, on which branch of science he had written quite a number of books.

He was the first demonstrator of chemistry at St. Bartholomew's Hospital in London and professor of chemistry at the Royal Academy in 1852. In 1854 he became chemist of the War Department, and held the office until 1888. In 1883 he was commissioner to the Electrical Exhibition at Vienna and was knighted in that year. He was created a baronet in 1893. The deceased was Bakerian Lecturer in 1007, and Rede Lecturer in 1888.

From 1888 to 1891 Professor Abel was president of the government commission on explosives, a member of the royal engineers' committee, and associate member of the ordnance committee. In 1891 he retired from government service. He was past-president of the Institute of Chemistry, of the Society of Chemical Industry, of the Chemical Society, of the Institution of Electrical Engineers, of the British Association, and of the Iron and Steel Institute.

The Albert, Bessemer, Royal and Telford medals were awarded to Sir Frederick. He was at one time vice-president of the Royal Institution, prime warden of the Goldsmiths' Company, chairman of the City and Guilds Institute for Technical Education, and was a member of the Royal Commission for the World's Columbian Exposition at Chicago.

Sir Frederick Abel's published works include "The Modern History of Gunpowder;" "Gun Cotton;" "On Explosive Agents;" "Researches in Explosives" and "Electricity Applied to Explosive Purposes." He was joint author with Colonel Bloxam of a "Handbook of Chemistry." At the time of his death Sir Frederick Abel was honorary secretary and director of the Imperial Institute, of which he became organizing secretary in 1887.

American Electrochemical Society.

Niagara Falls, September 15.—The second general meeting of the American Electrochemical Society assembled here this morning for a four-day convention. The headquarters are at the International Hotel. The first meeting of the society was held in Philadelphia in April last, but despite this tender age, the society already has a fine membership. Before the morning session of to-day was ended the register showed more than 100 members and guests present, and it was a significant fact that the majority of the attendance is made up of young men alert to the possibilities of their profession.

It was shortly after 10 o'clock when Dr. Joseph W. Richards, president of the society, called the meeting to order in the music room of the International. The reading and discussion of papers followed. The first paper was that of Francis A. J. Fitzgerald of Niagara Falls, entitled "Note on Testing Carbon Electrodes." The reading of the paper occupied about 20 minutes. It was well received and three or four participated in the brief discussion that followed.

Prof. J. W. Richards, Ph. D., Lehigh University, Bethlehem, Pa., followed with a most interesting paper on "Efficiency of Electric Furnace Operation." While Professor Richards read his paper, Dr. Charles A. Doremus of New York occupied the chair. There was a short discussion.

P. G. Salom of Philadelphia was to have read a paper entitled "Additional Notes on Lead Reduction," but President Richards announced that owing to the condition of patents pending, Mr. Salom had deemed it inadvisable to present his paper at this time. It was promised, however, that under other conditions the paper would be given at the annual meeting.

Alfred T. Weightman of Niagara Falls read a paper on "Cathodic Reduction," and Prof. Louis Kablenberg, Ph. D., University of Wisconsin, Madison, Wis., a paper on "Differences of Potential Between Metallic Cadmium and Solutions of Cadmium Iodide in Various Solvents."

This afternoon has been devoted by the members to visiting the plants of the Niagara Falls Power Company. While many of the convention had previously visited the big power house, they found in the magnificent new work a vast amount that deeply interested them and made them marvel at the future of Niagara Falls as an electrochemical center. This evening a reception was enjoyed at the hotel. The banquet which was on the programme for to-night has been changed until Wednesday evening. It will be an elaborate affair, in which Manager Greenwood will demonstrate the excellent facilities of his hotel.

When the convention assembles to-morrow morning it will be in the auditorium of the Natural Food Company on Buffalo Avenue. Several papers are on the programme for this session. The afternoon will be passed in visiting plants where invitations have been extended, and some will visit other points of interest. In the evening the gorge searchlight trip will have favor, and Wednesday morning will see the body again in session at the International Hotel. There are five papers on the programme for this session. On Wednesday afternoon the members will visit the Canadian side to view the scenic and industrial features of that locality. On Thursday morning the final session of the convention will be held. D.

[A report of the concluding sessions will be given in the Western Electrician next week.]

Among those registered as members and guests are the following-named:

C. M. Hall, Niagara, Falls; William Richards, Bethlehem, Pa.; W. D. Bancroft, Ithaca, N. Y.; C. W. Thomas, Nutley, N. J.; E. F. Roeber, Philadelphia, Pa.; Louis Kahlenourg, Madison, Wis.; Henry S. Carhart, Ann Arbor, Mich.; Carl Hering, Philadelphia, Pa.; Samuel Sheldon, Brooklyn, N. Y.; J. W. Richards, Bethlehem, Pa.; F. J. Tone, Niagara Falls; William Hoskins, Chicago, Ill.; Walter P. Hart, Philadelphia, Pa.; S. H. Ross, Philadelphia, Pa.; W. A. Robbins, Camden, N. J.; George W. Patterson, Ann Arbor, Mich.; Col. S. Reber, Washington, D. C.; William H. Brown, Jr., New York; C. F. Burgess, Madison, Wis.; Mrs. W. A. Robbins, Camden, N. J.; A. A. Kendson, New York; W. O. Snelling, Washington, D. C.; E. G. Acheson, Niagara Falls; F. G. Wiechmann, Brooklyn, N. Y.; W. H. Walker, Boston, Mass.; F. M. Becket, Niagara Falls; J. C. Heckman, Buffalo, N. Y.; John A. Miller, Buffalo, N. Y.; Harold C. Pease, Buffalo, N. Y.; James MacMahon, Niagara Falls; R. W. English, Buffalo; F. A. J. Fitzgerald, Niagara Falls; E. H. Mullin, New York; H. B. Moss, Buffalo; C. B. Barton, Berlin, N. H.; R. N. Koford, Buffalo; G. M. Turner, Buffalo; H. S. Lamsdale, Buffalo; G. W. Englehart, Buffalo; Henry Howard, Brooklyn, Mass.; R. S. Hutton, Manchester, Eng.; Dr. F. J. Mashaiske, Long Island City, N. Y.; O. W. Brown, Bloomington, Ind.; E. A. Byrnes, Washington, D. C.; G. F Brindley, Niagara Falls; A. P. Weightman, Niagara Falls; C. Hambuechen, Madison, Wis.; A. B. Marvin, Jr., Washington, D. C.; Henry Noel Potter, New York; Earl Blough, Ithaca, N. Y.; E. S. Shepard, Ithaca, N. Y.; F. E. Schmidt, New York; Norwood Dodge, Philadelphia, Pa.; G. M. Howard, Philadelphia, Pa.; Frank M. Oliver, Philadelphia, Pa.; Edward Hart, Easton, Pa.; R. J. Nwnn, Savannah, Ga.; Miss C. A. Lee, Rochester, N. Y.; Dr. Sarah R. A. Dolly, Rochester, N. Y.; C. W. Roepper, Philadelphia, Pa.; C. E. Acker, Niagara Falls; Woolsey McA. Johnson, New Brighton, N. Y.; W. F. Doerflinger, Niagara Falls; Henry G. Morris, Philadelphia, Pa.; Hughes Rodman, Philadelphia, Pa.; E. W. Smith, Philadelphia, Pa.; J. C. Roberts, Niagara Falls; N. S. Keith, New York; F. J. Maynard, Brooklyn; L. H. Flanders, Pittsburg, Pa.; L. A. Parsons, Baltimore, Md.; C. F. Lorenz, Iowa City; Erik W. Tillsberg, Worcester, Mass.; George N. Jefferson, Worcester, Mass.; E. R. Taylor, Penn Yan, N. Y.; Miss Edith Taylor, Penn Yan, N. Y.; Mrs. E. R. Taylor, Penn Yan, N. Y.; C. E. Taylor, Penn Yan, N. Y.; A. Von Isakovice, New York; Dr. Gustav Drobegg, New York; George W. Fletcher, Brooklyn; R. A. Witherspoon, Niagara Falls; William W. Whitten, Niagara Falls; T. E. Steere, Niagara Falls; Max Mauran, Niagara Falls; Richard F. Morgan, Buffalo.

Incandescent Lamp Trade in the Netherlands.

While about 500,000 incandescent electric lamps are annually used in the Netherlands, there are only three firms engaged in their manufacture, viz., Philips & Co. at Einhoven, and E. Goossens, Pope & Co. and the Company Constantia at Venlo. Most of the lamps used are imported, the principal part coming from Germany and a small percentage from England, Belgium and Switzerland.

Incandescent lamps are imported in every quantity, from lots of 50 or 100 to 1,000 or more. "I have not been able," says Mr. S. Listoe, the United States consul-general at Rotterdam, "to ascertain the total imports, no statistics existing on the subject. Foreign manufacturers who send incandescent electric lamps to the Netherlands are the Allgemeine Elektricitäts Gesellschaft, Berlin; Siemens & Halske, Berlin; Edison & Swan United Electric Light Company, Limited, London; La Société Anonyme Belge, Brussels; Improved Electric Glowlamp Company, Limited, London; Gebrüder Pintch, Berlin, and the Zurich Incandescent Lamp Company, Zurich, Switzerland.

"The market price per lamp for 1902 is quoted at 50 pfennigs (about 12 cents) by the Allgemeine Elektricitäts Gesellschaft. Various discounts are granted, according to the size of the order given. The Nernst lamp of this company, which has during the last year come into wide use here, costs two marks (48 cents).

"The import duty on electric lamps in the Netherlands is five per cent. of the value, inclusive of packing. There are no regulations restricting the importation of lamps.

"The competition in this line is very keen, and purchases are largely governed by price considerations; naturally, the best quality at the lowest figure is in demand. Generally speaking, the people here are favorably inclined toward American manufactures, and if American lamps can compete in price and in quality with German manufacture there will undoubtedly be a good market for them. Electricity is slowly but surely taking the place of gas and oil.

"There are no special underwriters' regulations applying to incandescent lamps in the Netherlands, with reference to the base of lamps. Most of the lamps are fitted with the ordinary 'Edison screw' bottom contact or with the 'Swan bayonet' bottom contact.

"The principal importers of electric lamps at Rotterdam are H. C. van Mens, G. S. Kaufmann & Landheer, J. M. A. Bekking, Continental Incandescent Light Company, Croon & Co., G. L. Dahlmann, Electricitiets Maatschappy Volta, Meteor, Nieuwmeyer, Heukelom & Co., Van Rietschoten & Houwens, J. M. Scheffer & Co., C. Wasser & Co., Wynmalen & Hausmann, and Van der Laan & Co."

[Mr. Listoe omits to mention the candlepower of the lamp quoted at 12 cents.]

COMMUNICATION.

Home-made Electrical Apparatus.

To the Editor of the Western Electrician:

How can I make an induction coil that will transform one volt to 10 or even more? What sizes of wire will be needed and how much, and what will be the length of core and diameter?

How can I make the most efficient electromagnet of 80 ohms resistance? What size and length of core and size of wire will be necessary?

D. E. MANN.

Dows, Iowa, August 30, 1902.

[Owing to the insufficient data given, the question in regard to the construction of an induction coil cannot be definitely answered. The primary coil, however, might be made by winding two ounces of No. 18 cotton-covered wire in two layers over a core four inches long. The core could consist of a bundle of iron wires, about No. 18, as thick as a lead-pencil. If the primary current has a potential of one volt, to obtain 10 volts on the secondary would require 10 times the number of turns as are in the primary winding. No. 38 wire may be used for the secondary coil. Constructive details for making the induction coil may be found in several books which treat of practical electrical construction. It is impossible to answer the second question as it stands, the data being insufficient. In general, an electromagnet of 80 ohms resistance might be constructed with about 100 feet of No. 39 insulated wire.—Ed.]

STREET-RAILWAY CONVENTIONS.

Pennsylvania Street Railway Association.

The tenth annual convention of the Pennsylvania Street Railway Association was held in the drawing room of the Country Club, near York, Pa., on September 10th. Captain W. H. Lanius, the president of the York County Traction Company, who had associated with him an able corps of assistants, successfully planned and carried out all entertainment features, which pleasingly supplemented the other details of what is considered the most successful convention in the annals of the association.

Captain Lanius, who is treasurer of the association, called the convention to order, and after a few appropriate remarks announced that John A. Rigg, president of the association, was unable to be present and that Vice-president Henry C. Moore of the United Traction Company of Trenton, N. J., would preside over the convention. Mr. Moore introduced to the association M. B. Gibson, mayor of York, who delivered an address of welcome, which was not a mere formality, but in which there was a ring of true and sincere hospitality.

In the course of his address Mayor Gibson traced the remarkable growth of York, and in more than one instance pointed out how the street-railway lines in the city had been potent factors. Vice-president Moore made a neat and appreciable response to Mayor Gibson's discourse.

The following-named active members were present: Henry C. Moore, president of the Trenton Street Railway Company; B. F. Myers and F. B. Musser of the Harrisburg Company; John Roth and C. H. Smith of the Lebanon Valley Company; O. M. Hoffman, J. H. Cramer and Charles W. Wilmer of the Conestoga Traction Company of Lancaster; George Hauger of the Schuylkill Valley Traction Company; Samuel S. Rigg, S. S. Hoff and Charles Banghart of the United Traction Company of Reading; John Clifford of the Wilkesbarre and Wyoming Traction Valley Company; C. F. Herr and F. W. Rhen of the Williamsport Passenger Street Railway Company, and Frank Givens of Columbia. The associate members in attendance were: W. H. Huehlings of the J. G. Brill Company, Philadelphia; R. E. Moore of the General Electric Company, Philadelphia; Foster Ivans and Charles Cushing of the J. A. Roebling's Sons Company, Trenton, N. J.; F. A. Tax of the Lobdell Car Wheel Company; C. A. Bragg and D. T. Cooper of the Westinghouse Electric and Manufacturing Company of Philadelphia; W. K. Beard of the Street Railway Journal, New York city; B. F. Swartz of the Lehigh Car Wheel and Axle Company.

Interesting papers were read by Charles S. Banghart and S. F. Hoff of the United Traction Company of Reading. Mr. Banghart's subject was "The Most Economical Management of the Repair Shop," while Mr. Hoff had for his theme "The Construction of a Power House for Suburban and Interurban Service." The report of Treasurer Lanius showed an existing balance of $1,873.93.

These officers were elected after the presentation of the report of the nominating committee: President, E. H. Davis, general manager of the Williamsport Traction Company, Williamsport; first vice-president, Edward C. Bailey, Harrisburg Traction Company, Harrisburg; second vice-president, W. W. Griest of the Conestoga Traction Company, Lancaster; secretary, Charles H. Smith of the Lebanon Valley Street Railway Company, Lebanon; treasurer, W. H. Lanius, president of the York County Traction Company, York; executive committee, B. F. Myers of Harrisburg, John A. Rigg of Reading, W. H. Lanius of York, E. H. Davis of Williamsport, and C. H. Smith of Lebanon. The selection of the place and date of the next meeting was left to the decision of the executive committee.

The entertainment features of the convention included an interesting ride over the traction lines of York, a smoker at the Country Club, a reception at the Lafayette Club, and a trip to the Gettysburg battlefield. At the reception by the Lafayette Club Hon. W. F. Bay Stewart delivered an interesting address on the York Haven Water and Power Company. His discourse treated principally on the interesting plant that is now being constructed on the Susquehanna River at York Haven.

New York Street Railway Association.

The Street Railway Association of the State of New York held its twentieth annual meeting at Caldwell, N. Y., on September 9th, 10th and 11th. Caldwell is situated on Lake George and is one of the most picturesque places in the state. A reception and hop for the visiting delegates was given Monday evening at the Fort William Henry Hotel, which was also the headquarters and place of meeting of the convention. The business sessions opened on Tuesday morning, the 9th, and were presided over by President G. Tracy Rogers of Binghamton, N. Y. In his annual presidential address Mr. Rogers discussed "The Street-railway Situation in New York." He spoke of the relation between the street railway and the people, and discussed many of the phases of street-railway development in New York state, such as legal matters, standardization of equipment, benefit associations, steam-railroad competition, amusement parks, franchises, pavements, franchise-tax law, New York city rapid-transit subway, etc.

Among the papers presented were the following: "Accidents on Electric Railroads," by C. R. Barnes; "The Handling of Accident Claims," by William A. Dibbs; "Power-house Accounting," by R. E. Danforth; "Removal of Snow and Ice in Borough of Manhattan," by W. Boardman Reed; "Discipline," by C. B. Fairchild. There were also general discussions on "Accidents" and "The Economical Use of Power by Motormen."

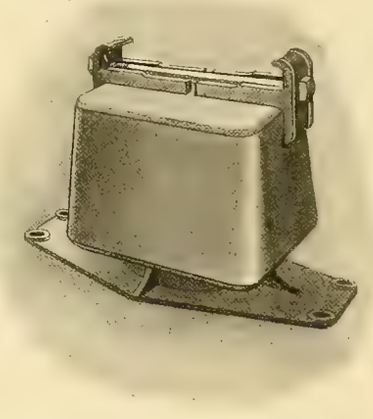
The entertainment features of the convention included the annual dinner at the Fort William Henry Hotel on Tuesday evening, and a steamboat ride down Lake George through the Narrows. The ladies were given a carriage ride to Warrensburg and an excursion on the mountain cable railway to the summit of Prospect Mountain. Other enjoyable pastimes were provided and the convention as a whole passed off successfully and profitably to those in attendance.

Special Train to Detroit Convention.

The Wabash railroad will run a special train of parlor cars and a dining car from Chicago to Detroit for the convention of the American Street Railway Association in the latter city on October 8th, 9th and 10th. The train will leave the Dearborn station in Chicago at 1 p. m. on October 7th, arriving in Detroit at 7 p. m. A table d'hote dinner will be served after 5 p. m. The special train will be personally conducted by N. C. Keeran, who had charge of the street-railway special trains to the Montreal, St. Louis, Niagara Falls, Boston and New York meetings. Mr. Keeran is the Chicago city ticket agent of the Wabash and is very popular with street-railway men, to whom he is well known.

Manhattan Third-rail Insulator.

The Manhattan third-rail insulator used by the Manhattan Railway Company on its third-rail elevated-railway system in New York city, the order for which was for 160,000, is of exceptional interest. An important feature of this insulator is its strength. Dr. Charles F. McKenna of New York recently made



MANHATTAN THIRD-RAIL INSULATOR.

a crushing test of one of the insulators, fitted on the iron stool which is provided for it. The whole was subjected to crushing stress, and the insulator supported a load of 19,500 pounds, or 5¾ tons, before breaking. Hugh Hazelton, engineer of the Manhattan Railway Company, is said to be well pleased with the success of the insulator. The Westinghouse people have adopted this design for the Mersey railroad of England, and Blackwell & Co. of Paris, electrical engineers and contractors, have secured the agency for the insulator in that city. The Standard Vitrified Conduit Company, 39-41 Cortlandt Street, New York, is the manufacturer of this insulator. The accompanying illustration shows the device set up. The insulators can be had separately or complete with stools, as desired.

Another Great Power Project in California.

Only two or three months ago the possibility of the building of an enormous power plant on one of the branches of the Feather River in California was mentioned in the Western Electrician and other papers. That plant was to have a possible capacity of 300,000 horsepower. Now another gigantic power scheme comes to light. H. H. Noble, president of the Northern California Power Company, is credited with being the authority for the information concerning this later scheme. The plant is to be located in Shasta County on the Pitt River and, it is said, with a glib ease that is startling, it will develop in the neighborhood of 500,000 horsepower. Two hundred and fifty thousand inches of water has already been appropriated from the Pitt by the company undertaking the enterprise. A flow of 4,000 cubic feet of water a second is to be conveyed 28 miles, thereby giving to the plant the power of a fall of 1,300 feet. The principal object of this mammoth power development is asserted to be to transmit power to San Francisco, a distance of 260 miles from the site chosen for the plant.

Dispute Over Central-station Heating in Evanston.

A dispute between the Evanston Yaryan Company, the City Council of Evanston, Ill., and the customers of the company has attracted some attention recently. The Evanston Yaryan Company has been furnishing an electric-lighting service and also supplying hot-water heating to its customers for about two years. Owing to alleged bad management of the company's affairs a receiver was appointed a month ago. An amended ordinance asking for more favorable concessions was brought up before the City Council on September 9th, but failed of passage. The citizens then took the matter in hand and at a public meeting appointed a committee to arbitrate the differences between the Yaryan company and the council.

There were originally the following four provisions in the amended ordinance to which the council would not agree: 1. That the franchise be extended from 25 to 50 years. 2. The right to discontinue either its heating or its lighting service at any time and at its own option. 3. The right to charge by the square foot of radiation instead of by the cubic contents of the house, as at present. 4. That the company should not be compelled to extend its service before January 1, 1905. The committee has succeeded in getting the company to accept a 30-year franchise and not to abandon its lighting service during the life of its franchise. This practically clears up two of the disputed clauses and it rests with the council to agree to the other two, and thus allow the company to continue in operation, or by not accepting them to close down the plant, thus depriving the 225 patrons of heat from the central station during the coming winter.

The third clause asked gives the company the privilege of charging 20 cents a square foot of radiation a year for heating instead of one-third of a cent a cubic foot of contents of the house, as at present. Theodore K. Jackson, receiver for the company, says that the increase in cost to the customers would average about 25 per cent.

In case the council does as requested and passes an ordinance acceptable to the Yaryan company, it is reported that the plant will pass into the hands of Samuel Insull, the owner of the Evanston Electric Illuminating Company, and the heat will at once be turned into the mains. Several private residences and apartment houses built in Evanston since the introduction of the Yaryan system were erected without chimneys or any other means whatever for installing stoves or furnaces, and the suspension of the system at this time would cause a great discomfort.

Searchlights in Mimic Warfare.

Recent tests during the war maneuvers near Newport seem to show that the electric searchlights of the fortifications were not as effective as had been supposed. It was thought that, with the aid of the powerful searchlights employed by the forts, it would be impossible for a naval enemy to get within range without immediately being discovered. This was shown to be too strong a reliance on the projectors, as a vessel could not be detected at a distance of over two miles, which is a short distance when a fast moving ship is covering it. The difficulty with the lights seemed to be that they were not well placed, and, in some instances, not well operated.

Again, it had been contended that the glare of light from a fort would so blind the gunners on the attacking ship that they could not see to aim their guns. But the fact was, that while the light did hurt the eyes at short distances, still the gunners found that it was more of an aid than a hindrance. Another point of interest as to the handling of the searchlight was brought out by the officers of the Olympia, who say that the shafts of light were not allowed to remain in any position for more than an instant. The water was swept continually and the boats passed over repeatedly before finally being discovered. This was particularly noticed on the night when the Olympia dashed by Forts Adams and Wetherell.

Matters Telegraphic.

In relation to a possible combination of the Postal Telegraph-cable Company and the Western Union Telegraph Company, Clarence H. Mackay, lately arrived from England, is reported to have made the following statement: "There is absolutely no truth in the rumors and published statements to the effect that negotiations are going on between the Postal Telegraph Company and the Western Union Telegraph Company with a view to a consolidation or sale. No consolidation or sale whatsoever is contemplated."

A report of the Western Union Telegraph Company for the quarter ending September 30th (partly estimated) shows a net revenue of $2,100,000, as compared with $1,949,716 for the corresponding period last year, thus showing an increase of $150,284. The fiscal year ended June 30th shows a net revenue of $7,202,328, as compared with $6,685,248 the previous year, the increase here being $607,080. The regular dividend payments remained the same in both years, amounting to $1,217,110.

SPACE TELEGRAPHY.

Disappointing Results in Naval Tests.

Rear-Admiral Royal T. Bradford, chief of the Bureau of Equipment of the United States Navy, under whose supervision tests in space telegraphy have been going on between the Washington Navy Yard and the Naval Academy at Annapolis for some time, says that "No reliable system of wireless telegraphy has yet been developed." The results obtained from the tests made with the different systems are not made public, but it seems to be evident that no system proved sufficiently reliable to warrant its adoption by the Navy Department. The recent army and navy maneuvers demonstrated the need of a "wireless" system, and investigation will not cease until that need is supplied.

The training-ship Prairie has been ordered to report to the board conducting the tests, the intention being to send the vessel out into Chesapeake Bay and exchange messages between it and the station at the Naval Academy. The plan followed will be similar to that which would be required in time of war between a defending squadron and shore fortifications. Upon the conclusion of these experiments, one of the ships of the North Atlantic squadron will be equipped with the system which has given the best results, and, with the Prairie, will be sent to sea. Communications will be carried on between the two ships as between a flagship and the ships of a fleet, and the defects and advantages of the system noted. None of the systems tested so far has given satisfactory results over a distance of 50 miles, and the question of interference remains to be solved. Rear-Admiral Bradford had hoped to obtain a satisfactory system and equip the ships which will participate in the impending winter maneuvers with it. This, however, will be impossible, judging from the results obtained in the recent tests.

Operations by Signal Corps During Recent War Maneuvers.

The utility of space telegraphy was clearly demonstrated in one instance during the recent army and navy maneuvers. The United States Signal Corps installed two sets of De Forest-Smythe apparatus, one at Fort Mansfield and the other on board the scout-boat Unique. These two sets were in working order a week before the maneuvers began, and continued to give service up to Saturday noon, September 6th, the end of the maneuvers. During this time the distances varied from five to 50 miles, but throughout and under all conditions of weather the system is said to have been in complete operation.

During the week of the maneuvers 72 official messages were transmitted from boat to shore, beginning at midnight, Sunday, August 31st. From that time on the Unique kept in constant touch with the movements of the enemy's fleet, and the operators at Fort Mansfield were continually in touch with them. These scout messages were transmitted by telephone to Colonel Davis at the headquarters of the firing district at Fort Wright, to General Greeley, chief signal officer, United States Army, and to General MacArthur at New London, and the operation of the land batteries at the different forts was largely governed by these messages.

About 95 per cent. of the messages transmitted were perfectly received at the receiving station. The longest distance transmitted was on Thursday, September 4th, when one of the operators in charge of the Fessenden apparatus on board a tugboat in Narragansett Bay sent the following message at the rate of 40 words per minute: "Now is the time for all good men to come to the support of their party." Though unexpected, this was received by the De Forest operator at Fort Mansfield, and later verified by comparison with the Fessenden operators. The distance was between 50 and 60 miles, and inasmuch as the tugboat's mast was but 40 feet in height the performance was considered a remarkable one, both for distance and speed, and demonstrates the extreme sensitiveness and high-speed qualities of the De Forest responder.

The apparatus at Fort Mansfield and on board the scout-boat Unique was identical. The sending apparatus included a small kerosene engine belted to an alternating-current generator, transformer, condenser and key. The antenna on board the boat consisted of three parallel stranded wires 65 feet in length. That at Fort Mansfield was similar, and was hung from an 80-foot mast. The average speed of word transmission during the maneuvers was 20 words per minute, and no code or abbreviations whatever were used.

General Greeley is said to have expressed himself as more than satisfied with the service rendered. The officer in charge of the Marconi station at Fort Wetherill stated that he found it impossible to make that receiver work faster than four or five words per minute, while the Fessenden station at Montauk Point, being unfavorably situated, was unable to do any long-distance work.

The operators on board the scout-boat Unique had a most exciting week of it. On three separate occasions the boat was constructively captured, sunk or completely destroyed by broadsides from the battleships. The navy soon learned that this innocent-looking tugboat had on board her apparatus of a nature most damaging to their plans, and were on the lookout for her continually. On Wednesday night, during a dense fog, the battleship Brooklyn suddenly loomed up not 100 yards away from the tug. The Unique instantly showed her heels and began to send forth messages announcing the discovery of the fleet and the pursuit. The Brooklyn turned and gave her her full broadside at point-blank range, nearly knocking the Unique out of the water with the concussion. Not content with this, the big battleship gave chase and turning, delivered her starboard broadside into the scout-boat. The captain, however, did not regard the wireless outfit as constructively injured and continued throughout the night to inform the army officers of the movements of the fleet.

On another night a severe storm was encountered and the boat came near foundering. The topmast, holding the aerial wires, was swept overboard, and the engine and dynamo on deck drenched with seawater. This put the wireless outfit hors de combat for several hours.

The United States Signal Corps men on shore and on board deserve the utmost praise for the zeal they displayed in making the wireless performance a success, staying at their posts continually day and night throughout the week.

So well pleased with the service are the Signal Corps officers that the station at Fort Mansfield is to be permanently established there, and the set from the scout-boat will be stationed at some army post in the vicinity, probably at Fort Wetherill. This will mean a range of some 50 miles, mostly over land, and will be the first of a number of wireless installations at the various artillery districts of the United States Army.

In Foreign Navies.

In a resumé of what has been accomplished by foreign navies during the year covered by the report, Captain Charles D. Sigsbee, chief of the Naval Intelligence Bureau, gives some interesting electrical news. The document is headed "Notes on Naval Progress," and was given to the public on September 13th. In relation to space telegraphing Captain Sigsbee says: "The material progress in wireless telegraphy may be said to have been chiefly in the matter of length of transmission, in which wonderful progress has been made." It is pointed out, however, that much less progress has been made in the securing of immunity of messages from interception—a condition of much more importance in naval maneuvers than distance of transmission. Summing up the present status of space telegraphy, it is said that it is still imperfect, offers many obstacles to success, is complex, costly, and delicate, and continues to be uncertain in transmission. Yet in spite of the disadvantages it is stated that space telegraphy offers so much in its present maritime field that it is being vigorously taken up everywhere. At the date of issue, there were more than 220 men-of-war and merchant vessels with wireless installations, as well as numerous coast stations. Special progress was made during the year in Great Britain, Germany, France, Russia, Austria, Denmark, Japan and Spain.

At the German War Maneuvers.

During the recent German war maneuvers interesting experiments were made with what appears to be a new system of space telegraphy. The information obtained is of a very general nature, visitors not being allowed to approach near enough to any of the apparatus to learn anything concerning its details. The system used was not the Marconi. The exterior of the apparatus, according to a newspaper account, is an iron box, about three feet each way, mounted on a wagon, resembling a gun carriage, which was drawn by four horses. The messages sent were caught, apparently, on a wire attached to a small balloon several hundred feet above the carriage. These stations were moved freely about the field, the horses sometimes going at full trot, but being stopped for telegraphing. The operator used a key, producing a shrill, metallic sound, audible for a hundred yards. The cavalry corps, in making a detour, kept in touch with headquarters through the wireless telegraph, enabling the corps to hasten or retard its movement throughout a 32-mile ride, as in the judgment of the headquarters staff changes in the situation were required.

Marconi Confident.

The following dispatch (ordinary cable, not wireless) was received on September 11th by the Marconi Wireless Telegraph Company of America in New York: "Have received following from Marconi: 'Perfect message received inside Gibraltar harbor and throughout entire course of Mediterranean tour direct from Poldhu, across France, Spain and Alps. All telegrams for king and minister received correctly on tape off Spezia.'" This message came from the London (England) office of the Marconi Wireless Telegraph Company, and explains itself.

Heretofore the inventor's success has been in the transmission of signals and messages over the sea, and signals partially over the sea and partially over land. From the Cornwall station in England to Spezia, which lies between Genoa and Naples, in Italy, the distance is about 1,100 miles. Previous to this, though signals had been flashed a long distance overland, complete messages had not been transmitted more than 40 miles.

Telephonic Experiments.

It is reported from Boston, Mass., that Greenleaf W. Pickard of that city has succeeded in telephoning by Hertzian waves, the human voice being accurately and distinctly reproduced. Recently he constructed an instrument at Cape May by which sounds were said to have been transmitted by Hertzian waves over a distance of 40 miles, but the latest test is the first instance in which articulation has been reproduced. Officials of the Bell Telephone Company, who were invited to witness the test, signed a certificate that it was successful, according to the account. The instruments were in two rooms of Mr. Pickard's house, and it remains to be seen whether they will work over greater distances. The inventor does not yet claim that the device will be a commercial success, but hopes to make it such in the near future.

Big Electric-railway Consolidation Proposed in Michigan.

Report has it that a big electric-railway deal is now under way in Michigan, by which all of the electric lines in the Lower Peninsula of the state, with the exception of the Detroit United railway and the Black & Mulkey line from Toledo to Detroit, will be combined under one management. This consolidation, if the plan is carried out, will be effected by a new company with a capital stock, it is said, of from $30,000,000 to $40,000,000. Among those said to be primarily interested in the consolidation are Harry G. Conant and W. W. Churchill of New York, representing the Westinghouse interests, George C. Smith, vice-president of the Fidelity Title and Trust Company of Pittsburg, and J. D. Hawks, president, and Wallace Franklin, secretary, of the Grand Rapids, Grand Haven and Muskegon Electric Railway Company.

It is stated that the new company will take over the Grand Rapids city lines, the Grand Rapids, Grand Haven and Muskegon, possibly the Holland and Lake Michigan line, the line from Battle Creek to Kalamazoo, the Lansing street-railway system, the Lansing-St. Johns line, the connection between Jackson and Lansing, upon which the Detroit, Ypsilanti, Ann Arbor and Jackson company is about ready to start construction, the interurban road between Saginaw and Bay City, and the city lines of Saginaw and Bay City, and the Detroit, Ypsilanti, Ann Arbor and Jackson. The plan also contemplates the building of a line to connect both Lansing and Grand Rapids with the Saginaw and Bay City systems. The recent jump in Detroit United Railway stock is taken to indicate that this line also may possibly be included in the combine.

Indiana Electrical Association.

As this issue of the Western Electrician is going to press the Indiana Electrical Association is holding its first regular meeting at the Denison House in Indianapolis. There is a good attendance of members and supply men and the convention promises to be a successful one. F. C. McReynolds of Kokomo, president of the association, called the opening session to order and delivered his annual address. The papers to be read and discussed at the meeting are as follows: "What We Hope to Accomplish by This Association," by A. M. Barron of Franklin; "Kinds of Indiana Coal Used and Results Obtained," by J. P. Clark of Terre Haute; "Rates by Meter and Otherwise," by C. F. Hewitt of Elkhart; "By-products," by J. H. Harding of Laporte; "Best Method of Dealing with Gas as a Competitor," by H. C. Kimbrough of Muncie; "Small Motors," by S. F. Dibble of Chicago; "Meter Prejudice and Its Cure," by S. E. Gard of Richmond; "The Desirability of Enclosed-arc Circuits of a Tub-transformer Variety from a Central-station Standpoint," by A. M. Barron of Franklin.

Electric Intramural Railway for St. Louis World's Fair.

A despatch from St. Louis, Mo., dated September 15th, states that Charles V. Weston of Chicago has been commissioned by Director of Works Isaac S. Taylor to design the eight miles of electric intramural railway which will be constructed on the World's Fair site at a cost of $750,000. Mr. Weston is the junior member of the firm of Weston Brothers, consulting and contracting engineers. He was formerly chief engineer of the Northwestern Elevated Railroad Company of Chicago, and had charge of the design and erection of the elevated structure.

DEVELOPMENT OF THE TELEPHONE FIELD.

Independent Telephone Men in Conference.

A well-attended conference of representatives of the national, interstate and state Independent telephone associations of the country was held at the Auditorium Annex in Chicago on September 9th and 10th. The assemblage was called by the advisory board of the Independent Telephone Association of the United States. The meeting was purely one for conference, to confer on matters of importance to the Independent telephone industry at the present stage of development, and, although the results appear to have been satisfactory, it was announced at the conclusion of the meeting that no official action had been taken—which, indeed, must necessarily be the case, as no organized body was in session.

The following-named representatives of the different associations were in attendance:

Independent Telephone Association of the United States of America—Judge James M. Thomas of New York city, president; Hugh Dougherty of Bluffton, Ind., first vice-president; Joseph B. Ware of Detroit, Mich., secretary and treasurer; H. D. Critchfield of Mount Vernon, Ohio, S. E. Wayland of Scranton, Pa., S. P. Sheerin of Indianapolis, Ind., and E. E. Webster of Minneapolis, Minn., members of advisory board; Dr. Henry S. Herr of Ottumwa, Iowa, R. F. Johnson of Saginaw, Mich., L. A. Goudy of Portland, Maine, Vinton A. Sears of Boston, Mass., Thomas E. Parmelee of Plattsmouth, Neb., C. H. Judson, Minneapolis, Minn., and Mrs. Annie M. Brett of El Paso, Texas, members of the executive committee from their respective states.

Interstate Independent Telephone Association—H. C. Raney of Fairfield, Iowa, president; Dr. I. A. Lumpkin of Mattoon, Ill., vice-president; E. M. Coleman of Louisville, Ky., secretary; H. K. Cole of Owensboro, Ky., J. B. Ware of Detroit, Mich., Charles E. Hull of Salem, Ill., and George M. Bandy of Perry, Iowa, members of executive committee.

Indiana Mutual Telephone Association—George W. Beers of Fort Wayne and Hugh Dougherty of Bluffton, members of executive committee; S. P. Sheerin of Indianapolis, member of legislative committee.

Southern Indiana Telephone Association—G. A. Kienle of Huntingburg, president.

Iowa Telephone Association—U. S. Alderman of Nevada, president; Dr. Henry S. Herr of Ottumwa, vice-president; H. C. Raney of Fairfield and J. S. Bellamy of Knoxville, members of executive committee.

Kentucky Telephone Association—H. K. Cole of Owensboro, vice-president.

Independent Telephone Association of Maine—L. A. Goudy of Portland, second vice-president.

Michigan Independent Telephone Association—J. B. Ware of Detroit, president; R. F. Johnson of Saginaw, treasurer.

Minnesota Independent Telephone Association—C. H. Judson of Minneapolis, member of executive committee.

Ohio Independent Telephone Association—Judge James M. Thomas of New York city, president; H. D. Critchfield of Mount Vernon, Ohio, secretary-treasurer.

Texas, Oklahoma and Indian Territory Independent Telephone Association—J. B. Earle of Waco, Texas, secretary-treasurer.

Other prominent exchange operators and men interested in Independent telephony in attendance were the following-named gentlemen:

Judge Peyton E. Edwards of El Paso, Texas, Z. C. Campbell of San Antonio, Texas; Thomas Bromley, Jr., of Alma, Mich.; Fred Deland of Pittsburg, Pa.; Judge R. S. Taylor of Fort Wayne, Ind.; W. J. Vesey of Fort Wayne, Ind.; Mr. Price of Saginaw, Mich.

The following-named representatives of the Independent telephone manufacturing industry attended the meeting:

F. F. Sapp, North Electric Company, Cleveland, Ohio; J. H. Parish, Standard Telephone and Electric Company, Madison, Wis.; I. E. Gardner, Northern Construction Company, Bryan, Ohio; Henry Shafer, International Telephone Manufacturing Company, Chicago; George W. Conover, Chicago; J. G. Ihmsen, American Electric Telephone Company, Chicago; E. B. Overshiner, Swedish-American Telephone Company, Chicago; Alfred Stromberg, Charles A. Brown, J. J. Nate and A. J. Rousseau, Stromberg-Carlson Telephone Company, Chicago.

Kansas Independent Telephone Association.

The convention of the Kansas Independent Telephone Association, held in Kansas City, Mo., on September 11th and 12th, was attended by 150 delegates from various parts of the state of Kansas, as well as by a few from Missouri and other states. The meeting was held in Kansas City at the invitation of the Home Telephone Company of that city. This is a new Independent company, and the association wished to give it the support of its presence in Kansas City. Mayor Reed delivered the address of welcome to the visitors, and in it denounced the local Bell company. He asked the co-operation of all the Kansas Independent companies in promoting the interests of the new company. The association, by vote, heartily indorsed the new company.

The last day's sessions were devoted largely to a revision of the association's constitution and by-laws. On adjournment the association voted to hold its regular annual meeting in Topeka, Kan., during the month of January next. The headquarters for the association while in Kansas City were at the Coates House. Among the exhibitors of telephone apparatus were the Sterling Electric Company, Stromberg-Carlson Telephone Manufacturing Company, Kellogg Switchboard and Supply Company, Central Telephone and Electric Company of St. Louis, Illinois Electric Specialty Company, Swedish-American Telephone Company and Electric Appliance Company.

Indiana Telephone Items.

A number of prominent farmers of Grant County have organized a telephone company and will file articles of incorporation in a few days. The company will bid for patronage not only in the county but will commence an active campaign for patrons in Fairmont and other towns, in each of which it is proposed to have an exchange. It will build toll lines to Marion, over which free service will be extended to all patrons. A recent increase of 25 per cent. in the rates by the local company—an Independent concern—is given as the cause of the new company's existence. Charles I. Parker of Fairmont will answer all communications in reference to the company.

Mayor Covert and City Attorney Funkhouser of Evansville have revived the municipal telephone scheme and say that $100,000 of the $190,000 worth of stock necessary has been sold. Policemen are being asked to subscribe for stock and efforts are being made to induce neighboring towns to take stock.

The Elwood exchange of the Delaware and Madison County Telephone Company is about to be placed in operation under the management of A. W. Martner. There are about 300 instruments connected with the exchange to start with, and this number is expected to be materially increased.

The strike of telephone linemen on the Cumberland lines near Petersburg has become serious. The non-union men working on the lines have been forced to quit work and leave town.

The Eel River Valley Telephone Company and the Warsaw Telephone Company, which have reached Wabash, over the Home Telephone Company's line in Wabash, were cut off last week by the last-named company. The Eel River company built a rival plant at North Manchester, where the old exchange, owned by the North Manchester Telephone Company, had a contract for the sole use of the Home company's system for toll messages. The Eel River company appealed to the courts, and the Home company for several weeks received but did not send Eel River messages. The North Manchester company complained, and next the Home company cut off the Eel River and Warsaw companies, the latter owned by the Straus brothers, Ligonier bankers. As the Bell company will have no relations with the Eel River company, that line can handle no Wabash business, though it is doing the larger part of the service at North Manchester. An application for a writ of mandamus to compel the Home company to take the Eel River business has been filed. The fight is between Independent telephone companies, and is the first of its kind in the state.

A deal has been made whereby the North Vernon and Vernon Telephone Company and the Jennings County Telephone Company became part of the Independent system. The stock of the two corporations passed to S. P. Sheerin and others for a consideration of $25,000. A meeting of the directors was called, and Mr. Sheerin was elected president of both corporations. Extensive improvements will be made by the new management. The acquisition is considered valuable to the Independent system.

F.

Telephone News from the Northwest.

The Dakota Central Telephone Company has expended $120,000 in extensions, improvements and general equipment during the last year. One thousand miles of new lines has been constructed and seven exchanges bought, including the exchange at Aberdeen, S. D. A number of further improvements are in contemplation, including copper-metallic circuits on the more important lines.

The Minnesota Rural Telephone Company has been refused admission to St. Cloud, Minn., by the council of that city.

The Zenith Telephone Company of Duluth, Minn., has installed a modern new switchboard, and its service is again satisfactory. On March 7th last the company's board was burned out, and an entirely new board had to be secured. An old board was obtained in Mineapolis, to serve until the new one could be secured. The substitute did not give very good work, and complaints have been numerous.

The Citizens' Telephone Company of Park Rapids, Minn., will begin work vigorously on the construction of a local exchange. All materials have been ordered.

The Minnesota Valley Telephone and Telegraph Company of Mankato, Minn., has been incorporated with $100,000 capital stock.

The Consolidated Telephone and Telegraph Company of Minneapolis will establish a local exchange for Grantsburg, Wis.

The question of ownership of poles has come up in St. Paul. The Northwestern Telephone Exchange Company has an arrangement whereby it uses the city fire-department poles. When these poles become unsafe they are replaced by the telephone company. The question arises, To whom do the new poles belong?

The Iowa Telephone Company is making extensive improvements to its plant at Muscatine, Iowa. A new switchboard is to be installed.

The Iowa Telephone Company has closed its exchange at Emerson, Iowa.

The Cedar Valley Telephone Company is building a line from Eagle Center to Tama, Iowa.

Wieland Bros. of Duluth, Minn., have bought the sunken steamer Thomas Wilson and have a diver working on it, preparatory to raising it. The diver has a telephone and an electric light to enable him to work more expeditiously.

R.

Ohio Telephone Notes.

It is stated that the stockholders of the Federal Telephone Company will receive about 70 per cent. of their original investment when its affairs are finally settled. There is now little doubt that the United States Telephone properties will be sold to the Barber syndicate; that is, 60 per cent. of the stock; and there is a movement to form a company to handle the Cuyahoga telephone plant. At the present time it is impossible to do any work on the extension of this plant, and the owners are anxious to sell it, that it may be put in condition to meet the demands upon it. It is thought the Everett-Moore syndicate will not have anything further to do with telephone properties when these matters are closed, with the possible exception of the Cuyahoga company.

It is reported that Toledo men disposed of a block of Louisville Telephone Company stock, amounting to $75,000, to Columbus and Cincinnati capitalists a few days ago. Bonds amounting to about $50,000 of the same company were also sold at a good price by Toledo holders.

The Minster Home Telephone Company has been granted a 50-year franchise in Minster in competition with the Bell Telephone Company and a Bellefontaine company. The local company is composed of 10 business men and at present has a capital stock of $10,000.

O. M. C.

Interstate Telephone Convention.

At a meeting of the officers of the recently formed Interstate Independent Telephone Association in Chicago last week it was decided to hold the next convention in Chicago on December 10th, 11th and 12th. The programme was partially outlined and was left in the hands of Secretary E. M. Coleman of Louisville for completion. The exact place of meeting in Chicago will be determined by a committee of which Dr. I. A. Lumpkin of Mattoon, Ill., and Charles E. Hull of Salem, Ill., are members.

The Interstate association was organized in Chicago last April. It has a large membership, embracing the Independent telephone interests in the states of Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin. H. C. Raney of Fairfield, Iowa, is the president.

TELEPHONE MEN.

Edward Joloff, manager of the Central Union Telephone Company at Kokomo, Ind., and Miss Effie Middleton were married on September 11th.

Benjamin W. Anderson, superintendent of the Plainfield (Ind.) Telephone Company, entertained his employes at dinner at the Commercial Hotel on September 13th.

C. P. Platt of the sales department of the Kellogg Switchboard and Supply Company of Chicago is confined to his house with typhoid fever. His many friends hope for a rapid recovery.

MANUFACTURERS AND DEALERS.

The Automatic Electric Company of Chicago, manufacturer of the Strowger automatic telephone system, has issued a little pamphlet entitled "The Battle of the Telephones," in which some of the phases of the Bell-Independent telephone competition are reviewed. The pamphlet is attractively prepared, and, of course, has for its main object the presentation of some of the advantages asserted for the automatic telephone system.

The Kellogg Switchboard and Supply Company of Chicago has just closed a contract with the Keystone Telephone Company of Philadelphia for two more common-battery, multiple-relay switchboards of 4,800 lines capacity each, for the Keystone company's fifth and sixth district exchanges, respectively. Included in this contract is a chief operator's desk, wire chief's desk and manager's desk, all of which will be of mahogany to match the main switchboard, together with all necessary power apparatus, relay racks, distributing frames, lightning arresters and sneak-current apparatus. This will make a total ultimate equipment of 34,080 switchboard lines, which the Kellogg company will have furnished the Keystone Telephone Company, for its extensive system in Philadelphia.

Checking Electrical Instruments.[1]

By Clayton H. Sharp.

It is the purpose of this paper to indicate a simple system for keeping the principal instruments of a central station or of a testing room properly checked.

Direct-current Voltmeters.

Undoubtedly the best arrangement for checking a voltmeter, as well as for the accurate measurement of steady direct-current potentials in general, is the potentiometer used with a standard cell. In central stations only a few voltages need to be cared for. A potentiometer suitable for reading only a few voltages can be made very simple in construction and in operation. Such a potentiometer may be used in connection with a voltmeter to keep all the pressure employed in the station checked up. The scale of the voltmeter should be calibrated once for all, so that the variation of its correction at all required points is known, after which a determination of the absolute value of its correction at one or two points suffices to give its correction at all points.

Simple Potentiometer.

A diagram of the circuits of a simple potentiometer intended to measure only one definite voltage is given in Fig. 1. The voltage to be measured is brought to the binding-posts (A) and (B), which are connected by coils of high resistance—100,000 ohms or higher. From a suitable point (D) of the coils a tap is brought out to the binding-post (D_1). (D) is so chosen that the resistance (AD) bears the same ratio to the resistance (AB) as does the electromotive force of the standard cell to the electromotive force to be measured.

The standard of cell (C) is connected to (A) through the binding-post (E), and the key (K), and is connected to (D_1) through the galvanometer (G) and the high resistance (R). The latter is intended for the protection of the cell against anything approaching a short-circuit, and may be itself short-circuited at (P) when the potentiometer has been nearly balanced. If (A) is connected to the positive side of the circuit, the positive terminal of (C) is connected to (E), and vice versa.

If connections are made as described, when the proper electromotive force is applied to (AB) and the key (K) is depressed, the galvanometer shows no deflection. If on depressing the key a deflection is noted, the electromotive force on (AB) must be adjusted until the deflection is reduced to zero. If

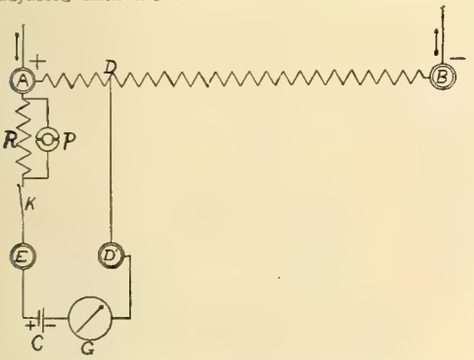


FIG. 1. CHECKING ELECTRICAL INSTRUMENTS.

a voltmeter is connected in multiple with (AB) and a reading of it is taken at the time the above adjustment is secured, the value of its correction is obtained at once.

If it is desired to arrange the potentiometer to read more than one voltage, more taps similar to (DD_1) are added. It is an advantageous arrangement to have the potentiometer read three or more voltages, which are multiples of each other, such as 58, 116 and 232. These voltages cover the principal ranges for incandescent lamps. Now, if two cells which agree with each other in the indication of any one voltage are connected in series on the 58-volt point, they should give the same indication as does one cell alone on the 118-volt point. Thus, the accuracy of the potentiometer can be partially checked.

The Clark standard cell has a large temperature coefficient, the variation of its electromotive force amounting to nearly 0.1 per cent. per degree Centigrade. It is consequently necessary in using a potentiometer with this cell either to apply a correction to its indications corresponding to the temperature of the cell, as can readily be done from a table of corrections, or to construct the potentiometer so that these variations can be compensated for.

A diagram of a three-point potentiometer with compensation for temperature is shown in Fig. 2. Here a series of taps is brought out from the resistance (AB) to contact studs over which a switch contact (G) sweeps. Each of the studs is marked with the temperature of the Clark cell to which it corresponds, hence in making measurements it is necessary only to set (G) on the proper stud to get results which need no correction for cell temperature.

This potentiometer may be further extended to make it a self-contained, portable instrument. To this end a pivoted galvanometer of the moving-coil type, of high resistance and strongly damped, together with three portable standard cells, are enclosed in the same box with the resistance coils When this is done, outside posts should be provided for connecting the cells either singly or in series, and for using, if desired, an outside cell and galvanometer.

Standard Cells.

There are but two classes of standard cells which need be considered to-day, the Clark cell and the cadmium or Weston cell. The Clark cell has electrodes of mercury and of zinc, or zinc amalgam in a saturated solution of zinc sulphate, with mercurous sulphate as a depolarizer. The legal value for its electromotive force is 1.434 volts at 15 degrees C. Its electromotive force decreases 0.0012 volt for each degree rise in temperature. This large temperature coefficient, amounting to nearly 0.1 per cent. per degree, is not the only disadvantage under which the Clark cell labors. It has been found also that changes in the electromotive force of the cell do not instantly follow changes in its temperature. The cadmium cell is exactly like the Clark cell, excepting that cadmium amalgam and cadmium sulphate are used instead of zinc amalgam and zinc sulphate. This results in cells of smaller electromotive force and of much smaller temperature coefficient than the Clark cell. If we accept the value for the electromotive force of the Clark cell given above, the electromotive force of the saturated-solution cadmium cell is 1.0194 volts at 20 degrees C. Its temperature coefficient is only 0.000038 volt per degree. My experience leads me to believe that it is decidedly more difficult to construct a cadmium cell which shall give the right electromotive force than it is to construct an accurate Clark cell. The smaller temperature coefficient of the cadmium cell, which is negligible in most technical work, makes it more convenient to use than the Clark cell.

To secure the utmost reliability in the indications of a standard cell, certain simple precautions need to be taken. The most important thing is to avoid drawing any appreciable current from it. The potentiometer method, being a zero method, makes no demands on the cell for current when once a balance has been secured. Until such a balance has been nearly secured, a high resistance should be included in the cell circuit. In order to secure the best results from the Clark cell, it should be protected from all sudden changes in temperature. For absolute certainty it is advisable to have three or more cells, which are checked against each other. The electromotive force of such cells may be relied upon as being within a few hundredths of one per cent. of its nominal value.

Direct-current Ammeters.

The best way to measure current strength accurately is (if we leave the silver voltmeter out of account) by finding the potential difference between the terminals of a conductor of known resistance, through which the current flows. Suitable conductors for this purpose are made of manganin, an alloy which has a very low temperature coefficient, of a resistance as low as one ten-thousandth of an ohm, and calculated to carry as much as 2,000 amperes without undue heating. The measurement of the potential difference must be made with a complete potentiometer. A modification of this method, which is very suitable for checking ammeters, consists in the substitution for magnanin low-resistance standards, high-resistance standards in the form of incandescent lamps. These lamps are standardized by measuring very carefully their current consumption at a given voltage or series of voltages.

Alternating-current Voltmeters.

These can best be checked by comparing them with a standardized direct-current voltmeter through the medium of an inductionless transfer instrument. Probably the best transfer instrument is an electrostatic voltmeter, although a hot-wire voltmeter, the series resistance of which has been wound to avoid inductance and capacity, can be used with good results. The hot-wire voltmeter is a specially sensitive one constructed by the Stanley Electric Manufacturing Company, one-tenth of a volt being easily readable on its scale. This voltmeter is calibrated by bringing it in multiple with a Weston laboratory standard direct-current voltmeter, which has been checked by a three-point potentiometer. The pressure is adjusted to the point at which a check is desired, and the error of the hot-wire voltmeter is determined. The alternating-current pressure is at once thrown on to the hot-wire instrument, and the check is obtained. For greater security the direct-current readings may be remade after the alternating-current measurements.

The other transfer instrument referred to is a Kelvin multicellular electrostatic voltmeter of the vertical-scale type, of 60 to 140-volt range, fitted specially with a mirror attached to the moving part so that deflections can be read with the aid of a telescope and scale, or of a lamp and scale. The torsion head of the instrument is adjusted so that its indications come on the scale at the voltage to be measured, and deflections on direct current are obtained. The leads to the electrostatic instrument must be reversed in this test, and the mean of the direct and reversed deflections taken. The alternating-current pressure is then applied and the deflection is again noted. To evaluate in volts the difference between the alternating-current and direct-current pressures, as measured in scale divisions, a near-by direct-current voltage is measured, and the number of scale divisions per volt is determined. By adjusting the torsion head of the instrument it may be used for checking voltages in the 50-volt range, or in the 220-volt range.

With unsteady pressures a good comparison is difficult to obtain, since the Kelvin instrument is very sluggish in its movements, due to oil damping, and to the very small moving force. For rough checks, such as alone are necessary when the pressure is unsteady, the telescope and scale may be dispensed with and comparisons made by reading the pointer of the instrument directly.

Alternating-current Ammeters.

For the calibration of alternating-current ammeters not belonging to the types, such as the Kelvin bal-

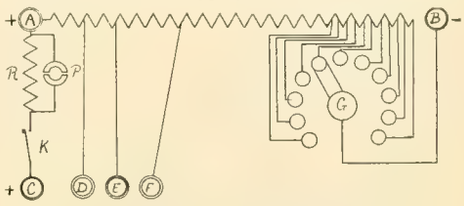


FIG. 2. CHECKING ELECTRICAL INSTRUMENTS.

ance, the Siemens electrodynamometer, hot-wire instruments, etc., which are themselves reliable direct-current—alternating-current transfer instruments, the series of ampere lamps used with an alternating-current voltmeter, calibrated at one point, serve admirably well.

Wattmeters.

Having voltmeters and ammeters calibrated by the methods indicated above, the calibration of direct-current wattmeters and of alternating-current wattmeters on power-factor unity, can be made from them. Incandescent lamps standardized for watts instead of for amperes, are useful in wattmeter calibration, rendering the use of a calibrated ammeter unnecessary. A set of lamps can serve both as ampere standards and as watt standards.

1. Abstract of paper read before the Association of Edison Illuminating Companies at Mount Washington Hotel, White Mountains, N. H., September 9 to 11, 1902.

Armour Institute Evening Classes.

The Armour Institute of Technology of Chicago has decided to establish evening classes for the benefit of boys and men who are employed during the day and cannot avail themselves of the opportunities afforded by the day classes. Machinery Hall, the new shop building which is about ready for occupancy, is equipped with the most modern appliances for shop instruction and will offer unusual facilities to engineering students. The courses offered are chiefly engineering and are selected with special reference to the needs of those who are engaged in technical pursuits during the day. They include experimental electrical engineering, electrical laboratory work and practical physics. Correspondence-school students will also find the opportunities for laboratory, shop and drafting-room work especially helpful. There will be three terms of 10 weeks each. The autumn term will begin Monday, October 6th. Each course will be given from 7:30 to 9:30 p. m. twice a week, either on Mondays and Thursdays or Tuesdays and Fridays. The classes will be under the supervision of Victor C. Alderson, dean of the institute, and among the faculty will be Professors H. M. Raymond, J. E. Snow, W. P. Noble and D. F. Campbell, Professor Snow having charge of the dynamo-laboratory work.

Electric Power Possibilities of Mountain Streams in France.

A congress was recently held in Grenoble, France, to consider the electric power possibilities of the mountain streams of France. One of the prominent speakers at the congress had spent a year in the Pyrenees, studying waterpower possibilities, and his report painted the possible development in that region in glowing colors. Mr. Hanotaux, former minister of foreign affairs, who presided over the assembly, made a statement in his inaugural address to the effect that only the development of the unbounded electric power of the country could save France from coming under the heel of American commercial domination. "In a few more years," said Mr. Hanotaux, "the inexhaustible coal fields of America must be called into requisition to feed the fires of the old world. If France acts in time its position will become unique and a new era of riches will dawn for one of the most favored countries under the sun."

The strike of the motormen of the Hudson Valley Railway Company has reached a critical point. On September 13th an attempt was made to start cars out of Saratoga, N. Y. The strikers tampered with the line and made it an impossibility to move a car. Sufficient protection cannot be obtained from the sheriffs along the road, and it begins to look as if the militia would be called out.

A Survey of Electrical Patents Granted by the United States.

By Story B. Ladd.

Part II.

Electric Signaling.

In this class 1,622 patents have been issued. We have in this class the railroad-car telegraph, in which is employed a circuit on the car extending from the metallic roof of the car to the rails, with transmitting and receiving devices therein, and an electric telegraph line in inductive proximity to the car, patented by Smith, 247,127, September 13, 1881; an improvement on the last, in which a closed electric circuit is employed on the car, patented by Phelps, 307,984, November 11, 1884; and as a still further improvement, the idea of using induction impulses from the train to the line wire so as not to interfere with the ordinary Morse signal sent between stations, patented by Edison, 350,235, October 5, 1886.

Of late years the line of invention has principally tended toward improving prior structures. There has, however, been marked advance in various lines illustrated in a number of patents, such, for example, as Thompson, 623,637, April 25, 1899, for signaling orders from one station to another, as from the pilot of a ship to the engineer, and having the signal repeated back to the sender; the patent to Hovey, 552,181, December 31, 1895, for sounding an alarm at grade crossings or other desired places; and that to Thebaud, 619,632, February 14, 1899, for recording the power generated by the flow of liquids. There has also been considerable activity in providing electric-railway systems with apparatus whereby when a car passes on a section it cuts out or deadens the adjacent section and at the same time displays a signal, so that the danger of collision is reduced to a minimum. Of this the patents to Tilghman, 573,496, December 22, 1896; Burger, 602,208, April 12, 1898; and Bancroft, 621,205, March 14, 1899, are examples.

Telegraphy.

In this class 4,337 patents have been issued. There may be mentioned among the important inventions of the last 30 years in this art the following: A duplex system with a condenser in the artificial line, by which it was made practicable to send two messages over the same line in opposite directions, patented by Stearns, reissue, 5,344, April 1, 1873; the quadruplex telegraph, in which two independently operated keys, one serving to control the polarity and the other the tension of the line current, have made it practicable to send two separate messages over the same line in the same direction, patented by Nicholson, 332,550, December 15, 1885; the sunflower multiplex, in which there is a series of contacts connected in independent groups, mechanism at each station for successively completing the line circuit through said contacts, telegraphic instruments in the circuit of each group of contacts, and means for automatically correcting the speed of the circuit-breakers at the several stations, by which it is proposed to send any number of messages in the same direction over the same line at the same time, patented by Delaney, 286,278, October 9, 1883.

In multiplex telegraphy an indefinite number of messages have been sent over the same line in both directions at the same time by the use of alternating currents, the frequency for each transmitter and its receiver being different from that used in any other. It has been found that by the use of local inductively or conductively connected branches of the main line, each tuned by properly proportioned inductance and capacity to the single frequency which it is intended to receive, each local will select its particular frequency to the exclusion of all others. This system is described in the patents to Pupin, 640,515 and 640,516.

A printing system employs a selector for distributing the currents to several setting magnets and a type wheel or type bar set to its appropriate position by a series of adjusting devices controlled by the magnets, whose limits of actions collectively are commensurate with the entire range of type-wheel movement, patented by Howe, 150,953, May 19, 1874; the same idea with the adjusters made independent of the press mechanism was patented by Fiske, 529,484, November 20, 1894; the same printing system, broadly speaking, combined into a complete system with an automatic transmitter, was patented by Buckingham, 487,982, December 13, 1892.

Synchronous multiplex printing telegraphy has been improved in several directions. The printing mechanism has been improved so that by the operation of a typewriter at the sending station exact copies are reproduced in similar machines at any desired number of receiving stations, and the multiplexing principles have been so refined that any desired number of these machines may be operated in both directions over a single wire at the same time.

Professor Rowland perfected a system the fundamental principle of which involves dividing the waves of an alternating current into groups of 11 impulses and modifying the groups by suppressing one or more waves according to a system of combinations, thereby transmitting 45 characters which by means of an automatic selector print the characters on a sheet of paper at the receiving station. The illustrative patents are Rowland, 622,636, 680,415, 680,753, 680,754, 601,667, 609,574, and 609,575. Gilmore patent, 695,203, effects a similar purpose by impulses of the same strength but different duration, thereby making his apparatus particularly susceptible of multiplex use in a sunflower synchronizer system. Burry, 680,693, shows a well-worked-out printing receiver for reproducing a printed page instead of the tape record of the well-known stock ticker.

Other notable inventions within the epoch are the autographic telegraph for transmitting chirographical characters by means of electric currents in two lines varied in force by the movement of the sending tracer in two directions, patented by Cowper, 217,588, July 15, 1879; the method of autographic telegraphy, which consists in transmitting the movements of the transmitting pen in pulsations varying in number with the linear extent of the movement, patented by Gray, 386,815, July 31, 1888; a fire telegraph embodying the broad idea of preventing one box when pulled from interfering with another box already pulled, patented by Gamewell, reissue, 8,891, September 9, 1879; the use of a metallic circuit either as such or as grounded circuits by means of ground taps, patented by Carter, 140,011, June 17, 1873; and a fire-alarm telegraph repeater in which the reception and repetition of one signal causes the other circuits to be locked out to prevent interference, patented by Gamewell, 165,923, July 27, 1875.

The new sub-class of telegraphy, wireless, containing 65 patents, represents the beginning and growth of the art of wireless transmission by broken-off radiant energy as distinguished from more or less imperfect earth or water conduction and as distinguished from the inductive transformer action of a local field of force, or the condenser action of charged plates. The perfection which this art has already reached in actual practice is foreshadowed rather than indicated by the first Marconi patent, 586,193, and the Lodge patent, 609,154, disclosing the principle of selectivity by tuning. Tesla, in his patents 645,576 and 649,621, has proposed a method of wireless transmission by actual conduction through the rarefied upper strata of the atmosphere.

Telephony.

In this class 3,969 patents have been issued. In this art, which dates from 1876, is found the broad art of causing electrical undulations similar in form to the vibrations of air accompanying sound, patented by Bell, 174,465, March 7, 1876; the metallic diaphragm in a magnetic telephone, patented by Bell, 186,787, January 30, 1877; the broad method of microphonically transmitting speech, patented by Berliner, 463,569, November 17, 1891; the broad idea of using a low-resistance conductor in a microphone, patented by Edison, 474,231, May 3, 1892; the use of finely divided carbon in a loose state in a microphone, patented by Hunnings, 246,512, August 30, 1881; the use of a weight and spring to hold the electrode against the diaphragm, and the use of two electrodes in combination with the diaphragm, the well-known form of Blake transmitter, 250,127, 250,128, and 250,129, November 29, 1881; in telephone systems, the use of a separate talking wire passing to each subscriber and to the central operator, called the Law system, patented by Shaw, 220,874, October 21, 1879; the use of test circuits in multiple switchboards, whereby the operator at any one board can determine whether the line is connected at another board, patented by Haskins & Wilson, 266,287, October 24, 1882; Kellogg, 308,315, November 18, 1884; and Scribner, 321,390, June 30, 1885; a divided central multiple board system, in which the telephone lines are divided into two classes and the multiple switchboards are divided into two sections, with an appropriate distribution of the spring jacks and annunciators, patented by Kellogg, 424,310, March 25, 1890; the combination of a terminal switchboard and a connecting switchboard, the call-receiving annunciators being at the terminal board and there being a separate set of operators at each board to divide the work, patented by Hall, 495,087, April 11, 1893; a telephone switch by which the telephone instruments and signaling instruments are placed in two branches from the main line, patented by Watson, 202,495, April 16, 1878; a telephone switch in which the telephone receiver automatically actuates the switch, patented by Roosevelt, 215,837, May 27, 1879; and a telephone switch in which the movement of the telephone receiver signals the central-office operator, patented by Scribner, 251,955, January 3, 1882.

A great number of automatic systems have been devised, and at least three have been actually constructed, whereby the operation of a large exchange is absolutely automatic. See Callender, 511,874; Strowger, 589,798 and 591,201; Seligmann-Lui, 639,186, and Faller, 686,892.

Telephone registers for measured-service systems have been produced in large numbers, as illustrated by the following patents: Field, 558,168; Hayes, 589,431; Dean, 609,331; Scribner, 617,839; McBerty, 641,400; and Scribner, 655,164.

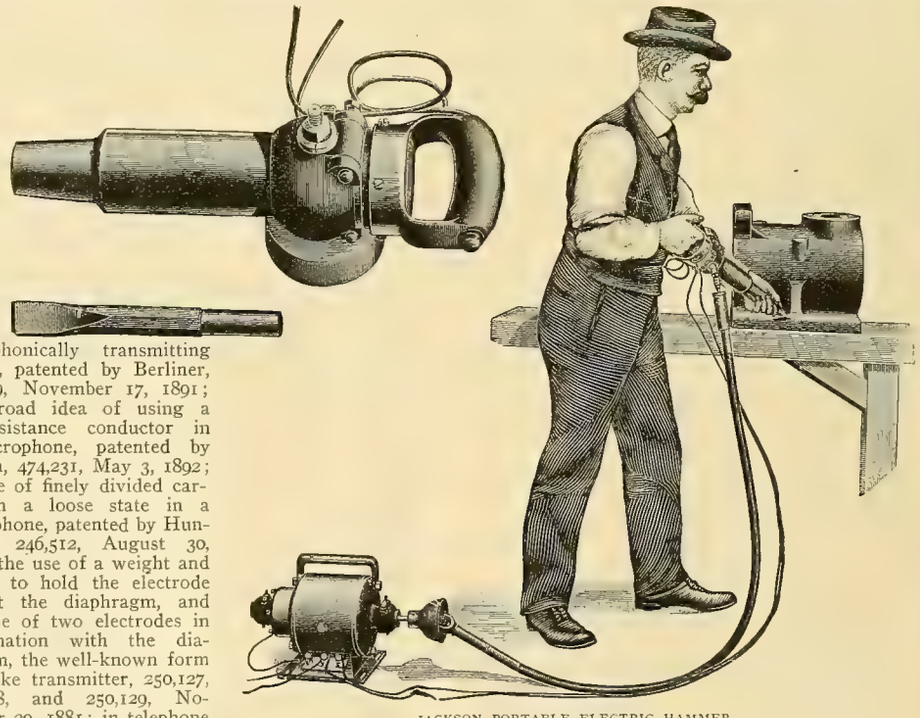
An improvement in long-distance transmission by wires of great practical and scientific interest is the loaded line disclosed in the Pupin patents, 652,230 and 652,231. This invention discloses the use in a long-distance line of inductance coils inserted in series, a plurality to the half-wave length, the purpose being to decrease the attenuation and distortion caused by the distributed capacity on the line by suitably proportioning and disposing such inductance sources. This invention has been applied to a line between New York and Chicago, making possible satisfactory telephonic communication between New York and Denver.

Multiplex telegraphy based upon the principle of selectively receiving a single one of a plurality of frequencies in a given branch circuit has been made applicable to multiplex telephony by the simple expedient of making all the frequencies to be selectively received higher than the highest overtones of articulate speech. See Hutin and Leblanc, 522,564, 596,017, and 628,246.

[*To be continued.*]

Jackson Portable Electric Hammer.

The Jackson portable electric hammer is being placed on the market by the Western Electrical Supply Company of St. Louis after being subjected to thorough tests. The company states that this is the first and only electric hammer on the market and that it will reduce by one-half the cost of work now performed by the well-known pneumatic hammers. This hammer, which is illustrated herewith, is



JACKSON PORTABLE ELECTRIC HAMMER.

adapted for all classes of work now done by the pneumatic hammers, such as chipping iron or steel, in foundry work, bridge building, calking boilers, structural iron and building work, shipbuilding, heavy stone dressing and light carving.

The main points which the company puts forth for this hammer are its simplicity of construction, efficiency and durability. It is not necessary to install any plant, as the current may be taken from any electric plant of from 110 to 500 volts. The hammer can be operated by a motor of from one-eighth to one-fourth horsepower, practically consuming no more current than an ordinary office fan. Power can be transmitted practically any distance with very little loss. This will be greatly appreciated by ship, bridge and structural-steel builders, as no plant is needed on the ground or close to the work, as the current may be obtained from the most convenient power circuit.

The cost is said to be about 20 per cent. of what a pneumatic hammer costs, and the cost of operation

is about five per cent. One great advantage that this hammer has over the pneumatic is that it can be run in the coldest weather, which is often an impossibility and a great detriment with pneumatic hammers. Where no current is obtainable, a small one-horsepower electric generator is capable of running three hammers. It is quickly and cheaply installed, and may be operated by a small gasoline engine, turbine waterwheel, or from shafting in a machine shop or foundry.

High-tension Work in the Far West.[1]

By George H. Lukes.

To the central-station man of the East or the Middle West, the tremendous development in high-tension transmission in the West, and particularly on the Pacific coast, seems marvelous and inexplicable. Each issue of the electrical journals seems to chronicle some new achievement more remarkable than all before. Distances and line voltages have been doubled and quadrupled, and the whole country from Old Mexico to British Columbia is dotted with transmission plants. It is not the purpose in this paper to take up the subject of long-distance transmission in any detail, for to do this would require a volume, but it is rather to point out some of the conditions that brought about this rapid development and the trend of growth at the present time.

When a sudden expansion in any industry takes the world by surprise it is generally found upon investigation that this rapid growth has been preceded by a slow growth extending over a considerable period of time. During this period various problems are met with and solved. Work is carried along on different lines converging on a single point, and when the conditions are ripe an era of astonishingly rapid development follows.

Such has been the case with high-voltage long-distance transmission work on the Pacific coast. The great mountain ranges that lie about 150 miles from the coast and extend north and south are the sources of innumerable streams of water that reach the Pacific through the larger rivers. These streams are of small volume, except at time of flood, but, on the other hand, the fall is exceedingly rapid, so that it is not unusual to finds heads utilized of from 500 to 1,500 feet, and even more. The installations consequently are of one general type, with variations here and there to suit local conditions. A dam is thrown up at some point on a mountain stream where a reservoir can be created, and from this dam the water is carried by means of a wooden flume, ditch, or, in some cases a wooden-stave pipe line, with a grade of from five to 25 feet per mile to a point where the maximum drop can be utilized. From the penstock, the pipe line, which is sometimes of steel, sometimes of cast iron, or, in cases of low head, a wooden-stave pipe, is run down to the power house below. The waterwheels are of the Pelton type and are direct-connected to alternating-current generators, which supply two or three-phase current at a frequency of 60 and a voltage of 1,000 or 2,000. The exciters are direct-connected to separate waterwheels. The raising transformers are of the water-cooled oil-insulated type and are generally located in a room separated from the dynamo room by fireproof walls. The lightning arresters are usually in a separate building to cut down the danger from fire. The high-tension switchboard is mounted on insulators, and consists of wooden frames upon which are placed air-break switches of various types. The high-tension bus-bars are simply extensions of the transmission lines and are bare wires mounted on insulators like those used on the lines. The transmission lines will be described in some detail later.

On seeing a plant of this character one realizes the importance of the hydraulic end of the enterprise. On looking further, it is seen that the hydraulic engineering is of a type peculiar to this part of the country and has been of comparatively slow growth. The country was originally a mining country, and still remains so, although the character of the mining has changed since the early days. The first miners were placer miners, and, needing water for their operations, constructed ditches and flumes to divert the water from its natural courses to their mines. In the course of time the placer mines were worked out, and hydraulic mining began. In this method of mining large streams of water under tremendous heads were used to wash down the dirt from the hillsides, and in this way dirt containing a small percentage of gold could be worked at a profit. In order to get water under a sufficient head for this work it was necessary to construct dams and flume the water long distances along the sides of the mountains. Hydraulic mining was afterward prohibited by law because the dirt which was carried down the rivers from the mines devastated the farming lands in the valleys below. Quartz mining, which was carried on at the same time as hydraulic mining, and which is the principal method in use to-day, stimulated the advance in hydraulic engineering, and particularly the development of the waterwheel.

The evolution of the waterwheel of the Pelton type is very interesting. Early in the '50's a demand for small power arose, which was met by the invention of what was called the hurdy-gurdy wheel. This was a very crude affair, made of wood, and looked very much like a circular saw with straight-cut teeth, the difference being that it was two or three inches thick. A jet was tangentially applied to the wheel, and, striking the teeth, caused it to revolve. With the introduction of quartz mining the hurdy-gurdy wheel was found inadequate, and it was developed through many intermediate forms into the present type of tangential wheel, which is simple in design, reliable in operation, and gives an efficiency of 80 per cent. Thus, it is seen that the growth in hydraulic engineering, which necessarily preceded long-distance transmission, covered a period of perhaps 40 years, and was relatively slow.

Turning now to the commercial side of the proposition, it is evident that until there was sufficient market for power there could be no long-distance transmission plants. Moreover, to make transmission of power necessary, natural conditions must also exist to prevent the utilization of power at the point where it is generated. In the East, where railroad facilities are good, manufacturing industries locate at the source of cheap power. Even at Niagara, the development of that great power with the express intention of transmitting it to Buffalo, has stimulated manufacturing at Niagara to an unexpected extent. In the West the power plants are necessarily located in the bottom of deep canyons, in mountainous districts, miles from any railroad, so that the market cannot move to the power, and the power has to be transmitted or not used at all. For well-known engineering reasons electrical energy cannot be transmitted efficiently over long distances, except in large amounts, and this calls for a large market for power. In California this market grew slowly, as the industries of the country became diversified. In the early days mining was the principal industry, but as the country grew older it was discovered that with irrigation large crops could be raised in the fertile valleys. The country became more thickly populated and towns grew into cities. With the introduction of electric lighting and electric railways a great demand was created for electric power.

The cost of fuel is the factor which determines whether or not a market exists for power transmitted from a distance. California has no coal beds to speak of, and hence the coal has to be imported. About three-fourths of the supply comes from British Columbia and Washington, and is semi-bituminous and lignite. As the country is practically covered by only one railroad, there is no competition, and freight rates to interior points have been excessive. The price of fuel, and therefore the cost of power, has been very high. In 1890 oil was discovered in Southern California, and has since been largely used for fuel. The consumption rose in 1900 to 4,000,000 barrels. The cost of fuel has fallen somewhat in consequence. As oil has only partially displaced coal, its price naturally hovers about that of coal, and the expectations of an extremely cheap fuel have not been realized. Still, from the point of view of the power-transmission man, the discovery of oil was a most unfortunate event.

Thus, for 40 years prior to 1890 the conditions had been slowly getting more favorable for long-distance transmission. A large amount of experience had been gained in the construction of dams, flumes and pipe lines. A waterwheel suitable for the purpose had been evolved and a market for power in large quantities had grown up. A method of transmitting power over long distances was lacking until the Frankfort-Laufen transmission experiments were made in 1891. In less than two years after these experiments, the historic Pomona transmission of 30 miles at 10,000 volts was in actual commercial operation in Southern California. Since that time the development has been very rapid, the capacity of transmission plants alone now aggregating upward of 100,000 horsepower.

As is usual with any new industry, the thing was at first somewhat overdone. The idea of "harnessing the forces of nature" is so fascinating to most people that the promoter found abundant opportunity for activity. Plants were projected and built that were foredoomed to failure. In some of these the cost of hydraulic development per horsepower was so excessive that the fixed charges were more than the earnings. In others great errors were made in estimating the flow of the streams from which the power was derived, and in dry seasons water ran short, necessitating the erection at large expense of auxiliary steam stations. The years 1897-1898, in which the average rainfall fell from 23 inches to nine inches, were great educators, and probably checked many a project that looked feasible up to that time.

At the present time these enterprises are much more carefully planned than in the early days. The pioneering days are over to a certain extent, and the second stage of development has begun. It has been demonstrated that it is possible to transmit energy in large quantities for distances up to 150 miles and over. With the extension of the lines into large cities for the supply of electric lighting and power for street railways the policy is followed of spending more money in first investment in order to secure reliability of service and low operating and maintenance costs. This tendency is shown in the hydraulic end by the substitution of tunnels and paved and cemented canals, for wooden flumes. Duplicate pipe lines are now provided and the power house itself is built in a more substantial manner and as nearly fireproof as possible.

The pole line has been found to be the weakest part of the transmission system, and I give some of the details of the construction of the latest pole lines, in order to show the care and foresight now displayed in this part of the work.

The poles commonly in use on the newest transmission lines are either of square sawed redwood, tapered from butt to top, or Oregon or Washington cedar. The Oregon cedar poles used by the Bay Counties company in its lines from Colgate to Oakland, a distance of 142 miles, are painted with hot tar from the top of the pole to a point six inches below the bottom cross-arm. The butts are saturated with hot carbolineum for 3½ feet where the pole enters the ground. The following table gives the data on the poles:

Height. Feet.	Top. Inches.	Butt. Inches.	Depth in Ground. Feet.
40	9x9	14x14	6
45	10x10	15x15	6½
50	12x12	16x16	7½
60	12x12	18x18	8

The redwood poles are from the hearts of young trees, not more than four poles being taken from one tree, and, being free from sap when set, they will last from 25 to 35 years. The following table gives the dimensions and other data on the redwood poles used by the Standard Electric Company on the transmission line from its power house at Electra to San Francisco:

Height. Feet.	Top. Inches.	Butt. Inches.	Depth in Ground. Feet.
35	7x7	12x12	5½
40	8x8	13½x13½	6
45	9x9	15x15	6½
50	10x 0	16x16	7
60	11x11	17x17	8

The cross-arms are made of selected kiln-dried Oregon pine six by six inches square and an overall length depending on the distance between wires. After passing through the dry-kiln they are placed in an enclosed boiler containing asphaltum oil and subjected to a temperature of 220° F. for several hours. This preserves the wood and at the same time increases the insulation of the pole top. The arms are gained into the pole a distance of one inch and are held in position by two five-eighths-inch through bolts with cast-iron washers three inches in diameter under both head and nut. The cross-arms are surfaced all around and crowned on top to shed the water. The insulator pins are of oak, locust, or eucalyptus wood. The latter wood is universally used on the coast on account of its immunity from attack by worms and bugs, even the deadly Toredo not touching it. The eucalyptus pins are treated in the following manner: The timber is sawed into sticks three inches square and placed in boiling water for 24 hours. After being air-dried for several months it is worked up into pins. The pins are then placed in a vat of boiled linseed oil and kept at a temperature of 210° F. for several hours. The pins are 16⅞ inches long over all and the diameter at the lower shoulder is 2¾ inches. They are driven into the cross-arm with special care, a hardwood pin-set being used. The pin holes in the arm are 2¼ inches in diameter and five inches deep, leaving one inch of solid wood below the pin. On each side of the pin, at a distance of three inches from the pin and two inches from the top of the cross-arm, one-half-inch carriage bolts are placed, in order to prevent the arm from splitting when unusual strains are thrown on the pins. That this accomplished the purpose is shown by the result of a series of tests made by the Standard Electric Company, in which the cross-arm was split without the bolts from a pull on the thread of the pin of 1,200 pounds, whereas with the bolts in position the pin broke at the shoulder with a pull of 2,000 pounds, thus almost doubling the strength of the arm.

One very noticeable feature of the pole-line construction is the absence of guy wires. On account of the high voltage the ordinary strain insulator is of no use, and the common practice is to use wooden struts. These are six by six inch timbers fastened to a dead man buried five feet in the ground and bolted through the pole at the cross-arm. Sometimes when a guy cannot be avoided, the strut is used as an anchor, or, if a guy is used, a six by six-inch timber 20 feet long is inserted in the guy as a strain insulator. The poles are usually set about 130 feet apart, and whenever a small angle is made in the line two poles are placed close together in order to divide the strain. On all angles double arms are used and double cap pieces bound with wrought-iron bands support the top wire. In single construction the pole pin is usually driven into the top of the pole and a wrought-iron band driven down on to the pole to keep it from splitting. In some cases a bracket pin three feet long and four by four inches in section is bolted through the pole.

As an illustration of scientific methods applied to pole-line construction, I will state that the line is staked out by a surveyor, the poles are set with a plumb bob, and the foreman of construction carries a thermometer and a set of curves, from which he fixes the proper sag to give to the wires. The wires are placed at the points of an equilateral triangle. The wires are from 36 to 42 inches apart and are spiraled, one-third of a twist being made every mile. The Telluride line in Utah is unique in that no iron was used in the construction. The cross-arms are mortised through the poles and wooden

1. Paper read before the Association of Edison Illuminating Companies at Mount Washington Hotel, White Mountains, N. H., September 9 to 11, 1902. Mr. Lukes is night operating superintendent of the Chicago Edison Company, Chicago.

pins are used instead of bolts. Wooden cross-arm braces are fastened to the poles and cross-arms with wooden pins. The object of all this is to increase the insulation of the pole head, but it is open to the criticism that it is mechanically weak.

The insulator is without doubt the most important part of the line. As long as the voltage did not exceed 20,000 and the wires to be supported were of small size the problem of providing a satisfactory insulator was comparatively easy. When 150-mile lines, transmitting 10,000 horsepower at 40,000 volts over aluminum cables seven-eighths inch in diameter were designed, great difficulty was experienced in finding an insulator that was both electrically and mechanically strong. The insulator in common use for this purpose is of the two-part type, the upper petticoat being of porcelain and the lower part of glass cemented into the porcelain. The upper petticoat is nearly flat and is provided with a rim and spout to drain the water clear of the cross-arm. The lower petticoat is shaped like a truncated cone and protects the pin. This insulator measures 11 inches in diameter across the top petticoat and is 11 inches in height. When in position on the arm the wire is 15 inches above the cross-arm. There is much difference in opinion among power-transmission engineers on the insulator question. Some condemn glass and others porcelain. Some insulators are strong mechanically and weak electrically, and others are just the opposite. The difference in opinion is probably due to the different nature of the troubles encountered. For instance, the engineers of one company were very much surprised to find that their insulators gave less trouble in wet weather than in dry. As soon as the fall rains began the insulator trouble ceased. An investigation showed that where the lines ran near railroad tracks the insulators got very dirty and insects of various kinds lodged under the petticoats. This decreased the striking distance and the insulators broke down. The remedy applied in this case was to shut down the line periodically and wash off the insulators. The general feeling among power-transmission men is that no insulator in use at the present time would be safe to use on 60,000 volts. The large transmission companies intend to go up to 60,000 volts as soon as additional line capacity is needed, but as this means changing every insulator on their lines at an expense of several hundred dollars per mile, they will delay action until they are reasonably sure that they have secured the proper insulator.

Aluminum wire has been used largely for transmission purposes on the coast with good results. The Standard Electric Company's line from Electra to Mission San Jose is aluminum cable of 37 strands, with a total cross-section of 471,034 circular mils. The weight per mile is 2,404 pounds, and its tensile strength is 28,000 pounds per square inch. Owing to the high coefficient of expansion of aluminum, care must be taken in stringing the wires to allow sag enough so that the wire will not be too taut in cold weather. A peculiarity of aluminum wire which makes its use in small sizes objectionable is its low melting point. Aluminum melts at 1,157° F., copper at 1,929° F., and wrought iron at about 2,800° F. When an iron wire falls across an aluminum circuit and makes a short-circuit the aluminum wire is melted through and the iron wire remains intact. Thus the trouble is cleared from the circuit at the expense of opening the line. This peculiarity was taken advantage of a year or two ago in a sub-station supplied from a long-distance line at 30,000 volts. A short-circuit occurring on one of the distributing circuits, the switchboard attendant pulled an air-break switch in the circuit. A tremendous arc resulted, which set fire to the sub-station. Not being able to reach the power house by telephone to have the line shut down, the sub-station was in imminent danger of being burned up. A quick-witted lineman seeing the danger drew a coil of iron wire over the aluminum transmission line outside of the station, and thus opened the circuit.

Transmission lines at these extremely high voltages are run as far as possible on private rights-of-way from 50 to 300 feet in width. In timbered country the trees are cleared out far enough on each side of the line so that no trees in falling can cross the line. The lines are patroled very carefully, each patrolman having a section 10 or 15 miles long. He reports frequently to the station over a private telephone circuit run on a cross-arm about five feet below the power circuit. At intervals of two or three miles taps are brought down from the telephone line to booths at the foot of the poles and insulated stools are provided in the booths for the patrolman to use while connecting his portable telephone set. The telephone wires are transposed frequently to cut down the induction, and, as a rule, work fairly well as long as the load is in a balanced condition on the transmission line. When something, such as a short-circuit occurs, which unbalances the power line, the telephone line goes out of commission. As the telephone is most urgently needed at times of trouble on the power line, the value of a telephone line on the same set of poles with the power line is questionable. For the reason also that crosses occur between the power line and the telephone line, thus endangering life, the plan of removing the telephone wires from the transmission pole line and installing on a separate pole line has been suggested more than once.

That pole lines are not absolutely reliable, and, moreover, are expensive to maintain, is shown by the fact that one company is seriously considering the plan of substituting a series of steel towers about 90 feet in height and 1,000 feet apart, the wires to be suspended from tower to tower and separated about nine feet. Although this construction will be more expensive than that of the ordinary pole line, it is thought that the decreased number of breakdowns and lower maintenance and depreciation charges would warrant the extra investment.

As long as the business of the transmission companies was confined to the supply of power for mining purposes and lighting small towns the question of reliability of service was not of vital importance. Interruptions of small duration of time, although annoying, could be tolerated, but with the construction of long-distance lines, using high voltages, for the purpose of supplying current to large lighting and railway companies, the requirements became much more severe. No large central-station manager could afford to buy current, even at a very low rate, if the source of supply was not reliable. This situation led to the construction of duplicate transmission lines. At first two lines were installed on the same set of poles, but it was found that when trouble occurred on one line it was usually communicated to the other line, and so this practice has been abandoned and duplicate lines on separate pole lines are now considered necessary. Even with the introduction of duplicate pole lines, the situation is not entirely satisfactory, on account of the short shutdowns caused by the difficulties in switching high-tension lines. The switches in ordinary use are of the air-break type, and while it has been claimed time and again that they can be opened safely under load, yet the fact remains that it is dangerous to do so, both on account of the surges set up in the transmission line, and the arc at the switch, which is often disastrous. When one transmission line is held in reserve and trouble occurs on the line in use it takes some little time to switch in the good line. When the two lines are run in multiple and a short-circuit occurs the usual practice has been to either burn off the trouble or shut down the station and start up on the good line. If the short-circuit is serious and is burned off, the disturbance in frequency and voltage is usually sufficient to cause all synchronous apparatus at the end of the line to drop out of step. The same operating problem, to a certain extent, confronts the eastern central-station manager who contemplates the erection of a large station generating alternating current at high voltage to be transmitted to sub-stations and there converted into direct current. The eastern man may avoid possible shutdowns by the use of time-limit oil switches and reverse-current relays, or he may as a last resource subdivide his station into several distinct parts, supplying separate lines, and use storage batteries as a reserve. In the West oil switches for voltages of 40,000 and over have not yet been developed, or if they have the price is prohibitive. Storage batteries can be used to a limited extent on direct-current and railway loads, but the high price has retarded their use.

The problem of securing good regulation on long lines has been a very troublesome one. Some of the difficulties due to inductive loads and charging currents have been overcome by the proper use of induction and synchronous motors, combined with reactance coils connected across the circuit, but the facts remain that a railway load on the end of a long-transmission line is a bad thing as far as regulation is concerned, and the time will come when the transmission companies will be forced to refuse railway business, unless storage batteries are installed to keep down the rapid fluctuations in load.

The transmission companies are wholesalers of electric current. They generate current, transmit it to the market, and sell it in large quantities to the local companies, reserving the right, as a rule, to sell current directly to large power consumers. The usual method of charging is by the horsepower per year. The rate varies from $18 to $90 per horsepower per year. The best price is obtained at points remote from railroads where fuel must be hauled by wagon, such as at mines. The lowest price is obtained at cities on the water where fuel is cheaper. Other lines of charging are in use in special cases, Current is sold to a street railway, for instance, on a car-mile basis; to a flour mill at so much per barrel of flour turned out. In one case it is sold to a local company for a certain percentage of its gross receipts. It is needless to say that this local company is selling light in large quantities at flat rates and is making money. Charging by the horsepower-year method is supposed to be logical for waterpower plants, because the operating expense does not vary with the load. Nevertheless, the method has all the objections that apply to any flat-rate system. It encourages waste and demoralizes rates. As long as the local companies can buy current on the horsepower-year basis they will sell light at flat rates. It is not impossible that the method of charging will have to be changed at some future time, for the following reasons: The water supply in this country is not unlimited. Already some of the companies find it necessary to provide storage to carry them through the dry season. As each company approaches the limit of hydraulic development it begins to cast about for some means of increasing its capacity. Some companies have found it practical to construct storage reservoirs at the heads of their pipe lines. During the hours of small load the water runs from the flume into this reservoir and when the peak comes on the reservoir is discharged into the pipe line, and thus helps to take care of the peak. When this point is reached by any company it is evident that any method of charging which reduces the waste, even at the hours of small load, becomes highly desirable, and so it seems quite likely that in the course of time it will be necessary to get on some sort of maximum-demand basis.

The future of long-distance high-voltage transmission in the West depends largely upon the development of oil as a fuel. If the production of the oil fields continues to increase so that oil entirely displaces coal as a fuel in certain sections of the country, it is evident that the price of fuel will be so lowered that the transmission plant will be unable to compete with local plants using oil as fuel. On the other hand, in certain sections, fuel will always be high on account of high cost of transportation. It is in these localities that the power-transmission companies will find their best field for growth.

Durability Tests of Storage Batteries.

A recent issue of the Centralblatt für Accumulatoren und Elementenkunde contains details of tests carried out by order of the French minister of the marine with storage batteries of French manufacture, presumably for use on submarines. The method of testing the durability of the cells was as follows: The cells submitted by the various manufacturers were connected up in series to form one battery, and were charged and discharged 250 times. A current of 330 amperes was used for the first charging operation for a period of four hours, and subsequent chargings were carried out with the same current for a period equivalent in ampere-hours to a 50 per cent. increase on the previous discharge from the battery. The discharge was carried out at 660 amperes, and was continued until the electromotive force of any cell had fallen to 1.65 volts. Two chargings and dischargings were completed daily, and Sundays were observed as rest days. The level of liquid in each cell was preserved constant by additions of water or acid during the period of the test. The cells which fell below 1.65 volts in less than half an hour from the commencement of any period of discharge were withdrawn from the series, and the plates submitted to a final examination in presence of a representative of the makers. The number of cells entered for the test was 21, these being submitted by 13 manufacturers. The experiment continued from October 10th to March 17th, and on the latter date only five cells were left as survivors of the durability test. The following are the trade names and final electromotive forces of these five cells: Heinz (1.860 volts), Union (1.790 volts), Metaux (1.772 volts), Max (1.714 volts), Fulmen-d'Arsonval (1.650 volts). Of the above five makes of batteries, the first four are manufactured exclusively with pasted plates. The maximum weight of accumulators for the French navy is fixed by the ministry at 225 kilogrammes. The Heinz cell had a total weight of 181 kilogrammes, of which 106 kilogrammes represented the weight of the plates.

Blast-furnace Gases for Factory Power Plant.

The Union Steel Company of Pittsburg, Pa., will adopt electrical power distribution for its new mills. The power will be generated by steam from the waste gases from the blast furnaces, and will be distributed in the form of alternating current to rotary converters at the mills, where it will be used largely as direct current. The Union Steel Company has recently purchased from the Westinghouse Electric and Manufacturing Company two 800-kilowatt, alternating-current generators, one 800-kilowatt, direct-current generator and five rotary converters.

High-speed Electric Mail Delivery.

An Italian engineer, Mr. Piscicelli, is said to have invented a system of mail delivery to be operated by electricity which will carry mail at the great speed of 248 miles an hour. The scheme provides for small aluminum boxes suspended from overhead trolley wires. The Italian government has appointed a committee to investigate and report upon the invention. If the report is favorable, a trial of the system will be made between Rome and Naples, between which points the inventor asserts he can deliver mail in 25 minutes. This distance is approximately 110 miles. By his method the inventor says he can cut the mail-transit time between Rome and Paris down to five hours.

The Springfield and Central Illinois Electric Railway Company have been incorporated with a capital of $200,000. The principal office of the company will be at Springfield. The new road will extend from Springfield through the counties of Sangamon, Logan and McLean to Bloomington, and through the counties of Sangamon and Macon to Decatur. The line will also have a southern branch, extending from Springfield to Carlinville, and west from Springfield to Jacksonville.

CORRESPONDENCE.

New York Notes.

New York, September 13.—The Pennsylvania franchise situation begins to look more favorable. President Cantor now agrees to ovrlook all other points for which he has been contending, provided the railroad company will include in the franchise the "prevailing rate of wages" clause, and an agreement that the working day for the laborers shall not be longer than eight hours. These last two points the president says he will not concede, as he believes that they should be part and parcel of all franchises granted by the city. The next meeting of the aldermanic committee and railroad officers will take place on the 17th instant, when, in all probability, a settlement will be reached agreeable to all parties.

The Rapid Transit subway, after an expenditure of nearly $21,000,000 and the loss of 24 human lives, is three-fifths completed. The figuring on the proportion of the work accomplished is done on a financial basis. Thirty-five millions of dollars is the amount to be paid for the completed contract, and at present, in round numbers, $21,000,000 has been paid out. In the course of construction it has been necessary to excavate some 3,000,000 cubic yards of solid rock, and for months contractors have been using 1½ tons of dynamite a day for the blasting. The work is progressing rapidly, and it is expected to see the streets cleared up in a great many places in a short time. One of the obstacles still in the way of the work is the Hall of Records.

The application made by the New York Central and Hudson River Railroad Company for the swinging of Park Avenue 50 feet further west through seven blocks, as mentioned last week, has not been granted as yet, but no opposition has so far developed.

Controller Grout has made the statement that it is the intention of the Low administration to make contracts on or before July 1st next for the following projects: An east side extension of the rapid-transit tunnel from Forty-second Street to The Bronx; the Broadway spur, or extension, to the Rapid Transit tunnel, from Fourteenth Street to Forty-second Street; the Jerome Avenue extension and a second tunnel to Brooklyn.

Commissioner Monroe, of the Department of Water Supply, Gas and Electricity, offered a resolution to the Board of Estimate at its meeting on the 12th instant, that, in Broklyn, trolley feed wires and all others except those now securely attached to elevated structures on several of the most traveled thoroughfares in Brooklyn be put underground. Professor Colin of the Brooklyn Rapid Transit Company, objected to the passage of the resolution on the ground that it was unnecessary. The resolution suggested by Commissioner Monroe was adopted.

The entire plant and property of the Automobile Company of America, at West Side Avenue and Broadway, Jersey City, was sold yesterday by Henry C. Cryder, the receiver. The property was bought by Richard Currier of New York for $100,000, subject to two mortgages amounting to $65,000 and unpaid taxes and interest amounting to $3,000. The company's liabilities are about $210,000. It is understood that the plant is to be operated by a new company to be formed for that purpose.

The A. B. See Electric Elevator Company, which has a factory at 116 Front Street, Brooklyn, has bought more than eight acres of land on Pacific Avenue, Pine and Carnoth Streets, Jersey City, and will erect works there, moving from Brooklyn. The new buildings are to cost $70,000.

Mayor Low received a delegation from the Manufacturers' Association of Brooklyn in reference to a new plan for relieving the crush at the Manhattan end of the Brooklyn Bridge. The plan was prepared by Neil Poulson, an engineer of the Hecla Iron Works, and consists of an interchangeable switching by which trolley cars can be loaded and unloaded on different sides of the structure. President McCarroll of the Manufacturers' Association said that the plan would relieve the congestion. It was decided after discussion to submit the plan to a committee of experts, one to be suggested by Commissioner Lindenthal, one by the Brooklyn Rapid Transit Company, and the third by the Manufacturers' Association. O.

New England News.

Boston, September 13.—The selectmen of Rehoboth and Seekonk, Mass., have held hearings on the Norton and Taunton Electric Street Railway Company's petitions for locations in those towns, and no opposition was developed. The selectmen will undoubtedly grant the franchises, and the company can then complete its proposed lines from Boston to Providence. Only five persons appeared at the Rehoboth hearing and only three at the Seekonk hearing. This ends the fight between this company and the Bristol County Company, both of which have been granted locations.

The Connecticut Railway and Lighting Company is to build a one-story building at New Britain, Conn., a building in Waterbury, Conn., and a new plant at Shelton, Conn., all at a cost of $200,000.

Following the example of the Connecticut Railway and Lighting Company, the Norwich and Montville (Conn.) Street Railway Company is installing a 560-ampere-hour storage battery of 270 cells, to be used in supplying supplementary power. The company is building a brick addition to the power house, 30 by 50 feet, for the accommodation of the storage battery.

The Norton and Taunton Street Railway Company has petitioned the Massachusetts railroad commissioners for authority to extend its lines into the towns of Foxboro, Sharon, Stoughton, Canton and Milton, Mass. Objections to the extension into the three last-named towns have been filed by the Blue Hill Street Railway Company and William Odlin, receiver for the Stoughton and Randolph Street Railway Company.

The Salem and Lawrence (Mass.) electric railway was opened for traffic last week. The first car carried General Manager Page and Superintendent Walcott of the Boston and Northern Railroad Company, Directors Peterson and Porter of the Middleton and Danvers company, the mayor and aldermen of Salem and the Danvers selectmen. The road is about 11 miles long and the running time for the first trip was a little less than 1½ hours. The mayor, aldermen and heads of city departments of Lawrence joined the party when the car reached that city. The road is part of the Boston and Northern system, but is managed separately. B.

Southern Developments.

Charlotte, N. C., September 13.—An agreement has been reached regarding the merger of the street-railway lines of Macon, Ga., and all terms of the ordinance have been agreed upon. As soon as the ordinance is reported back to the council and adopted, the consolidation will go into effect.

It is said that the Cape Fear Electric Company will soon take up the work again on its proposed power plant at Buckhorn Falls, near Fayetteville, N. C.

An offer of $25,000 has been made the town of Scranton, Miss., for the electric-light and water plant. The offer comes from a northern capitalist, who also is projecting an electric railway between Pascagoule and Moss Point over the present railway connecting the two places, which will be acquired separately from the plant.

The town of Fayetteville, N. C., has accepted the bid of the Richmond Engineering Company for the electric lighting of the town. The bid of the company was $11,306, and is for direct-current series arc light for street circuits and alternating current for incandescent lighting.

C. M. Ferebee has been granted a franchise for a street-railway, gas and electric-light and power plant of Elizabeth City, N. C.

W. M. Glazebrook is president of the Reversible Electric Car Sign Company chartered at Richmond, Va., to manufacture electric signs and other specialties.

The Postal Telegraph-cable Company has established a new office, that of electrical engineer for the South, with headquarters at Atlanta, Ga. J. Hargrave has been appointed to fill the position.

E. W. Trafford of the Passenger and Power Company of Richmond, Va., states that $200,000 worth of machinery has been ordered for the company and that this will have to be placed before the company can get its wires underground. An extension of the time limit will be asked. L.

From the Buckeye State.

Cleveland, Ohio, September 13.—The Scioto Valley Traction Company will have one of the best properties in the state, if all the plans are carried out as they have been formulated. It is expected that the cars will compete with the Hocking Valley and the Norfolk and Western steam roads in time between Columbus and Lancaster and Columbus and Circleville. The power house will be located at Valley Crossing, four miles south of Columbus, where the two branches of the road meet.

Ex-Governor Asa S. Bushnell had a very interesting interview in the Cincinnati Enquirer a few days ago in regard to the benefit electric roads are to the farmers of the country, and the fact that they form feeders for the steam roads rather than come in competition with them. He gives figures to prove that there would be a great saving to farmers in shipping their products over the electric roads for even five or six miles instead of hauling that distance to the steam-road station, and at the same time the electric road would make good money and the steam road would not lose anything. He thinks that a network of electric roads all over the state would be of great benefit to the farmers and steam roads and would benefit the cities and large towns beyond measure.

The Merkhofer Electric Works Company of Cincinnati has been incorporated with a capital stock of $10,000 by C. W. Ratterman, Jacob Merkhofer and others.

It is said that a new road to connect Columbus, Delaware and Marysville is being projected by Pittsburg capitalists who have purchased the Magnetic Springs property, which will be converted into a fine summer resort, with a large hotel and several smaller ones. The road is to form a feeder for these. The gentlemen who are mentioned in connection with this enterprise are Chris Magee, Jr., W. M. Galbreath and C. M. Buchanan.

It is reported that the Appleyard syndicate is negotiating with the American Railways Company for the Dayton lines, as well as the Springfield system. This syndicate is becoming one of the most important in the state, and is destined to be a greater factor in the development of the state in the future than in the past.

An election will be held at North Amherst on October 6th to vote on the issuance of $10,000 bonds for the purpose of putting in a municipal lighting plant.

For August the Northern Ohio Traction Company made a fine showing, the surplus for dividends being $29,412.13, after all expenses had been deducted.

J. C. Hooven of Dayton has completed the organization of the Richmond and Ohio Traction Company, which will build a line from College Corner, on the Indiana line, to Richmond, as a western extension of his proposed line from Hamilton to College Corner, under the name of the Cincinnati, Hamilton and Indiana Traction Company. O. M. C.

Information from Indiana.

Indianapolis, September 13.—J. P. McGeath has been granted a 35-year franchise for an interurban line into the city of Alexandria, the line coming from Hartford City. The company put up a $5,000 bond to complete the line by July next. The route is on Washington Street, and, as the Union Traction Company wants Washington Street, difficulty is expected in adjusting the matter.

The Richmond Interurban Company has completed its extension of 18 miles between Cambridge City and Dublin, with the exception of the crossing of the L. E. & W. tracks. No agreement has been reached by the two companies, and the railroad has a watchman stationed at the point where the crossing is to be made. The Richmond company says it has a franchise and will build the crossing when it gets ready, and there is a probability of a clash. The Union Traction Company is experiencing a similar trouble with the L. E. & W. near Elwood on its line to Tipton.

A franchise has been granted to Messrs. Storen and Shea to build a traction line through Jackson and Scott Counties. The line is to run from Columbus to Selersburg by way of Seymour and Scottsburg. The line must be completed in two years. This is the beginning of the Louisville trunk line.

The Central Labor Union, by a vote of six to 13, has lifted the boycott on the Terre Haute, Brazil and Interurban road. The meeting was a stormy one and lasted until midnight. This action formally ends a strike began January 19th. Most of the striking motormen and conductors returned to work some time ago. Manager Grant of the company said he would win out against the strikers "if it took him all summer," and he did.

The Indianapolis and Shelbyville line was opened for regular traffic last Thursday. Cars are now making hourly trips and the patronage is good. The fare for the round trip is 75 cents.

The Indianapolis-Plainfield line will open for regular traffic Tuesday morning. Cars are now making trial trips. The fare will be 20 cents each way.

A number of high-speed motor cars have been ordered by the Indianapolis-Greenfield line to be used in a limited service between Indianapolis and Dayton, Ohio. They are geared to 60 miles an hour, will seat 56 people and are expected to cover the distance in 2½ hours. The respective companies are completing the extensions, and the through line service will be begun in a short time. At Dayton there will be connections with the fast limited electric cars east to Springfield and Columbus and lines to Toledo and Cincinnati. Next year there may be a line connecting Columbus with Pittsburg, and Indianapolis will have through fast connections with the headwaters of the Ohio.

Chicago and Cincinnati are to be connected, perhaps, with interurban electric lines by way of Indianapolis. According to the plan, the Indiana Northern Traction Company will make the system north of Indianapolis and the Indianapolis and Rushville Company the southern connection.

A night and a day force is working on the power-dam enterprise on the St. Joseph River, between South Bend and Elkhart. This dam is to cost $1,000,000, will furnish 6,000 horsepower and will form a nine-mile lake of back water. It will furnish water and electric power to South Bend, Mishawaka, Elkhart, Goshen and other towns.

Mayor Alderman of Goshen vetoed the 50-year franchise granted the Hawks Electric Company. The council will now grant a 25-year franchise with a reservation that the city may purchase the plant at any time after 15 years. The new franchise regulates the price of lights. Many citizens, however, "view with alarm" the possibility of muncipal ownership of the electric-light plant.

A few months ago the old stage coach that traveled between Indiana Medical Springs and Attica gave place to a monster automobile. The latter proved such a terror to farmers' teams that it has been returned to the factory and recourse had to the old stage coach again. Enough damage suits have been filed against the Springs company to amount to what a dozen such machines would cost. F.

Northwestern Notations.

Minneapolis, September 13.—The plans of the Highland Canal and Power Company of Duluth are being carefully examined by representatives of the Weyerhauser lumber interests and also by representatives of the city of Cloquet, Minn. The former will ascertain if the formation of an immense reservoir will affect the facilities for getting timber to the saw mills at Cloquet. The city of Cloquet will ascertain what effect, if any, the diversion of the water in the manner planned will have upon its future.

The electric-light plant at Watertown, Wis., has been sold to a new company, of which F. E. Woodward of Watertown is president. Parties of Grand Rapids, Wis., are interested.

The new interurban line between Oshkosh and Omro, Wis., has been completed and put in operation. Officials of the city of Oshkosh, of Omro, Algoma and other towns made the trial trip as the guests of the company. A banquet was served at the hotel in Omro at the end of the trip.

The city of Nebraska City, Neb., has made arrangements for electric street lighting, after being in darkness for the last year.

James Cooper of Denver, Colo., has arranged to purchase the electric-light plant at Glenwood, Iowa, from A. H. Winkler. The new owner contemplates putting in a steam-heating plant.

The Electrical Commission of Duluth has organized and is now considering the matter of getting the wires underground. The ownership of conduits is one of the matters which the commission will consider carefully. There is quite a sentiment in favor of the city constructing the conduits and renting space to the electric companies.

The Gilruth department store at Watertown, S. D., has just installed a complete electric-light plant. The plant will charge the automobile delivery wagons and will also operate fans in the summer, in addition to furnishing light.

The Dubuque and Pacific Railway Company has filed amended articles of incorporation, changing its title to the Iowa Traction Company. The new company proposes to build an electric line from Dubuque to Cedar Rapids. R.

PERSONAL.

C. D. Strong has resigned as general manager of the Gas and Electric Company of Lincoln, Neb., and is succeeded by L. G. Van Ness of Denver, Colo.

A. F. Roome of New Orleans, La., has been appointed superintendent of all telegraph lines of the Southern Pacific Company, with headquarters in San Francisco.

H. E. Sawyer has been appointed superintendent of the Dayton, Springfield and Urbana (Ohio) road, and C. E. Simonson has been made superintendent of the traffic department.

The results of last week's Democratic caucuses in Massachusetts practically assure the gubernatorial nomination of Colonel William A. Gaston, chairman of the board of directors of the Boston Elevated Railway Company.

The firm of Charles A. Brown & Cragg, well-known patent lawyers of Chicago, has been dissolved. Mr. Brown will continue the practice of patent, trademark and copyright law, with an efficient corps of assistants.

It is reported that Clarence H. Mackay, having arrived in New York from England, will succeed his father as president of the Commercial Cable Company, the Commercial Pacific Cable Company and the Postal Telegraph-cable Company.

E. L. Draffen is now representing the Gould Storage Battery Company of New York in the West, with offices in the Rookery Building, Chicago. Mr. Draffen is already well known in the storage-battery field through his energetic work in the Cleveland office of the Electric Storage Battery Company of Philadelphia.

The friends of Colonel W. S. Rogers, who, for so many years, had charge of the old Brush factory at Cleveland after it was turned into a general factory building, will be interested to know that he is now acting in Cleveland as appraiser of fire losses. Mr. Rogers makes a specialty of the adjustment of losses on manufacturing plants, general machinery and electrical apparatus. His offices are in the Williamson Building in Cleveland.

E. K. Seymour of the contracting department of the Chicago Edison Company has resigned his position to go to Cuba to engage in electrical engineering and construction work, near Cochinois, on the southern coast. Mr. Seymour is a competent young electrical man and is well liked by his associates, who regret his departure. An American syndicate proposes to develop a large tract of the island south of Havana, and Mr. Seymour will have charge of the building of the necessary telephone and telegraph lines and power and lighting plants.

ELECTRIC LIGHTING.

The Hartford (S. D.) Electric Light Company has been incorporated.

The capital of the Helena (Mont.) Light and Construction Company has been increased $150,000 for the purpose of making extensive improvements. A. L. Smith is secretary.

The city of Blue Ridge, Ga., will construct an electric-light plant to cost $15,000.

Weiser, Idaho, has voted to issue $40,000 in bonds for an electric plant and waterworks.

Columbus, Ohio, is receiving bids on a municipal electric-lighting plant. C. M. Addison is clerk.

The Light and Power Company of Huntington, N. Y., has been incorporated with a capital of $75,000.

The electric-light plant of Glenwood, Iowa, has been sold to J. Cooper, who will continue to operate it.

Mohawk, N. Y., has voted to issue $15,000 bonds to remodel and improve the electric-light and waterworks plants.

A contract for a municipal lighting plant in Washington, Iowa, has been let to a Chicago firm. The consideration is $12,500.

A 10-year franchise for electric light has been granted to the Ladysmith Light and Power Company of Ladysmith, Wis.

Charles Meeker of Lafayette, Ind., is at the head of a company which is preparing to build and operate an electric-light plant in Medford, Ind.

Omaha, Neb., at a special meeting of the council, adopted plans and specifications for an addition to the city's electric-light plant. Bids will be advertised for.

The Ebensburg (Pa.) Light, Heat and Power Company has been incorporated with a capital stock of $50,000 by J. W. Leach, J. W. Kephart and S. L. Riggs.

Fire recently destroyed the electric-light plant in Cœur d'Alene, Idaho. The plant belonged to James Monfigham, and his loss is about $10,000. The plant will be rebuilt.

The Milwaukee (Wis.) Electric Railway and Light Company has been granted a permit to erect a power house on Commerce Street. It is said the plant will cost $100,000.

The Sussex Light, Heat and Power Company of Georgetown, Del., has been incorporated with a capital of $25,000 by William J. Thoroughgood, Wilber F. Tunnell and others.

Harrodsburg, Ky., will vote on the question of bonding the city to the amount of $10,000, the money to be used in buying or constructing electric-light and waterworks plants.

The Central Gas and Electric Company of Hot Springs, S. D., has been incorporated with a capital of $1,000,000 by Simon Louderback, James G. Meer and Charles W. Hagmen.

The Watertown (Wis.) Electric Light Company's plant has been transferred to the recently organized Watertown Electric Company, which is composed of capitalists of Watertown and Grand Rapids.

The village of Verndale, Minn., will receive bids until September 25th for the installation of a complete electric-light plant. Plans and specifications for the same may be obtained by applying to City Recorder H. Lyons, Verndale, or to Engineer O. Claussen, St. Paul, Minn.

The Denver (Colo.) Highlands Electric Company will ask the Denver City Council for a franchise. The Highlands company has been operating for some time in the town of Highlands, which has recently been annexed to the city of Denver. The company promises to operate in Denver on a flat rate and to pay the city three per cent. of its earnings per annum for the franchise.

ELECTRIC RAILWAYS.

The Natchez (Miss.) Street Railroad Company certifies to an increase in capital stock from $150,000 to $300,000.

The Pacific Electric Railway Company of Los Angeles, Cal., is making experiments with magnetic brakes on some of its cars.

It is said that J. P. Morgan & Co. are backing a project to build an electric railway from Maysville, Ky., to Columbus, Ohio.

The street-car strike at Ottumwa, Iowa, has been settled by the company agreeing to recognize the union. Cars are running on all lines.

The Toledo (Ohio) Railway and Light Company has awarded a contract to A. Bentley & Sons for the erection of new car shops on Central Avenue, to cost $125,000.

The Macomb and Western Illinois Railway Company has been incorporated with a capital of $300,000. The incorporators are D. P. Pennywitt, Henry C. Agnew and E. J. Hampton.

The Lehigh Valley Railroad Company has completed the installing of an electric block-signal system. The system works on the principal of standing at "danger" until set to "safety" by an approaching train, provided the block ahead is clear.

The Winnipeg (Manitoba) Electric Street Railway Company, although making extensive improvements in its city lines, is laying plans for suburban extensions. Next year a suburban road will be built by the company to St. Boniface and to Fort Rouge.

It is reported that Samuel Thomas and Edwin Gould have purchased the North Jersey Street Railway Company, the Jersey City, Hoboken and Paterson Street Railway Company, and the Central New Jersey Traction Company. The management of the roads will be consolidated.

An electric freight and express business is to be installed on the street-railway systems in and about Utica, N. Y., in the early fall. The Utica and Mohawk Valley Railway Company has the scheme under consideration, and has been, through its officers, inspecting similar systems in different parts of the country.

The electric railways have brought suburban property around Boston, Mass., into the real estate market at an advanced figure. A smart demand is reported for it, and the cause is attributed to the improved electric-car service which makes it possible for a man to live in the suburbs and still reach his business in due season.

On September 24th a meeting of the stockholders of the St. Louis and Suburban Railway Company will be held to vote upon a proposition to increase the capital stock from $3,000,000 to $7,500,000, and also to pass upon a proposition to increase the bonded indebtedness of the company $7,500,000. S. M. Kennard is president of the company.

It is rumored that the Camden Interstate Railway Company has bought a piece of land at Kenova, W. Va., on which to erect its principal power house, machine shops, and some buildings for employes. Kenova is situated on the Ohio River, half way between Huntington and Ashland. The company's power house is now located at Ashland.

The Ohio Central Railway Company has filed an application for a franchise through the streets of Columbus, Ohio. The company is to build a road between Columbus and Lancaster. Another company has already asked for a franchise over the same right-of-way, but the Central company has underbid it on fares and promises a straight three-cent fare or 40 tickets for $1.

The Massillon (Ohio) council has recently passed an ordinance which limits the speed of local electric street cars to eight miles an hour, and the town authorities say that they will enforce the speed rule. Motormen of the railway company have a schedule which compels them to run their cars considerably above the speed limit, and the outcome is awaited with interest.

Application has been made to the County Board of Cook County, Ill., for a franchise authorizing the Chicago, Milwaukee Avenue and Inland Lakes Traction Company to construct and operate a street railroad in Milwaukee Avenue from the present city limits of Chicago in Jefferson to the north line of Cook County. The petition for the franchise is signed by George Leininger, president, and G. F. Lanaghen, secretary of the company.

A clever contortionist and acrobat was recently arrested in New York city on the complaint of several street-car companies which he had swindled. The man would allow himself to be run down by a trolley car, and through his skill, would fall in such a manner as to escape unharmed. He would pretend to be injured and would institute proceedings against the railway company, always settling his claim outside of the courts, however.

The Mesaba Electric Company of Duluth, Minn., has been incorporated with a capital of $50,000. A. A. Hartley, O. D. Kinney and others are interested. The new company intends to build electric railways between towns on the Mesaba range. The first road to be built will connect Eveleth and Virginia, both in Minnesota. The distance is 4½ miles. Surveyors are now at work and the road is expected to be finished and in operation by next spring.

W. R. Wright, a British engineering expert, who is to direct the installation of an electric street railway system in Wellington, New Zealand, is now on his way to America to study the electric traction methods employed in this country. Most of the machinery for the Wellington roads will be supplied by American manufacturers. The Lorain Steel Company of Johnstown, Pa., has a contract for rails, and the J. G. Brill Company of Philadelphia has an order for 34 cars.

Some two or three weeks ago, the East St. Louis (Ill.) Electric Railway Company was granted the right, by the City Council, to connect its tracks with those on the Eads bridge over the Mississippi River. An injunction was asked by a local automobile company, restraining the railway company from making the connection. The injunction proceedings were heard by Judge Burroughs, who decided in favor of the railway company, allowing it to continue its work of making the desired connection. This connection will allow cars to run from East St. Louis, Ill., over the bridge into St. Louis, Mo.

The Detroit United Railway has begun the publication of a small weekly paper which is known as the Detroit United Weekly. It is carried on all the cars and is made up of news in regard to the road, the interesting points of the city, time tables and other information of the kind. It is distributed free of cost. It is the intention of the road to in-

struct patrons upon points over which they and the company are liable to disagree. This is perhaps the only street railroad company in the United States which publishes a paper. The Cleveland roads carry circulars on their cars for distribution, but they merely advertise the interesting points of the city and instruct patrons how to reach them over the city lines.

By a unanimous vote the South Bend (Ind.) council has taken from the Indiana Railway Company, which operates an electric street railway in South Bend and also interurban roads to Goshen, its perpetual and unlimited franchise to the city's streets and alleys, this being in conjunction with Judge Beeker's decision against perpetual franchises made in the Logansport case. This step was taken to enable competing lines to build roads, the old franchise having given the Indiana company complete control of the city's streets. A new company has applied for a franchise from South Bend to Elkhart.

Marion, Ind., has brought suit against the Marion Transit Railway Company and the Union Traction Company for injunction and damages to the extent of $50,000. The suit is the result of the use, by the Union Traction Company, of the tracks of the Marion Transit Railway Company's lines and the abandonment of the use of others. The Union Traction Company has taken possession of the property of the Marion Transit Railway Company, although the council claims the transfer is without legal right. The suit was brought to enjoin the company from the use of streets held by franchises of the Marion Transit Railway Company.

John B. Parsons, president of the Philadelphia Rapid Transit Company, announces that the plans for the company's elevated road and subway in Market Street, Philadelphia, will soon be completed, and that work will be commenced this fall. The subway in Market Street will run from the Delaware River to Twenty-third Street, and the elevated road will run from that point to Sixty-third Street. It is believed that the franchise for an underground railway on Broad Street, which was the only franchise the Mack-Foerderer people did not transfer to the Union Traction Company, is owned by the Pennsylvania Railroad Company.

AUTOMOBILES.

The Jonesboro (Ark.) Automobile Company has been incorporated with a capital of $10,000. The company proposes to purchase three automobile passenger coaches, each of a carrying capacity of 12, and one freight coach, and to establish regular service through the streets of Jonesboro and to Nettleton, a short distance away. The organizers of the company are S. A. Warner, Jr., W. W. Cate, A. L. Malone and others.

PUBLICATIONS.

The C. W. Hunt Company of West New Brighton, Staten Island, N. Y., has issued an illustrated pamphlet descriptive of its cable railways for handling coal and merchandise.

The De Laval Steam Turbine Company of 74 Cortlandt Street, New York city, has issued in bulletin form the results of a test of a 300-horsepower De Laval steam turbine dynamo by Dean & Main of Boston.

The Link Belt Machinery Company of Chicago is distributing an attractive booklet which describes the Renold silent chain gear. This gear is made up of stamped links of peculiar form, shouldered studs and countersunk washers. The catalogue states the advantages of this construction over leather or rubber belting, spur gearing and chain drive, and a number of illustrations show its application to a variety of uses, including the electric drive.

Fred M. Locke of Victor, N. Y., has issued a comprehensive and well-illustrated catalogue on his Victor insulators. These insulators are well known by their use throughout the West on high-tension transmission lines. They are made in different sizes adapted to all potentials from 25,000 to 100,000 volts, actual line voltage. The catalogue illustrates a great variety of combination, porcelain, cable, strain and glass insulators. A list of plants using Locke insulators and pins is given at the back of the book.

A new monthly journal, Electrochemical Industry, has made its appearance. It is edited by Dr. E. F. Roeber and is published in Philadelphia by a company, of which Prof. J. W. Richards of Lehigh University, president of the American Electrochemical Society, is the president. It is the purpose of the proprietors to make the new journal an authoritative exponent of electrochemical science and its various applications. The first issue, including a technical digest prepared by Carl Hering, certainly presents a very creditable appearance.

SOCIETIES AND SCHOOLS

The next meeting of the American Institute of Electrical Engineers will be held at 12 West Thirty-first Street, New York, on Friday, September 26th. A paper will be presented by B. G. Lamme of Pittsburg, on "The Washington, Baltimore and Annapolis Single-phase Railway." The succeeding meeting will be held at the same place on Friday, October 24th, and a paper will be presented by Prof. Charles P. Matthews of Lafayette, Ind., on "An Integrating Photometer for Glow Lamps and Sources of Like Intensity."

Leland Stanford University, located at Palo Alto, Cal., has made a considerable change in its electrical-engineering department, both as to faculty and quarters. The administrative head of the department is to be Professor Albert W. Smith, recently returned from an extended leave of absence, during which he was engaged in practical work with Westinghouse, Church, Kerr & Co. The acting head of the department will be Professor Frank G. Baum, with J. P. Jollyman and A. S. Kalenborn as student assistants. A new engineering building will be completed shortly, and the electrical department will be given commodious quarters in it. Apparatus is arriving daily and a complete new electrical outfit will be installed by Christmas.

A catalogue recently issued by the Massachusetts Institute of Technology, Boston, Mass., contains a very complete account of the institute's department of mechanical engineering. A schedule of studies, descriptions of the courses of study, requirements for graduation, lists of faculty and graduates, and other pertinent information is given, while the pamphlet is very well illustrated with a number of views in the mechanical-engineering laboratories. Another catalogue prepared in a similar way is devoted to the courses in mining engineering and metallurgy and also contains several illustrations of the mining and metallurgical laboratories.

TELEGRAPH.

The telegraph department of the United States Weather Bureau is preparing to lay a cable between Glen Haven, Mich., on the mainland, and South Manitou Island, in Lake Michigan, a distance of about 10 miles.

Report says that an American combination has offered $600,000 for one-third of the stock and the patents held by a Danish company which is exploiting the Poulsen telegraphone. It is said that the offer was received coldly.

Military telegraph lines have been erected in Alaska with great effort and hardship. The lines are 425 miles long and connect Fort Egbert, Eagle City and Fort Liscum, the last named located near Valdes, Alaska. It has required two years to build the lines and has cost nearly $500,000.

Burnell Welborn of Stewartsville, Ind., is probably one of the youngest telegraph operators in the country. The boy is only 10 years old, and yet, it is said, he can handle a key as well as operators many years his senior. He has often had charge of the stations at Cynthiana and Stewartsville on the Evansville and Terre Haute railroad.

According to statistics just issued, the German cable system consists of 73 lines connecting different parts of the home territory, six with the colonies, and 19 with foreign countries, making a total of some 17,000 miles. One-third of all the German cables are state concerns, while the other two-thirds are in the hands of private companies. Of the world's total mileage only four per cent. belongs to Germany.

MISCELLANEOUS.

Dr. Waller, an English medical man, has recently shown that electrical reactions afford evidence of vitality not only in animal tissues but also in plants. Before the Physiological Society, last winter, he gave a beautiful demonstration of the susceptibility to electrical reactions of a beanstalk. He then proceeded to kill a portion of the stalk by electricity and to show that after death the electrical reactions were no longer forthcoming.

A few days ago the electrical workers employed by telephone and electric-light and power companies in and about Utica, N. Y., went out on a strike. The workmen demand a minimum wage of $2.50 a day of nine hours length. About 60 men are out. Some of the principal companies affected are the Central New York Telephone and Telegraph Company, the Home Telephone Company, the Utica and Mohawk Valley Railroad Company, the Utica Gas and Electric Company and the Archbold-Bradv Company.

TRADE NEWS.

The Electric Contracting Company of Syracuse, N. Y., has been incorporated. The capital stock of the company is $120,000. The directors include John Dunn, Jr., and others.

The Spartanburg (S. C.) Electrical Machinery Company has been incorporated. The company is to establish a wholesale distributing house for electrical supplies. The capital stock is $8,000, and the incorporators are J. G. Simpson, T. W. Wright and B. M. All.

The India Rubber and Gutta Percha Insulating Company of Yonkers, N. Y., is installing alternating-current Westinghouse motors to replace a number of small isolated steam engines formerly used for driving the carpenter shops and the winding and braiding departments.

The New York Times states that the Onondaga Dynamo Company of Syracuse, N. Y., has made an assignment. It is without preference and is made to Charles G. Baldwin, the liabilities amounting to between $60,000 and $70,000. J. W. Eager was president of the company.

American manufacturers are requested to furnish John Denham, electrical engineer of the Cape Government railways, Cape Town, Africa, with catalogues containing prices, discounts, etc., of electrical fittings, cables and wires, arc and incandescent lamps, switchboards, measuring instruments, etc.

A combination of the Electric Manufacturing and Supply Company and the J. A. Erner Company, both of Cleveland, Ohio, is reported. The name of the new company will be the J. A. Erner Electrical Manufacturing Company. The officers of the new company are: President, J. A. Erner; secretary, D. J. Jordan; treasurer, C. T. McKinstry.

Sealed proposals will be received at the Office of Indian Affairs, Washington, D. C., until October 9th for furnishing the necesary materials and labor required to construct and complete steam heating, electric lighting, and sewer systems at the Fort Totten Indian School, N. D., in accordance with plans, specifications, and instructions to bidders which may be obtained at No. 265 South Canal Street, Chicago, and No. 119 Wooster Street, New York city, and at the school. For further information apply to Charles L. Davis, superintendent Indian School, Fort Totten, N. D.

The Dickey-Sutton Carbon Company of Lancaster, Ohio, has been incorporated under the laws of Ohio with a capital stock of $100,000. The company expects to have its plant in operation about December 1st, when it will be in shape to make a general line of carbon products, including open and enclosed-arc carbons, carbon brushes, telephone carbons, dry batteries, etc. The following-named gentlemen constitute the officers of the company: President and treasurer, H. M. Sutton; vice-president and general manager, Edmund Dickey; secretary, S. S. Wilson; superintendent, Robert Dickey. The officers, with Richard Sedgwick of Richmond, Ind., constitute the board of directors.

The Jewell Electrical Instrument Company of Chicago has moved its factory and office to 61-63 Union Park Court, corner of Carroll Avenue, Chicago. For over a year the Jewell Electrical Instrument Company has felt the necessity of larger quarters. The company now occupies a commodious factory, and all machines and apparatus necessary for accurate electric testing and exact calibration are now practically installed. Ammeters can now be calibrated as high as 2,500 amperes and over. The Jewell company has just placed upon the market a new line of pocket ammeters and voltmeters, as well as a new line of "baby" switchboard instruments. To reach the new factory from the downtown district it is necessary to take the Lake Street Elevated to Sheldon Street, thence walking one block west and three blocks north.

BUSINESS.

The Electric Appliance Company, Chicago, is advising the trade to anticipate its requirements in the matter of Gutmann wattmeters. The growing popularity of this meter is bringing a rush of orders that is bound to tax the capacity of the factory.

B. F. Vreeland of Denver, Colo., has been in the cedar-pole and post business for about four years and has a good stock of seasoned poles and posts in shipping condition now on hand at his yards in the Northwest. Mr. Vreeland has shipped western poles, especially the long lengths, as far east as New York state.

Calvin B. Roulet is making an extensive business trip throughout the West in the interest of the Osburn Flexible Conduit Company of New York city. Mr. Roulet was in Chicago last week, with the intention of remaining several days. He states that the demand for Flexduct has been most flattering, and is highly pleased with the results thus far on his trip.

The St. Louis office of the General Incandescent Arc Light Company recently closed another order with the American Car and Foundry Company for enclosed arc lamps for its Madison car works. With this order the G. I. Company will have equipped the American Car and Foundry Company's works at St. Louis, Mo., St. Charles, Mo., and Madison, Ill., amounting in all to 526 lamps.

The Steam and Electrical Equipment Company of Pittsburg, Pa., reports the following sales for last week: One 200-kilowatt General Electric street-railway generator to the Gerstin Company of New York, and a 66-inch by 17-foot horizontal return-tubular boiler to the American Car and Foundry Company of St. Louis. The company reports brisk inquiries for the machinery which it is offering and says it is difficult to get enough apparatus to supply the demand.

The Western Electrical Supply Company of St. Louis, general selling agent for A-B arc lamps, reports that the demand for these lamps is increasing steadily. It is said that over 100,000 of these lamps are in use, and that they are being rapidly adopted by many of the larger cities. The A-B is one of the oldest arc lamps on the market, and as the manufacturer has devoted his exclusive at-

tention to the manufacture of arc lamps, he has lost no opportunity to improve the lamp in every way, and to-day claims to have the simplest, strongest and most efficient lamp on the market. These lamps are made with weatherproof, solid-copper or pressed-steel cases, and for all circuits.

One of the lustiest of the late comers in the electrical field is the American Insulated Wire and Cable Company of 241 and 247 South Jefferson Street, Chicago. This institution was organized about a year ago by Alderman N. T. Brenner and William Loeffler of Chicago, to manufacture "American brand" weatherproof wire and cables. For a long time the American company found its winding plant at Jefferson Street amply sufficient for its needs. Recently, however, the business in "American brand" wire and cables has increased to such an extent as to compel the extension of the company's factory. Much larger quarters are now occupied, but in the same building. Mr. Brenner states that the company's success has been phenomenal, and he attributes this growth naturally to the high-grade quality of "American brand" wire and cables. The company does a large business with telephone and electric-lighting companies, and is in a position to furnish wire from Chicago stock, as its entire product is manufactured in the Chicago factory.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 9, 1902.

708,539. Vibratory-current Relay. John M. Fell, Arlington, N. J., assignor to the American Telephone and Telegraph Company. Application filed September 16, 1901.

A relay adapted to produce steady makes and breaks in a local circuit is described. It consists of a permanent magnet with coil-surrounded poles, two insulated spring bars of diverse weight and rate of vibration mounted by one end in a common support, and together extending over the poles of the magnet to a point beyond them, and an armature attached to the heavier spring bar and supported thereby in front of the magnet poles. A stop is adapted to maintain the armature out of contact with the magnet poles and to establish a nodal point in the heavier spring bar. The local-circuit points are normally in contact but adapted to separate when the springs are vibrated by the magnet.

708,559. Trolley Pole. Charles D. Jenney, Indianapolis, Ind. Application filed December 8, 1900.

The pole extends from the car to the overhead conductor and embodies in its structure a spring whereby it may yield in any direction and a bowl-like socket formed with outwardly curved sides within which the spring-like lower end of the pole may be secured.

708,622. Automatic Fan. Walter E. Coleman, Newdorp, N. Y., assignor to the Coleman Manufacturing Company. Application filed December 10, 1901.

The fan is driven by an electrical motor pivotally supported in a ring. The ring is pivotally supported between two arms upon the base and connected with other mechanical devices.

708,623 and 708,624. Fan. Walter E. Coleman, Newdorp, N. Y., assignor to the Coleman Manufacturing Company. Applications filed January 17, 1902, and March 31, 1902.

Arrangements similar to the above are described.

708,639. Tool for Electricians. Isaac W. Heysinger, Philadelphia, Pa. Application filed October 26, 1901.

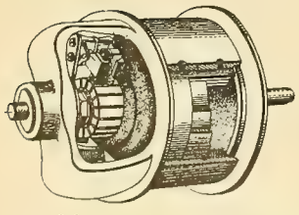
A combination knife and screw-driver is described.

708,653. Incandescent Electric Lamp. Albert W. W. Miller, South Orange, N. J., assignor to the American Electric Company. Application filed October 17, 1901.

The lamp comprises a bulb having a neck, a removable sleeve enveloping the neck, and means for clamping the sleeve against endwise withdrawal from the neck, the base terminal of the lamp and its insulating medium. The opening in the base end of the sleeve is other than circular and loosely embraces a correspondingly shaped insulating medium to lock the sleeve against rotation.

708,656. Electric Railway. Thomas E. Murray and John Van Vleck, New York, N. Y. Original application filed November 22, 1901. Divided and this application filed February 26, 1902.

In the system are combined a track, a car, a main feeder line, a main conductor line divided into block sections, and a breaker line parallel to the conductor line and divided into similar block sections. A circuit-breaker is interposed between one end of each main conductor line block section and the main feeder, and means are provided for electrically opening the circuit-breaker interposed between the opposite end of each breaker line block section and the main feeder.



NO. 708,803.—DYNAMO AND MAGNETO-ELECTRIC MACHINE.

708,664. Commutator Brush Holder. Walter J. Richards, Milwaukee, Wis. Application filed January 20, 1902.

The holder consists of a bearing plate, means for pressing the brush endwise against the commutator, an arm extending over the outer end of the plate and adapted to bear at its free end against the face of the brush opposite the plate and to hold the same against the plate.

708,671. Antiseptic Attachment for Telephone Mouthpieces. Henry C. Smith and Mark H. Woolsey, San Francisco, Cal. Application filed February 24, 1902.

Combined with a telephone mouthpiece is a cap containing an interior filling of porous or absorbent material saturated with a sterilizing substance, and divergent spring arms embracing the mouthpiece, one of the arms forming a hinge member for one edge of the cap and the other member having a latch to engage the opposite edge of the cap.

708,694. Method of Manufacturing Secondary-battery Plates. George H. Christian, Cleveland, Ohio, assignor of one-half to Charles Herbert Taylor, East Cleveland, Ohio. Application filed December 7, 1901.

The step described consists in electrolytically reducing an oxide of lead in an electrolytic cell, having an electrolyte containing a compound of an organic reducing agent.

708,695. Method of Manufacturing Plates for Secondary Batteries. George H. Christian, Cleveland, Ohio, assignor of one-half to Charles Herbert Taylor, East Cleveland, Ohio. Application filed December 7, 1901.

The step described in this patent consists in electrolytically deoxidizing an oxide of lead in an electrolytic cell having an electrolyte containing an organic reducing agent.

708,708. Electrode Separator for Batteries. Arthur W. Harrison, Los Angeles, Cal., assignor of two-thirds to F. A. Marcher, Los Angeles, Cal. Application filed May 7, 1902.

The separator is composed of yucca having the non-fibrous portion thereof removed.

708,710. Circuit-breaker. Edward M. Hewlett, Schenectady, N. Y., assignor to H. Ward Leonard, Bronxville, N. Y. Application filed September 29, 1898.

One claim reads: In an electric switch, the combination of a pair of fixed contacts, a bridging contact and a barrier of insulating material between the fixed contacts and spanned by the bridge; the barrier consisting of fixed and movable portions and means for causing the movable part to follow the bridge as the switch is opened. (See cut.)

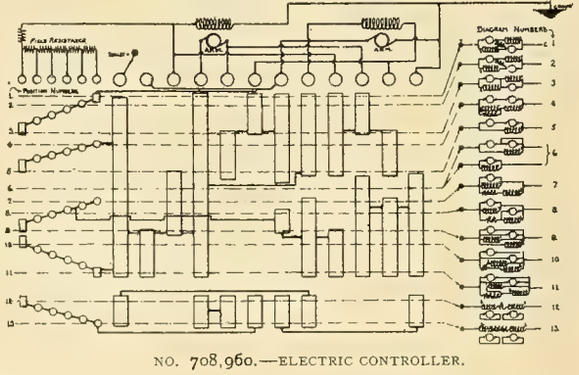
708,724. Operating Mechanism for Motor Controllers. Frank A. Merrick and Joseph D. Forrer, Johnstown, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 12, 1901.

An electric controller is described which combines with a regulating switch and a reversing switch, a handle for the reverse switch composed of two complementary members, one of which has an operative engagement with the reverse switch shaft, and the other of which is loose with respect to the shaft. Means controlled by the regulating switch are provided for preventing movement of the loose member in certain positions of the regulating switch.

708,739. Shade-holder for Incandescent Electric Lamps. Richard W. Schmelz, Brooklyn, N. Y., assignor of one-half to William V. Geis, New York, N. Y. Application filed October 7, 1901. Renewed July 17, 1902.

The holder is composed of a spring wire bent centrally to form a spring ring and open at one side and provided at the open side with a laterally directed loop or shank composed of two parts, the bottom portion of the loop or shank being shorter than the other and the separate parts thereof being bent to form a spring ring open at one side.

708,755. Elevator. Milton A. Clennam, San Francisco, Cal., assignor to the Cahill & Hall Elevator Company, San Francisco, Cal. Application filed January 26, 1901.



NO. 708,960.—ELECTRIC CONTROLLER.

Parts of the system are a cage suspended and movable between the floors, a motor and mechanism by which the cage is operated, independently operated mechanism including controlling switches, circuit-closing devices for each floor and connected together in sets and detents for the circuit-closing devices, and electric circuits and mechanism energized thereby to determine the direction and distance of movement of the cage.

708,803. Dynamo and Magneto-electric Machine. Nathan H. Edgerton, Philadelphia, Pa. Application filed August 22, 1901.

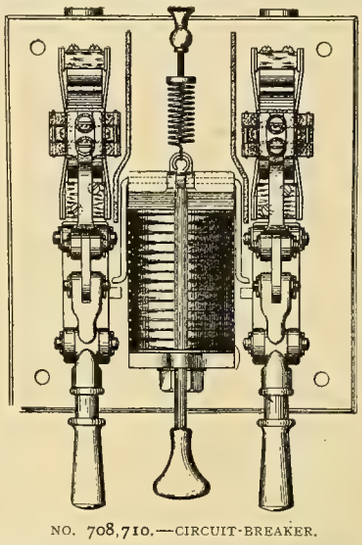
In the machine are combined an armature, an annular frame, and spacing devices secured to the inner periphery thereof at diametrically opposite points and having bevelled edges which contact with the ends of the curved magnet strips. The latter are retained in position by their contact with the spacing devices, the strips being concentric with and within the plane of rotation of the armature. (See cut.)

708,813. Automatic Photographic Recording Apparatus. Achilles de Khotinsky, Chicago, Ill., assignor to Thomas Jansen, Chicago, Ill. Application filed November 8, 1901.

Combined with a photographic camera are means for feeding a sensitized strip step by step, a shutter mechanism, a movable holder for the papers to be recorded, electrically actuated devices for operating the strip feeding and shutter mechanisms and the holder, the circuit-controlling means embracing a switch for starting one of the parts, the operation of the other parts being automatically accomplished in sequence.

708,875. Dynamo and Magneto-electric Machine. Nathan H. Edgerton, Philadelphia, Pa. Application filed May 23, 1902.

In this machine are combined an isolated field magnet or magnets, composed of soft iron, energized or intensified from or by the current flowing through the armature coils, and an armature embraced by the magnets and having its windings parallel with its shaft.



NO. 708,710.—CIRCUIT-BREAKER.

708,927. Device for Connecting the Electrical Gear of Electric Cars. Alexander Siemens, Westover, Milford-on-Sea, England, assignor to Siemens Brothers & Co., Limited, Westminster, London, England. Application filed March 24, 1902.

The device consists of frames each carrying a controller and relay provided with flexible conductors, the frames being suspended from the ends of each car, means for connecting the adjacent frames of two cars together, and means for suitably coupling the shafts of the controllers together.

708,960. Method of Controlling Electric Motors. John C. Henry, Denver, Colo.; Susie A. Henry, executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Application filed June 3, 1899.

The method consists in placing each armature in series with the corresponding field magnets in separate circuits, and cross-connecting from one of such circuits to the other at points between the armatures and fields, whereby the field of each of the separate machines are connected in shunt with the armatures of the other machine. (See cut.)

708,961. Method of Controlling Electric Motors. John C. Henry, Denver, Colo.; Susie A. Henry, executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Application filed April 1, 1901.

The inventor describes a method of regulating a pair of motors, whose fields are excited by a circuit independent of the armature circuit which consists in weakening the field of one of the motors by shunting resistance around it to decrease the voltage of the motor, breaking the armature circuit, allowing the current to pass through the field and resistance in series with the other motor and then short-circuiting the field and resistance.

708,962. Electric Vehicle. Susie A. Henry, Denver, Colo., executrix of John C. Henry, deceased, assignor to the Stanley Electric Manufacturing Company. Original application filed June 3, 1899. Divided and this application filed December 27, 1901.

A controller for a pair of motors is described. It comprises contacts and connections adapted and arranged, in one position of the controller, to connect the motors in parallel, in opposite relation to each other, each armature being in series with its field, and in a succeeding position cross-connecting them so that each armature is in shunt with the field of the other motor and in series with its own field.

708,969. Electric Railway. Thomas E. Murray and John Van Vleck, New York, N. Y. Original application filed November 22, 1901. Divided and this application filed March 14, 1902.

Parts of the system are a track, a car adapted to travel on the track, an electrically controlled brake mechanism on the car, fixed circuit terminals placed at intervals along the track and in proximity thereto, and a selective device carried by the car whereby the circuit may be automatically closed from any predetermined fixed terminal to the electric mechanism of the brake, and the brake thereby actuated.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, SEPTEMBER 27, 1902. No. 13

Progress on the Telephone Tunnels in Chicago.

Perhaps no more interesting engineering work is now under way in Chicago than the construction of an elaborate system of tunnels under the streets of the downtown business district for the Illinois Telephone and Telegraph Company, which purposes to construct an automatic telephone system having an initial capacity of 25,000 subscribers' lines and an ultimate capacity for 100,000 subscribers. These tunnels are from 6½ to 14 feet in diameter, horseshoe-shaped, and their tops are 24 feet or more beneath the street pavement. They are destined for the cables of the telephone company, although it has been suggested that compressed-air pipes and possibly other electrical wires might find accommodation in these large bores. The work has been under way, more or less, for three years. The material encountered in building the tunnels is mostly blue clay, which is cut out by curved knives and taken to headings by small cars drawn by mules. Several articles describing the progress of this extensive work have appeared in the Western Electrician, notably the illustrated ones of March 17, 1900, and April 5, 1902. The present description of the work accomplished and under way is based on an illustrated lecture delivered before the Western Society of Engineers, by George W. Jackson, general manager and engineer for the Illinois Telephone Construction Company, on September 17th. Mr. Jackson's address was interesting and brought down to date. Portions of it are given:

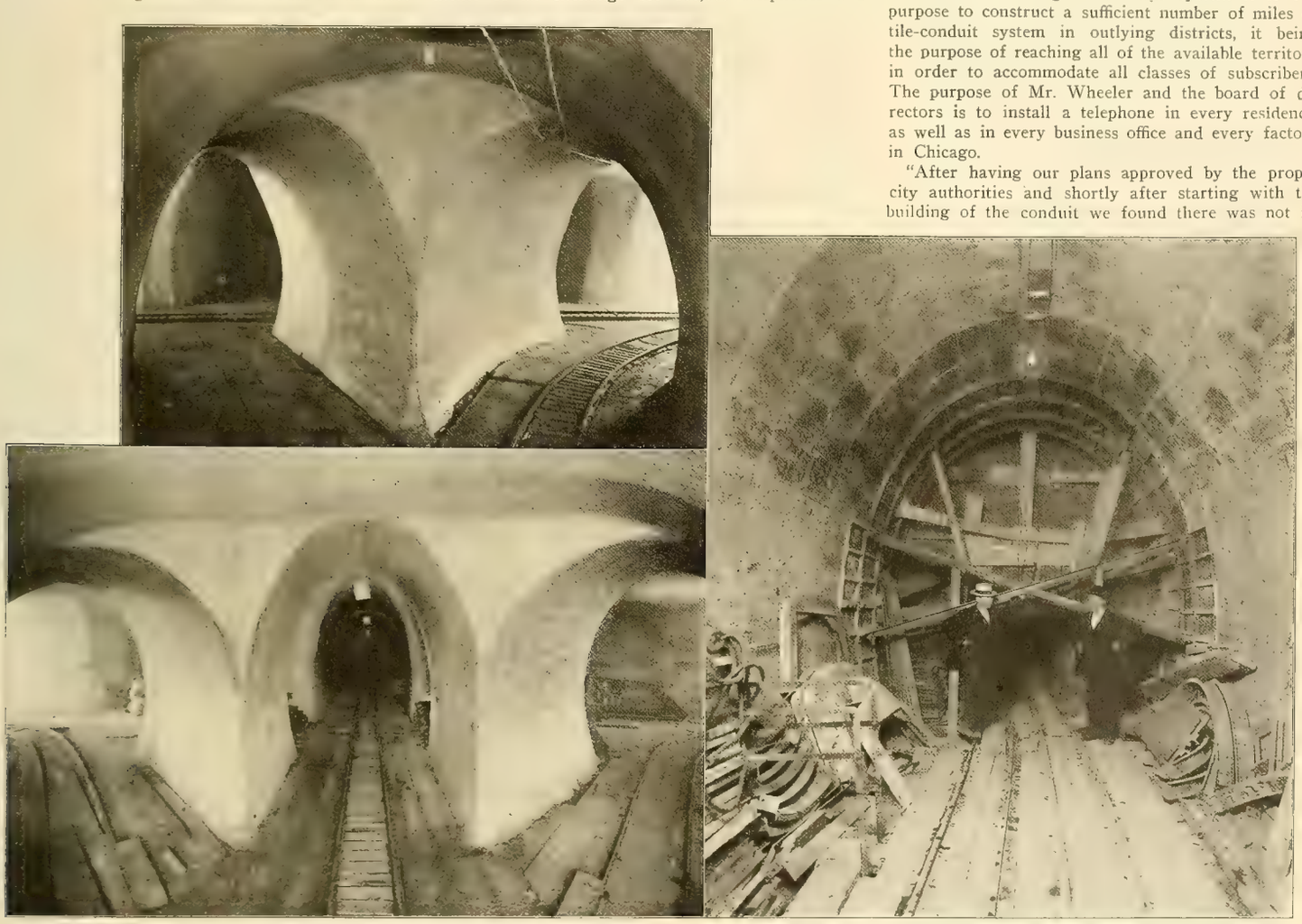
"I have been directed by Mr. Wheeler, the president, and the board of directors of the Illinois Telephone and Telegraph Company to build a telephone system composed of conduits and cables which will accommodate 100,000 subscribers, and it is with the intention of building an exchange of this size that we have proceeded with the work. Experience has taught me in the past that up to the present time telephone companies in different cities have made a serious mistake by not building their conduit systems large enough to accommodate their increased business from year to year in its reasonable expansion. After thoroughly canvassing the situation with Mr. Wheeler, it was found there was no available space left near the surface of the streets where a system could be built which would accommodate an exchange of 100,000 subscribers. For instance, a six by 7½-foot lateral tunnel would only allow us to place enough cable, by crowding, for 25,000 telephones, coming in from one direction to a central exchange. After thoroughly canvassing the requirements of an exchange for 100,000 telephones and figuring on the space required, we found that the space was not to be obtained near the surface on account of the present congested condition of the streets. Mr. Wheeler and myself then studied the practical situation relative to building conduits by the tunnel method, and after thoroughly satisfying ourselves that we were right, Mr. Wheeler asked the city authorities to grant him a permit under the plans as submitted in accordance with the ordinance which allows him to construct his conduit system.

"After obtaining the permit work was started at the first shaft, or what is known as shaft No. 1. It required considerable time and thought in locating our shafts, as we had to show property owners by the location of our shafts that we would in no way inconvenience their tenants. After locating shaft No. 1, we leased other basements, which are located as follows: Shaft No. 2 on Dearborn Street, just north of the Fisher Building; shaft No. 3, at 113 and 115 Franklin Street; shaft No. 4 at State and Lake Streets; shaft No. 5 at Randolph and Clark Streets; shaft No. 6 at Harrison and Clark Streets; shaft No. 7 at State and Eldridge Court; shaft No. 8 at Congress and Market Streets. The location of these shafts allowed us to proceed with the building of the conduits covering the downtown district.

"The scope of the work is intended to reach the territory on the South Side to Seventy-first Street, on the West Side to Kedzie Avenue and on the North to Fullerton Avenue, it having been decided that the building of the tunnel by conduit methods would be the speediest and most economical. From the tunnel system extending on the south, west and north it is the intention to build side branches covering the entire city. These side branches will largely be constructed, as far as economical, by the method of tunneling. From this system it is our purpose to construct a sufficient number of miles of tile-conduit system in outlying districts, it being the purpose of reaching all of the available territory in order to accommodate all classes of subscribers. The purpose of Mr. Wheeler and the board of directors is to install a telephone in every residence, as well as in every business office and every factory in Chicago.

"After having our plans approved by the proper city authorities and shortly after starting with the building of the conduit we found there was not in existence an accurate map of the streets. We decided that no further work could be done until such time as a new survey was made, and I had our engineering department make a new topographical survey. Making this survey required considerable time, it being impossible for our engineers to run lines until after the congestion was off the streets at night, and compelling us to run our lines after 10 o'clock at night, and before five o'clock in the morning. As can be appreciated by engineers, doing work under these conditions was very slow and tedious, but while it was slow and expensive, it has amply repaid the company. I would like to mention that this part of the engineering was under the management and direction of Mr. Alfred Slade, an engineer who has been connected with me for several years.

"After this new survey was made, and having the same checked and approved by the engineer appointed by the Department of Public Works, we were then ready to proceed with the work in the downtown district, and upon notifying Mr. Eric-

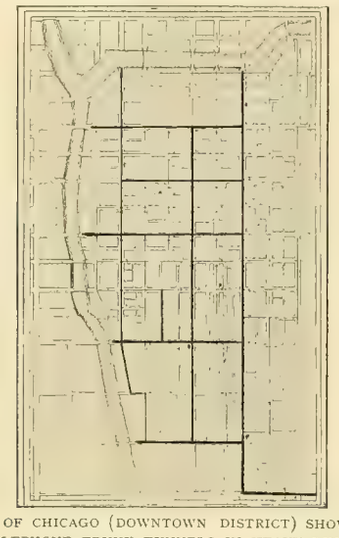


Under the Corner of Van Buren and Sherman Streets, Looking South.
Under the Corner of Dearborn and Washington Streets, Looking North.

Under the Corner of Franklin and Washington Streets (Trunk System).

TELEPHONE TUNNELS IN CHICAGO.

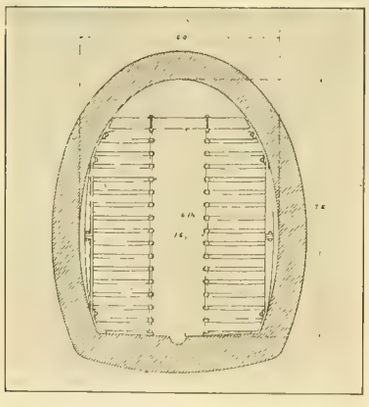
son, the city engineer, of our intention to proceed with the work, we were informed that he would not allow us to proceed in the way that the first permits were granted on account of the number of manholes that would be required by us. Mr. Ericson took the position that the building of manholes such as we would need would be in the way of a subway, which, in his judgment, the city would some day build. He compelled us to adopt a method whereby the building of manholes would be ob-



MAP OF CHICAGO (DOWNTOWN DISTRICT) SHOWING TELEPHONE TRUNK TUNNELS IN HEAVY LINES.

viated. After designing numerous cross-sections and carefully figuring out what space would be required to accommodate our business, the tunnel size 12 feet nine inches by 14 feet, was submitted. In going over the situation with Mr. Ericson, city engineer, he finally decided that 12 feet nine inches by 14 feet would enable us to lower the reels and cables from our warehouse down to the level of our conduit system, transporting the car reel and cable around to the different lateral systems. By this method of lowering the reel and cable down and transporting it around, it did away with the building of manholes. This method was finally approved by Mr. Ericson, city engineer, with the understanding that we would drop the roof of our 12¾ by 14-foot tunnel so that it would not come any closer than 24 feet six inches to the surface. In our original permits as granted we had the right to construct our conduit as close as 22 feet six inches from grade.

"At the present time we have constructed about 12 miles of conduits. After satisfying ourselves as to the nature of the soil, we adopted the air system of tunnel excavation, and while it was not altogether necessary for us to use this system, as the nature of the soil we would have to go through was such that it would stand without caving or swelling, we put in the system more for the purpose of being protected from labor troubles than anything else,

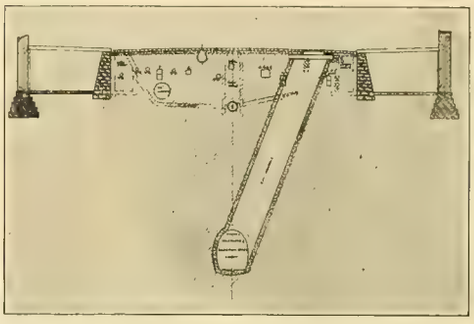


TELEPHONE TUNNELS IN CHICAGO.—CROSS-SECTION OF LATERAL CONDUIT SHOWING CABLE-SUPPORTING RACKS.

as with the air system if the men should, unfortunately, go on a strike, we would have no annoyance, as there would be no danger if the work was left in an uncompleted state.

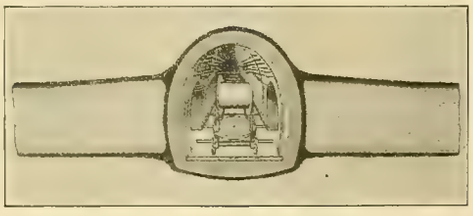
"In installing our system, air locks were placed just outside the several shafts. Iron doors with frames were embedded in the concrete, the locks being long enough to accommodate in some cases as many as 10 cars. These locks are constructed so that they will hold the air in the completed portion as well as the uncompleted portion of the conduit. Two doors are used. The cars are allowed to enter through the outer door. After the lock has received the proper number of cars, the doors close; the air is then drawn from the completed tunnel, allowing the air to flow inside of the lock until it becomes filled, thus equalizing the pressure in the lock with that in the finished tunnel. In locking out again, the inner door is closed, the valves opened at the outer door allowing the air to escape, and thus allowing the outer door to open again. The air-lock system is operated by a system of valves.

"After excavating, the concrete is placed in the bottom and thoroughly tamped. The lagging is placed on top of the concrete, iron ribs being placed on the bottom, the lagging and ribs being placed three feet apart. After the ribs have been placed the lagging is then placed behind the ribs and the concrete thrown in behind the lagging in layers of six inches. The use of concrete absolutely avoids any chance of settlement, as the concrete is tamped into the space between the lagging and excavation. It makes no difference how irregular the digging or mining may have been done, every void is filled in. Concrete is thus placed until it reaches what is known as the key. As it is important to have



TELEPHONE TUNNELS IN CHICAGO.—CROSS-SECTION OF STREET SHOWING MANHOLE ORIGINALLY PROPOSED (SINCE ABANDONED).

the key properly placed, it is built in sections of three feet, or, in other words, the keyboards are three feet long. These keyboards are placed on the ribs, which are three feet apart. The concrete is then thrown in, and, after three or four shovelfuls are thrown in, the concrete is then rammed, care being taken that the concrete is rammed so that every void is filled. By this any possible chance of the ground settling is obviated. In the trunk system the ribs are made of five-inch channel irons and lagging plates made of No. 12 steel. These steel ribs and lagging were used as an extra precaution on account of the extra weight of the concrete, as well as to allow the men to tamp the concrete thoroughly, without having the work left in irregular shape. The walls of the six by 7½-foot lateral conduit are constructed with 13-inch bottoms



TELEPHONE TUNNELS IN CHICAGO.—INTERSECTION OF TRUNK AND LATERAL TUNNEL CONDUITS.

and 10-inch walls of concrete. The trunk systems are constructed with 21-inch bottoms and 18-inch walls of concrete.

"The work was carried on by three shifts of men working eight hours each, the first shift of miners going on at four o'clock in the afternoon and working until 12 p. m., the second shift going on at 12 o'clock midnight and working until eight o'clock in the morning, the third shift, which was known as the concreting shift, going on at eight o'clock in the morning and working until such time as they were through. The work of the third shift was arranged in such a way that they would get through their work so the miners could go to work at the regular time.

"The distance excavated by the two shifts of miners averaged about 21 feet at each heading. The number of working headings averaged, taking in all the different shafts, about 14. It required about 20 men to operate each heading. Thus a total of about 850 men were engaged on the tunnel construction, while about 600 men were employed in the office forces, engineering department, and in the hauling of gravel, stone, cement and excavated material.

"The cement used for the making of concrete was American Portland. All tests of cement were made by the company, and each barrel was tested and subjected to a 14-day test before being accepted, under the most rigid specifications possible to draw up. All concrete was made with the mixture of five parts of broken stone and screenings to one part of cement. A large part of the concrete was composed of gravel, gravel being used in the same proportions as broken stone, five parts of gravel to one of cement. This mixture of concrete was used on the straight line of the conduit. At the intersections a mixture of four parts stone or gravel to one of cement was adopted and used.

"In managing the work, in order to have everything run smoothly, considerable care had to be exercised to see that the excavated material was promptly disposed of, as any delay in disposing of the excavated material would cause delay, and consequently considerable care had to be given to this branch of the work. A large equipment (some 900 in number) of tram cars was built. The tram cars were built to run on a gauge 14 inches wide. Double-track systems were laid throughout the entire tunnel system. For handling concrete and excavated material small cars were used—20 inches inside by 48 inches long. From the knowledge I have obtained in the management of this work I believe that the smallness of the cars was instrumental in successfully carrying out the building of the 12 miles of tunnel in the short space of time it has taken to construct the system. The reason for this is that if a car jumped the track an ordinary man could set it back on the track, which kept the moving of excavated material going on continuously without any interruption; also in the transportation of concrete the smallness of the cars made it possible for the men to handle the concrete more readily

PROGRESS ON THE TELEPHONE TUNNELS IN CHICAGO.—MULE CAMP, SHAFT NO. 8.

and speedily, obviating any chance of the concrete being set.

"Another method that we adopted for handling the excavated material was at shaft No. 8. This shaft is located on the river at the foot of Market Street. At this shaft we constructed an incline, using an endless conveying chain with dogs, constructed in such a manner that they took hold of the axles of the cars and conveyed the cars to the ground surface. From the ground surface they were conveyed to the edge of the river. Here a system of moving platforms was erected, so that the platforms could be raised or lowered for loading scows and not interfere with boats going up and down the river when not in use. This method of handling excavation was found to be very economical and did away with possible annoyance of delay.

"In carrying out the construction of this 12 miles of work we have not as yet had a single complaint from a taxpayer or a pedestrian or a complaint from any department of the city hall. We have been also very fortunate in not having an accident on the work. In conclusion, allow me to say that there is no doubt that the people of Chicago will receive great benefit from the building of an exchange of 100,000 telephones, and I know it is the desire of the company to give them every benefit that can be derived therefrom. I also know that it is the desire of Mr. Wheeler and the financial men interested with him to have the good will of the people of Chicago and to give our people the best telephone system in the world."

The following table, prepared by Mr. Jackson,

gives in a concise way the tunnel work accomplished up to September 1, 1902:

Total number of feet finished.....61,726

By Shafts.

Shaft.	No. Feet.	Working Days.	Average Feet Per Working Day.
1	18,730	294	63.6
2	14,595	247	59
3	2,464	118	20.8
4	17,510	229	76.4
7	1,244	63	19.7
8	7,183	176	40 8

Average working days from all shafts.....188 days.
Average feet per day from all shafts.....328 ft.
Total excavation from all shafts.....175,000 cu. yds.

Material Used.

Cement.....90,000 barrels.
Stone.....30,000 cu. yds.
Gravel.....60,000 cu. yds.

Indiana Electrical Association.

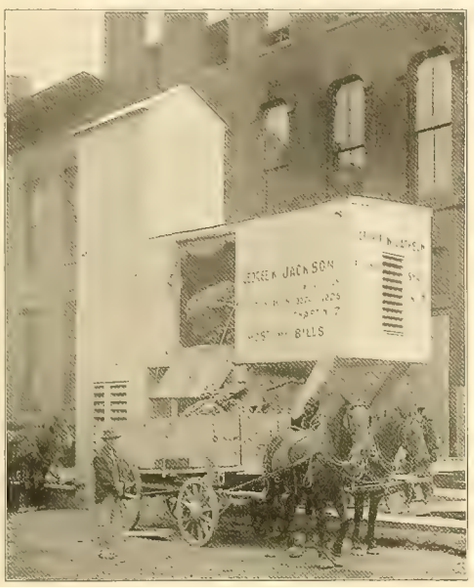
The first annual convention of the Indiana Electrical Association was held at the Hotel Denison, Indianapolis, under the presidency of T. C. McReynolds, the able manager of the Kokomo Electric Light and Power plant, extending over two days ending September 18th. Every condition and circumstance seemed to conspire to make the meeting a success. The interest manifested, the hearty participation of the members and the increasing attendance upon each succeeding session put all doubts to flight concerning the success and value of this new association.

The opening address was made by President McReynolds, who felicitously congratulated the association upon the progress made during the six months of its existence, the large attendance and the interest manifested by the craft throughout the state. Mr. McReynolds said that Hal. C. Kimbrough, manager of the Muncie Electric Light and Power Company and the present efficient secretary, was the father of the lusty Indiana Electrical Association. He said that since the organization meeting in March the electrical business had responded cheerfully to the progress of the age and enjoyed a large and profitable share in the season's prosperity. Great progress has been made in modernizing electrical plants by displacing old apparatus with new and modern supplies and machinery with a view of taking care of the constantly increasing demand for heat, light and power. The president deplored the fact that in some of the small towns in Indiana, capital had been timid because of the limited return on investments in electric plants.

"This embarrassment, however," continued the president, "is being rapidly overcome by reorganization and the installation of modern equipments and a consequent increased profit because of the better and more satisfactory service. The central-station business is susceptible of greater development than many appreciate. In many eastern towns there is an average of one light to every inhabitant, while in Indiana there is not one light in actual service to every five inhabitants. The field is prolific and the increase in the volume of business does not necessarily entail a corresponding increase in the expense of operation. But central-station managers should know definitely the full capacity of their plants. If running at full capacity additional consumers should not be added; rather encourage a class of consumers that can be supplied during the hours when the plant is being run at its minimum capacity. This can be accomplished by increasing the motor power distribution. This business is calculated to be more remunerative than that of lighting from the fact that service extends over a greater number of hours.

"It is one thing to develop a business and another to conduct and retain it. These involve a multitude of questions requiring the serious consideration on the part of the central-station manager. The most careful scrutiny is required to prevent items of waste and keep the expenses commensurate with the volume of business done. The question of current and its transportation to the consumer may be ever so carefully guarded, yet, if its delivery is not watched with conscientious skill, much loss will result."

Mr. McRevnolds said that the meter system is the only just basis upon which to operate, and that fuel, labor and taxes should govern largely the rates charged for current. He referred to the competition manifest in natural-gas towns, and said that electricity was gradually winning favor over all competitors. He commended the programme committee,



PROGRESS ON THE TELEPHONE TUNNELS IN CHICAGO.—LOADING WAGON AT SHAFT NO. 7.

and thanked the officers and members for valuable suggestions and assistance in giving the Indiana association a vigorous start.

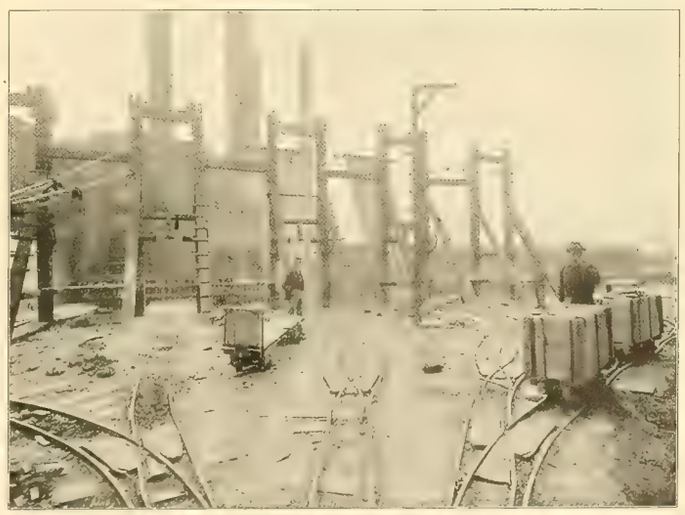
The points brought out by the opening address were vigorously discussed by the members led by S. E. Gard of Richmond. Thus early in the convention it was shown that the members were responsive and enthusiastic concerning the purposes of the association and the benefits derived by an exchange of personal experiences. An interesting paper was read by A. M. Barron of South Bend, on, "What We Hope to Accomplish by this Association." In substance he said the subject was so prolific as to be bounded by a wide horizon of possibilities. The troubles of a central-station man begin with the fire placed under the boiler and continue more or less throughout every element necessary for the installation and operation of an electrical system. The purposes of the association are helpfulness, the gaining of knowledge by an exchange of experiences and suggestions based on each other's troubles and the best method of overcoming difficulties. Mr. Barron said that there was urgent need of consultation and coöperation to influence legislation to enact laws affording better protection against theft of electrical current and to curtail the present arbitrary power of city councils to hedge and limit the extent of electrical improvements in a town or city. "We hope," said he, "to introduce a measure providing for a state board to which we can appeal when imposed on by local class legislation or by arbitrary peanut councilmanic politicians; also general laws governing the supply of electricity, the furnishing of electricity by meter measurement at prices based on local conditions, and this to apply to the arc lamp used in street lighting, as well. We shall ask that local legislation may govern only the physical installation of our property, but not its earning power; expert examination of all wiring by licensed inspectors appointed after competitive examination by a board of examiners, one of whom is to be a member of our association. We desire to adopt rules governing the employment of men in our central-station business to the end that the standard of service may be kept on the highest plane. We shall in every honorable way discourage municipal ownership of public utilities and pledge ourselves to the support of those manufacturers that do business on the line of the Golden Rule and who do not encourage the installation of municipal plants in opposition to existing plants solely for the purpose of selling their apparatus. We further hope to secure legislation that will protect our investments made in good faith from municipal-ownership agitation; laws that will prevent a municipality from competing with us without compensating us on the basis of an arbitration decision."

Hal. C. Kimbrough of Muncie presented a paper on "Best Methods of Dealing With Gas as a Competitor." Mr. Kimbrough is a young man of advanced ideas. He often provoked amusement by asking the members how they would deal with ludicrous complications, such as are encountered in a natural-gas town. He said natural gas is an oil product and its use is very destructive to house furnishings and decorations, but because of its cheapness, it is very hard to displace. In many instances householders are induced to allow an electric service put in for special occasions and the superiority and cleanliness is so apparent that such trial service becomes permanent. "Among the merchants we have overlooked no opportunity to place our lights, and there have been times when they would not turn them on for weeks, but there always comes that inevitable time when gas runs low and our electric service is in demand. Thus by easy stages and by patient waiting we have been enabled to get a foothold, because of superiority of service." Mr. Kimbrough disclaimed any knowledge of artificial gas as a competitor; "but while the problem of resident lighting is still with us we do not fear artificial-gas competition," said he. Mr. Kimbrough advised against any attempt to compete with gas on a flat rate, "for the tendency of the consumer is to waste your product and energy without appreciating your philanthrophy." He enjoined upon the members the necessity of educating the people to the justice of meter measurement as one of the fundamental principles of this organization.

J. H. Harding of Laporte read an interesting and comprehensive paper on "By-products." He said that the question that presents itself to the wide-awake central-station man is, how to make use of the exhaust steam and other waste. The installation of a heating plant in connection with an electric-light and power plant, however, is likely to be all expense and no profit unless every detail is properly worked out. The rates for heating in this state vary from 15 cents to 18 cents per square foot of radiation per year. Mr. Harding explained the method of estimating the radiation and sounded the alarm of danger in making serious error in this respect. "To the customer, the heating of residences and offices has been a success from the start, so much so that consulting engineers are kept busy making estimates on heating and equipping buildings." Mr. Harding concluded by saying that it is only a matter of time until the public will demand central-heating plants, and it is largely "up to" the present electrical plants to furnish that service.

The paper of J. P. Clark of Terre Haute, on the

Dock and Dump.



Dump Tracks.

PROGRESS ON THE TELEPHONE TUNNELS IN CHICAGO.—REMOVAL OF EXCAVATED MATERIAL AT SHAFT NO. 8.

"Kinds of Coal Used and Results Obtained," was not presented, owing to Mr. Clark's inability to attend. This was a disappointment, as the members were anxious to hear this paper, as the fuel question is one of great importance. The subject, however, was discussed and the Indiana bituminous coal seemed to lead all other kinds in tests thus far made. "The Desirability of Enclosed Arcs of a Tub-transformer Variety, From a Central-station Standpoint," formed the subject of a paper presented by A. M. Barron of South Bend. This paper was replete with technical information and provoked many questions and inquiries from the members, which Mr. Barron readily answered.

S. E. Gard of Richmond, in a paper, entitled, "Meter Prejudice—Its Cure," suggested the advisability of all the power-house owners making an effort to educate consumers of electricity into the knowledge that electricity, if sold to them by measurement, is much cheaper than if rated at so much a light, in that they know exactly what they get and pay for it accordingly. He urged upon the association to make a campaign among the electrical men with a view to getting the consumers to realize that this is the most equitable method and then make an attempt to establish a uniformity of meter charges.

The association appointed a legislative committee and left the date of the next meeting with the executive committee. Thirteen new members were admitted, making in all 61 active members. Present officers were continued until the next meeting. The Varney Electric Company of Indianapolis tendered the members a dinner at the University Club. Many supply men were present, and their participation added materially to the importance of the occasion.

The Arcophone or Speaking Arc Lamp.[1]

By G. K. Smith and R. A. L. Snyder.

The "arcophone," as its name implies, is an arc lamp made to speak. The arc lamps used in this demonstration are two Schuster hot-wire 110-volt direct-current constant-potential standard-style, taking about seven amperes each.

The only 110-volt direct current obtainable for these experiments was furnished by Earl Marvin, of the National Biscuit Company, from a motor circuit in its factory just back of the lecture room. A motor circuit is not exactly the best source of current supply for this experiment. The impulses due to the brushes of the motors running over the commutator bars make the arcs slightly noisy.

The other apparatus used in this experiment was loaned by the Central District and Printing Telegraph Company, and consists of iron-clad repeating-coils, common-battery transmitters, and Western Electric rolled condensers.

The diagram shows very plainly the wiring of the circuit. It consists of an arc circuit and a transmitter circuit. The transmitter is used to make a pulsating current in accordance with sound waves that strike its diaphram. The repeating coil transforms the pulsating current from the transmitter circuit to the arc circuit. The condensers serve to make shorter circuits for the pulsating currents. The condensers also serve to cut down the natural pulsations

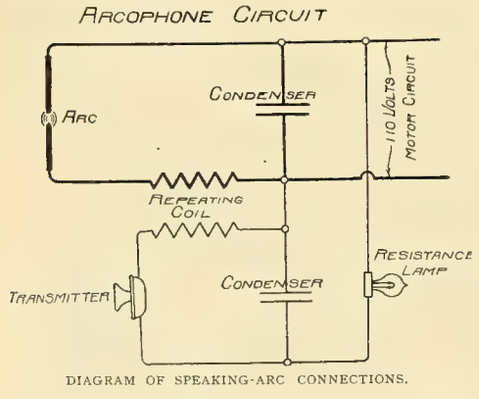


DIAGRAM OF SPEAKING-ARC CONNECTIONS.

of the current in the motor circuit, which otherwise would make a noisy arc. The resistance lamp cuts down the current to the proper amount for the transmitter circuit. The arc transforms the pulsating current into sound waves.

Several theories have been advanced as to what causes these sound waves to issue from the arc. The most logical explanation appears to be the one giving the cause as the sudden expansion and contraction of the air due to the variations of the temperature of the arc.

When a person speaks into the transmitter the sound waves striking the diaphram cause the current to pulsate in the transmitter circuit. This pulsating current sets up similar pulsations in the arc circuit through the repeating coil. The temperature of the arc varies as the square of the current passing through it. As the arc is composed principally of carbon vapor in a high state of molecular vibration, it would have a very low specific heat. The temperature of this vapor varies almost instantly with the current. When this current is pulsating the temperature of the arc is raised or lowered correspondingly. The volume of vapor is increased or diminished in accordance with its temperature. Hence the volume of the vapor increasing and diminishing sets up sound waves in the surrounding air.

Through the four transformations just described we have been able to reproduce speech, music, whistling, etc., of very excellent strength, quality and timbre.

It would be rather surprising to most people, if in the very near future all the arc lamps in town suddenly began to announce the current events of the times. With our present knowledge such a thing is possible.

The speaking arc lamp will probably have a great commercial value in advertising.

1. Read, with demonstration, before the Engineers' Society of Western Pennsylvania at Pittsburg, April 2, 1902. The authors are connected with the Central District and Printing Telegraph Company (Bell telephone) of Pittsburg.

Alternating-current Railway Systems.

By Frank C. Perkins.

I. Single Phase.

The alternating current is now being so extensively used in connection with electric-traction work, especially with polyphase power transmission and rotary converters, that it may be of interest to note, by a retrospective glance, what has been done in recent years by engineers in Europe and America in the design and invention of electric-railway systems using single-phase and polyphase alternating currents, with and without rotary converters, on the cars or along the line, as well as the various types of induction systems of electric traction which have been patented in the United States by prominent American and European electrical engineers.

On account of the advantages which the alternating current has for power transmission at high potentials and the growing tendency for its use in electric traction, much more attention has been paid to the study and design of converter systems for electric-railway work than is generally known; and some of the systems proposed are bound to be of great value and to be extensively used in the near future.

By converter electric-railway systems is meant not only those using rotary converters and static transformers along the lines, but those using converters and rectifiers on the cars, with and without storage batteries, as well as the polyphase railways, using purely alternating currents with direct-current motors. Induction systems are considered to be those where converters or transformers are employed, the primary of which is stationary along the line and the secondary is movable and mounted upon the train.

The 500-volt direct-current system is used almost exclusively at the present time, both in Europe and America; and while its range is largely extended by the three-wire, 1,000-volt system, as on the City and South London electric railway—the two lines of trains, with their 500-volt motors, being balanced on either side of the system—a much wider range of current distribution is possible by the use of three-phase transmission and rotary converters; and this system, which has such excellent qualities and is exploited by manufacturers of great resources, will be most extensively used during the coming years. Whether the three-phase alternating systems using polyphase motors directly upon the cars will find a great field in high-speed traction, or whether the single-phase alternating-current system with transformation on the train to direct current, as proposed by Messrs. Mordey and Jenkin, will solve the question of electric working for steam trunk-line railways, is a question which the future alone can tell.

The substitution of static transformers for rotaries and the use of three-phase motors on the trains, as proposed by Ganz & Co. for the Metropolitan railway of London, are now in use on the Swiss mountain railways with success, and are asserted by Ganz & Co. to be equally as practicable for city service and long-distance, high-speed railway work, while for the latter work some prominent engineers advocate the use of high-tension motors of the three-phase type directly on the trains, doing away with the transforming stations entirely. Some of the disadvantages of the three-phase system, even with the cascade-motor arrangement, which is the equivalent of the series-parallel control in direct-current working, are that when the train is under full speed only half the motors are in use doing work. Again, the use of two or more trolley wires is a great difficulty to contend with; and the heavy starting currents produce excessive feeder losses and

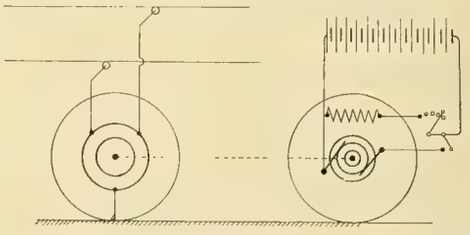


FIG. 1. DERI COMBINED ALTERNATING DIRECT RAILWAY SYSTEM.

require great generator capacity at the central power station.

If the single-phase alternating-current system, as proposed by Mordey and Jenkin, can be successfully developed, and is found practicable, the difficulty of several trolley wires, required as with the polyphase system, is avoided. It is proposed to use the Ward Leonard method of speed regulation, employing an induction motor driving a direct-current dynamo,

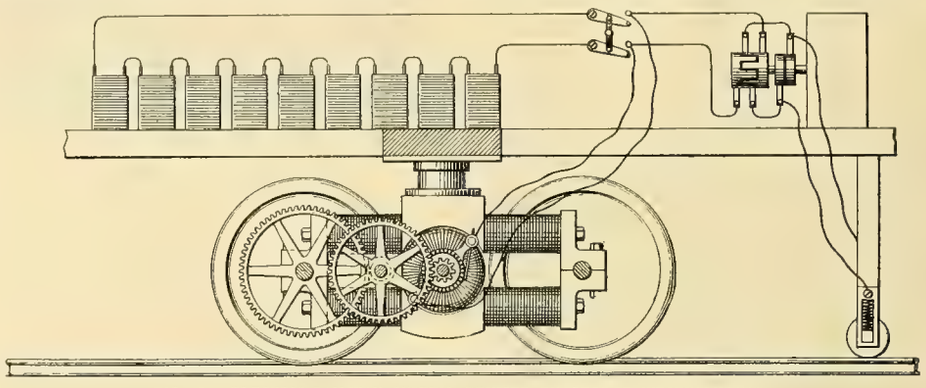


FIG. 2. ELECTRIC-RAILWAY SYSTEM DEVISED BY GEORGE WESTINGHOUSE.

whose voltage may be varied as desired by the field rheostat while operating at a constant speed, and supplying the direct current to the railway motors at low voltage, giving a very heavy starting torque with the use of very little power. The motor-generator set which is proposed on the train is operated continuously at a constant speed by a single-phase motor with current from the high-tension line directly to the motor terminals. All starting resistances are avoided, and the speed of the motors is regulated entirely by means of the generator field rheostat.

Mr. Max Deri of Austria-Hungary has invented a combined alternating-direct-current system for electric traction (Fig. 1), in which he uses storage batteries upon the car or train. He says: "The advantages of employing alternating currents, more particularly multiphase currents, for transmission of power, are well understood, but in the construction of electric-railway systems it has not as yet been found practicable to employ single-phase alternating currents successfully. This is mainly because alternating-current motors, although more solid in construction and in many respects more advantageous than direct-current motors, do not work as well on electric railways because of the great variations of speed required and also because of the difficulties in starting alternating-current motors and of utilizing alternating currents in connection with accumulators. With a view of utilizing alternating currents to some extent for electric railways, it has been repeatedly proposed to construct such railways with transforming stations to convert the alternating current into continuous current; but such transforming appliances are expensive, involve considerable loss of energy, require special care and are in many respects uneconomical."

Mr. Deri claims to do away with these difficulties and to permit the use of single-phase or multiphase alternating currents, without employing transformer stations, but by using accumulators on the car in connection with a direct-current dynamo or motor on the car axle and line conductors supplying alternating currents to an alternating-current motor also on an axle of the car.

Mr. Deri states that he employs the alternating-

current motors and direct-current motors to the best advantage, the greater part of the work for producing power being obtained from the alternating currents directly, and but a small part, the work of the accumulator, being obtained through the transformation.

According to this system, the single-phase alternating current from the line conductors furnishes power to run the train, and during this time the direct-current dynamo, being driven on one of the car axles, charges the storage battery, which acts as a sort of transforming device, the accumulators acting also as a "booster battery" to equalize the motive power. In running on a down grade the storage battery is being charged, and on an up grade, where the alternating-current motor does not supply sufficient power to move the train at the desired speed, the battery supplies current to the dynamo, which is thereby converted into a direct-current motor to aid the work of the alternating-current motor. The battery can also be used to supply the necessary current for motive power in stretches where the line conductors are interrupted. The starting of the train is also accomplished by the direct-current motor and current from the battery, as the single-phase motors cannot be started under load, but after attaining the proper speed they work well. The shunt motor is used, as the battery pressure need not be more than 100 or 200 volts. The shunt motor and battery form a braking device, utilizing the kinetic energy of the moving train in stopping, at the same time providing a powerful torque for starting.

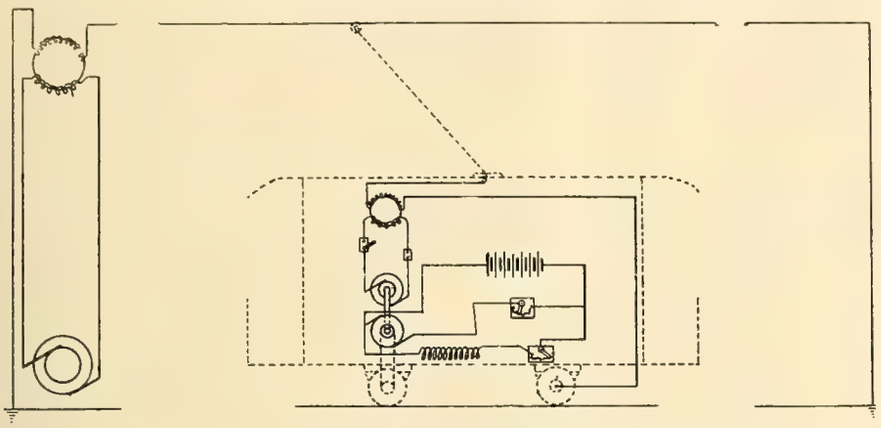


FIG. 3. ENTZ RAILWAY SYSTEM WITH ROTARY TRANSFORMER AND STORAGE BATTERY.

In the United States patent of George Westinghouse, Jr., for his system of electrical distribution of alternating currents for electric railways, with static transformers, rotary converters and rectifiers, the inventor shows a method of utilizing direct-current motors and storage batteries upon the car and also a rotary converter or rectifier, as illustrated in Fig. 2, utilizing the single-phase currents from the line and transforming to direct current in a similar manner to that mentioned by Mordey and Jenkin.

A converter system for electric railways has been invented by C. S. Bradley, utilizing a static transformer upon the train, together with an alternating-current, motor-driven rectifier, supplying direct current to the motor driving the cars.

A system of converter electrical distribution has been designed by J. B. Entz, which utilizes, as shown in Figs. 3 and 4, a storage battery upon the car, as well as a rotary transformer, which is directly connected to the axle of the car, the direct current from the battery being employed to start the alternating-current portions of the apparatus, and compensating for variations from average load. Normally, the motor car or locomotive is propelled by the alternating-current motor end of the rotary converter, deriving the single-phase current from the power station over the trolley line. If the load is decreased, as in going down hill or when the train is being brought to rest, the current from the direct-current end of the rotary transformer charges the battery. When there is an increase in the load, such as would overload the alternating-current motor, as in going up hill, the battery is permitted to help out the alternating-current motor by driving the direct-current end of the rotary converter as a motor. The starting of the train is also accomplished by supplying direct current to the direct-current end of the rotary from the battery, and when up to speed the alternating current supplies the necessary power.

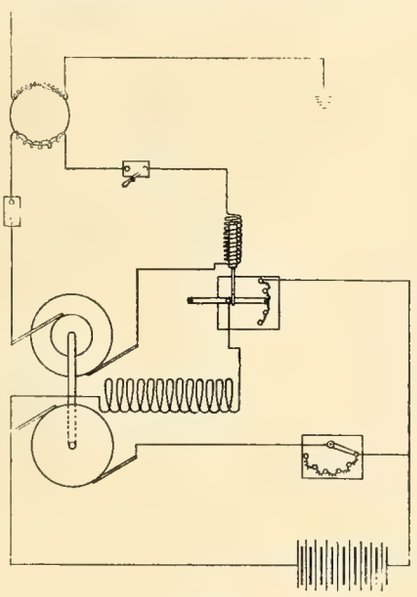


FIG. 4.—ANOTHER ARRANGEMENT OF ENTZ RAILWAY SYSTEM.

Another design of electric-railway system using a rectifier on the car driven by an alternating-current motor, as well as a storage battery and direct-current motor, is that shown in Figs. 5 and 6, and was patented in the United States recently by Harry C. Reagan, Jr.

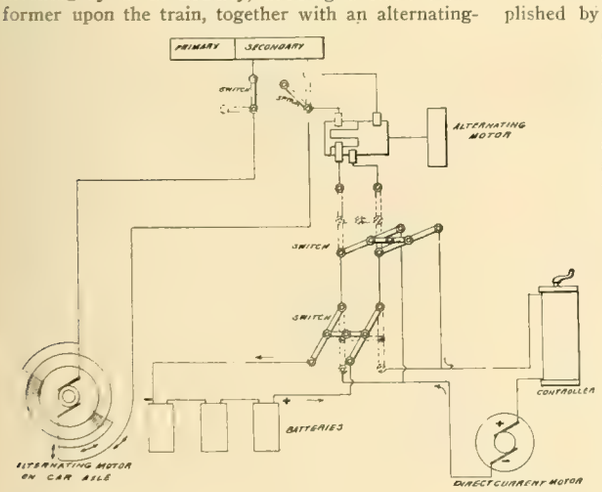


Fig. 5.

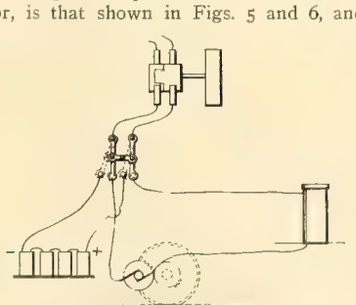


Fig. 6.

ALTERNATING-CURRENT ELECTRIC RAILWAY.—REAGAN SINGLE-PHASE SYSTEM.

[*To be continued.*]

The Blue Ridge (Ga.) Electric Light and Power Company has been incorporated with a capital stock of $10,000. The incorporators are John H. Carter, E. O. Dobbs and J. F. Holden.

Jury Regulations for St. Louis World's Fair.

The following selections from the special rules and regulations providing for an international jury at the St. Louis World's Fair will give prospective exhibitors and others a good idea of the system of making awards.

1. The total number of jurors in the International Jury of Awards shall be approximately two per centum of the total number of exhibitors, but not in excess of that number, and each nation having 50 exhibitors or more shall be entitled to representation on the jury. The number of jurors for each art or industry, and for each nationality represented, shall, as far as practicable, be proportional to the number of exhibitors and the importance of the exhibits.

2. Each group jury shall be composed of jurors and alternates.

The number of alternates shall in no case exceed one-fourth of the number of jurors, and they shall have a deliberative voice and vote only when occupying the places of absent jurors.

3. The United States jurors and alternates of the group juries shall be nominated by the chiefs of departments to which the respective groups belong. The jurors and alternates of the group juries representing foreign countries and the United States insular possessions shall be nominated by the commissioners of such countries.

5. The chief of each department shall have general charge of the organization and direction of the group juries in his department.

He shall be admitted to all sessions of these juries for the purpose of directing their attention to matters relating to the judging of exhibits

6. The work of the group juries shall begin 30 days after the opening of the exposition, and shall be completed on or before 60 days after the opening of the exposition.

8. Each group jury shall carefully examine all exhibits pertaining to the group to which it has been assigned.

[Rules 12 to 14, inclusive, provide for department juries and a superior jury to review the work of the group juries.]

15. The superior jury shall determine finally and fully the awards to be made to exhibitors and collaborators in all cases that are formally presented for its consideration.

If, for any reason, an award is not satisfactory to an exhibitor, he may file written notice to that effect with the president of the jury within three days after the official notification of the award, and this notice shall be followed, within seven days after the date of the official notification, with a written statement setting forth at length his views as to wherein the award is inconsistent or unjust.

16. The work of the superior jury shall be completed on or before 130 days after the opening of the exposition, and as soon as practicable thereafter formal public announcement of the awards shall be published by the Louisiana Purchase Exposition Company.

18. The deliberations of all juries shall be strictly secret.

The president of the exposition company, the director of exhibits, and the chiefs of departments, shall have the privilege of attending any sessions of the several juries.

A majority of any jury, shall, in all cases, render and confirm a decision.

19 The exhibits of persons occupying the position of jurors or alternates, and such exhibits as may have been exempted under Section 2, Article XXII., shall be classed as noncompetitive, and shall not be examined by the jurors.

24. Whenever it is applicable, a decimal scale system shall be used in judging the merits of exhibits, 100 representing perfection; and as a suggestion to juries, for instance in commercial exhibits, the following is offered:

(a) Value of the product, process, machine or device, as measured by its usefulness, its beneficial influence on mankind in its physical, mental, moral, and educational aspects
Counting not to exceed 25

(b) Skill and ingenuity displayed in the invention, constructions and application.
Counting not to exceed 25

(c) Merits of the installation as to the ingenuity and taste displayed, the cost and the value as an exposition attraction.
Counting not to exceed 10

(d) Magnitude of the business represented, as measured by the gross sales during the calendar year preceding the opening of the exposition.
Counting not to exceed 10

(e) Quality or cheapness, with reference to the possession by the exhibit of the highest possible quality, or the fact that the article is sold at so low a price with reference to its quality as to make it a valuable acquisition to the purchaser.
Counting not to exceed 10

(f) For the completion of installation within required time, and for excellence of maintenance.
Counting not to exceed 10

(g) Length of time the exhibitor has been in business as showing whether exhibit is a development of original invention, or is an improvement on the work of some prior inventor.
Counting not to exceed 5

(h) Number and character of awards received from former expositions.
Counting not to exceed 5

25. A special award, consisting of a gold medal, in each department, may be recommended by the department jury, for the best, most complete, and most attractive installation.

26. The following scale of markings shall be used in determining the final merits of an exhibit, and fixing the award that should be made, 100 being used as indicating perfection:

Exhibits receiving markings ranging from 60 to 74, inclusive—bronze medal.
Exhibits receiving markings ranging from 75 to 84, inclusive—silver medal.
Exhibits receiving markings ranging from 85 to 94, inclusive—gold medal.
Exhibits receiving markings ranging from 95 to 100, inclusive—grand prize.

30. United States jurors, except such as are officers and employes of the exposition, shall receive necessary and actual cost of transportation, and compensation at the rate of $7 per day for such time as they are actually engaged in the work assigned them at the exposition.

A comparative report of the gross earnings of the Detroit United Railway for the second week of September, 1901 and 1902, and also for the periods between July 1st and the second week of September of the two years shows the following: Second week of September, 1902, $67,282; 1901, $60,344, showing an increase of $6,938; July 1st through second week of September, 1902, $2,397,441; 1901, $2,090,119, giving an increase for 1902 of $307,322.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Progress on the Telephone Tunnels in Chicago. Illustrated. 205, 206, 207
Indiana Electrical Association.—Convention at Indianapolis, September 17 and 18, 1902. ..... 207, 208
The Arcophone or Speaking Arc Lamp. By G. K. Smith and R. A. L. Snyder. Illustrated. (Engineers' Society of Western Pennsylvania.) 208
Alternating-current Railway Systems. By Frank C. Perkins. Part I. Illustrated 208, 209
Jury Regulations for St. Louis World's Fair 209
Editorial 210
American Electrochemical Society.—Convention at Niagara Falls, N. Y., September 15-18, 1902 211
An Apparent Electrochemical Paradox. By Carl Hering. (American Electrochemical Society.) 211
Suburban Electric Road at Salt Lake 211
Electric Intramural Railway for St. Louis World's Fair 211
Electric Lights and Telephones for Divers' Operations 211
Development of the Telephone Field 212, 213
Chicago Telephone Company Building Three New Exchanges 212
Poor Bell Service in Seattle 212
Extensions and Improvements 212
Independent Progress in Buffalo 212
New Companies 212
Long Telephone Spans 212
Independent Telephony in Southwestern New York 212
Brokers' Estimate of the Old Erie System 212
Telephone Men 212
Indiana Telephone Items 213
Southern Telephone Developments 213
Telephone News from the Northwest 213
Bell Instrument Output 213
General Telephone News 213
Manufacturers and Dealers 213
Electrochemistry at the World's Fair, St. Louis. By W. E. Goldsborough. (American Electrochemical Society.) 213, 214
Electric Train Connector. Illustrated 214
A Survey of Electrical Patents Granted by the United States. By Story B. Ladd. Part III 214, 215
Haberkorn Double-piston-valve Engine. Illustrated 215
Western Union to Make Extensions in the South 215
Communications 215
Electric-light Apparatus Wanted. By Robert J. Boone 215
A Question of Location 215
Economical Turn-down Lamp. Illustrated 216
Hawaiian Cable Shipped from London 216
That Municipal-ownership Challenge 216
Rates Low but not Available 216
Central-station Heating to be Resumed in Evanston 216
Chicago Street-railway Arbitration 216
Trolley Strikers Enjoined 216

DEPARTMENTS.

Correspondence 217, 218
New York Notes 217
New England News 217
Canadian Intelligence 217
Southern Developments 217
From the Buckeye State 217
Information from Indiana 217, 218
Northwestern Notations 218
On the Pacific Slope 218
Personal 218
Electric Lighting 218
Electric Railways 219
Publications 219
Telegraph 219
Space Telegraphy 219
Miscellaneous 219
Trade News 219
Business 219
Illustrated Electrical Patent Record 219, 220

CONVENTIONS AND EXPOSITIONS.

International Association of Municipal Electricians, Richmond, Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

MR. PERKINS' article on "Alternating-current Railway Systems," begun in this issue, is a timely one. It does not take up such late developments as the Arnold single-phase electro-pneumatic system, but is useful in giving a brief resumé of the art leading up to the very recent developments which are exciting so much attention. The subject is treated in three divisions. Single-phase systems are treated this week. Next week's installment will be devoted to polyphase systems, while the concluding portion will deal with various induction methods of alternating-current railway operation. Much valuable information may be gained by a perusal of the three parts of this article.

THE opposition telephone project of the Illinois Telephone and Telegraph Company in Chicago is of exceptional interest and novelty. The exchange is to be an automatic one and very large, starting off with capacity to serve 25,000 subscribers, and with allowance for an ultimate capacity of 100,000 lines. In addition, the underground conduits have been built on a deep-tunnel system entirely new in telephone work. The work, as will be seen from an article in this issue, has now reached a stage where it would appear, even to the most sceptical, that it must be carried to completion. The time now set for giving service from this automatic exchange, with its fine tunnel system, is next spring. Unless the plans should miscarry at the last minute, Chicago will be able to show to the world next year the very latest thing in telephone-exchange service. Certainly the completion of this elaborate project will be awaited with eagerness by all interested in telephone development.

SENSIBLE changes in the schedule of dues of the National Electric Light Association, adopted at the Cincinnati convention last May, and a combined effort since that time, have resulted in a highly gratifying growth of that useful organization. Since the Cincinnati meeting 94 new members have joined the association, and at the last account the recruits were still coming in. There still remains a large field to draw from, however, and the society ought to have a thousand or fifteen hundred members instead of four or five hundred.

Central-station companies are many times repaid by the existence and work of the association for the expense of maintaining it, which is comparatively trifling. With greater membership and greater financial resources, the association could accomplish much more—embark vigorously, in fact, on several lines of work, such as lamp testing, uniform-accounting propaganda and municipal-ownership education, in which merely a good beginning has been made. The association should appeal particularly to the smaller central stations, for nowadays most all of the larger companies in the big cities are eligible to membership in the restricted Association of Edison Illuminating Companies, leaving the National organization as the one where small and large companies of all descriptions may meet on a common footing for mutual helpfulness. Electric-light companies display the part of wisdom in joining the National Electric Light Association, which was formed to conserve their interests, and we hope that the influx of new members will continue.

THE recent accident to President Roosevelt at Pittsfield has brought up the question of the regulation of the speed of electric cars in Massachusetts. The state railroad commissioners wish to obtain the authority to regulate speed, which is now vested in municipal authorities. Leading electric-railway men prefer the state control, as that would make a uniform rate of speed in all parts of the commonwealth. The commissioners asked the last Legislature for the necessary authority, but that body took no action on the matter. The commissioners' last report contained the following: "Under existing law the steam railroad is prohibited from crossing the highway at grade, and a city or town is prohibited from laying out a street across a railroad at grade, without the consent of the board. The electric car, in moving along the streets of a city, must by force of circumstances often be, and ought by regulation always to be, restricted to a speed consistent with the safety of other travelers upon the highway. The same car, moving over private land or over a way of its own, approaches a highway under practically like conditions with the railroad train. The law, therefore, restricting the grade crossings of railroad and railway, should be extended to the crossings of railway and highway. Where such crossings can be avoided at an expense not too burdensome, this should be done. Where such crossings cannot be avoided by reasonable outlay, suitable safeguards should be provided."

Thomas Post, a former state senator and a director of the Berkshire Street Railway Company, says: "If the commission had had authority over locations at the time of the laying out of the grade crossing where the accident to President Roosevelt's carriage occurred, such a crossing of the highway would never have been permitted." It may be added that the railroad commissioners' position seems to be a reasonable one; the reform they advocate should be carried out.

CHEERING tidings come from Boston to the effect that all the gas companies are to be merged and eventually will furnish gas for fuel only. Of course, there is nothing novel or inspiring in the news of a mere merger of industrial companies, but the announcement of an intention to manufacture gas for fuel consumption exclusively carries with it the corollary that electricity is to be relied upon for illumination. Indeed, the newspaper announcement says in specific terms: "The Brookline company's plant will produce electricity, which will ultimately supersede gas completely as an illuminant. This means eventual consolidation of all the gas and electric-light interests of the city. Ultimately the gas plants, except that of the Brookline company, will be closed and sold, or used to produce gas for fuel only. Electricity will be made sufficiently cheap to become the sole illuminant in general use." Without entering into the merits of the large question of industrial combination, it may be said that the general idea of using gas for fuel only, relying on electricity for light and power, is entirely sound. Gas is slowly losing ground as an illuminating agent. The superiority of electricity is universally recognized, the only argument against it being that of expense. But with increased experience in central-station management the cost of producing and distributing the current is being intelligently reduced, and although the electric-light man still labors under the disadvantage of possessing no means of storing his product in large quantity, still economies are constantly being effected which reduce the cost to the consumer. In street lighting gas has for some time been forced to the rear, in this country at least, and in interior illumination a similar fate seems surely to await it.

FEW persons would suppose that in law a submarine telegraphic cable could be regarded as merely a projection of the land and therefore not coming within the jurisdiction of an admiralty court. Such, however, is the fact—at least in some cases. The point came up recently in the case of the Western Union Telegraph Company against the schooner Guide. Judge De Haven of the United States District Court dismissed the libel against the vessel on the ground stated. The suit was for $8,000 damages for injury done by the anchors of the schooner to a cable between San Francisco and Oakland. Judge De Haven, in his decision, quotes Hughes on Admiralty, as follows: "The line is frequently narrow between the navigable waters and structures bridged over them. Anything that is attached to the shore, although the water may be beneath it, is considered as a mere projection of the shore, and torts happening upon such structures are not within the jurisdiction of the admiralty courts. This applies more especially to wharves and bridges, which are fixed structures." The judge adds: "In my opinion the same rule is applicable to a cable with ends attached to the main shore and its body resting upon land under navigable waters." Perhaps, however, this doctrine does not apply to cables lying in the high seas, beyond the three-mile limit. Nearly all injuries to cables occur within the legal shore line, to which national jurisdiction extends. It would be interesting to know if the ruling of Judge De Haven would still obtain if the injury to a cable were sustained, in some manner, out at sea. The whole subject of the legal status of cables in the high seas is involved in some obscurity, as was shown by the cable-cutting episodes during the Spanish-American war. There has been some agitation to bring about an international conference on the subject, but the matter was allowed to drop.

American Electrochemical Society.[1]

TUESDAY'S SESSION.

The second day's session of the convention of the American Electrochemical Society, held on Tuesday of last week, was in the auditorium of the Natural Food Company on Buffalo Avenue, Niagara Falls, N. Y. The first paper was that of Marcus Ruthenberg of Philadelphia, Pa., on "Developments in Electrometallurgy of Iron and Steel." In the absence of the author, the paper was read by Dr. Edward Hart of Easton, Pa. The author stated that there are many iron ores too low in tenure to permit smelting; that concentration is essentially the separation of the valuable from the valueless, and that in ores in which the iron is carried as magnetite it becomes a simple and beautiful method of separation. An essential feature is to determine what fineness of mesh is required to release each individual particle from its neighbor, for if not ground fine enough the magnetic portion will drag a non-magnetic portion into the heads, deteriorating the quality of the concentrates. To prevent adhesion, the ground ores may be handled in water. Those who took part in the discussion were Dr. Hart, Dr. Keith, W. McA. Johnson, C. J. Reed, P. G. Salom and Professor Richards. Dr. Keith felt the author was too sanguine, while Mr. Salom didn't see any danger of the electric furnace superseding the blast furnace.

Professor R. S. Hutton, Owens College, Manchester, England, read a paper on "The Fusion of Quartz in the Electric Furnace." It was well received. Professor Hutton made mention of the fact that the process was not in commercial use, and that he had no commercial interest in it, simply mentioning it in order to suggest a new industry. The paper was discussed by C. E. Whitney, Professor W. D. Bancroft, F. A. J. Fitzgerald, Dr. Doremus and Professor Haber, the last named of Carlsruhe, Germany.

Eugene A. Byrnes, Washington, D. C., read a paper on "Voltaic Cells with Fused Electrolytes." It was briefly discussed. Carl Hering of Philadelphia presented his paper on "An Apparent Electrochemical Paradox," given in abstract on this page. The discussion was extended, being participated in by Hugh Rodman, W. McA. Johnson, Professor Carhart, C. J. Reed, Professor Hutton, Professor Burgess, Professor Bancroft, Professor Kahlenberg, Professor Haber, Professor Richards and W. M. Bradley.

Dr. Henry S. Carhart, University of Michigan, followed, with a paper on "The Nickel Concentration Cell," restricting himself to the consideration of two different classes of cells. The discussion that followed was interesting, and those who took part in it were Professor Bancroft, Professor Haber, Carl Hering, Professor Kahlenberg, Professor Carveth, Frank A. Pattison, A. T. Weightman, C. J. Reed, W. R. Whitney, Professor Richards and Dr. Keith.

The practice of the convention was to have the various criticisms made after the paper was read, following which the author would reply thereto.

WEDNESDAY MORNING.

On Wednesday morning Professor W. E. Goldsborough of St. Louis talked about "Electrochemistry at the World's Fair, St. Louis." An abstract of his address is given on another page.

Professor H. T. Barnes, Ph. D., McGill University, Montreal, Canada, presented a thorough paper on "Theory and Practice of Continuous Flow Calorimetry." With drawings he illustrated how to obtain the relative and accurate measurement of the calorimeter. His paper was discussed by Professor Kahlenberg, Alfred H. Cowles, Professor Hutton, H. N. Potter, W. R. Whitney, C. J. Reed, Professor Carhart, Frank A. Pattison. Arvid Reuterdahl, Providence, R. I., presented a paper on "The Electronic Hypothesis and Its Applications." The paper attacked the law of gravity. In the discussion Professor Carhart said that he didn't want it to appear that the society approved of the deductions made in the paper. Woolsey McA. Johnson, New Brighton, S. I., N. Y., read a paper on "The Electrolytic Dissolution of Soluble Metallic Anodes." Professor Bancroft, C. J. Reed and Dr. Keith discussed it. Hugh Rodman of Philadelphia read a paper on "Storage-battery Invention." Dr. Keith, C. J. Reed, Norman Dodge and others participated in the discussion.

WEDNESDAY AFTERNOON.

The programme called for a visit to the Dufferin Island, Canadian side, on Wednesday afternoon, but, owing to the scenic beauty having been temporarily destroyed by the power developments there in progress, the society was advised not to visit the point, so held an afternoon session. The opening paper was by Professor F. Haber, Ph. D., Carlsruhe, Germany, his subject being "Phenomenon of Formation of Metallic Dust from Cathodes." It was with much pleasure that the society greeted a member of the parent electrochemical society of the world, and Professor Haber's paper was heard with benefit by all. Professor Haber gave two illustrations of the dust formation, and in the discussion that followed the reading of the paper Dr. Keith, Professor Bancroft, C. J. Reed, Professor Carhart, Professor Kahlenberg, W. P. Taggart and Professor Richards took part.

Alfred H. Cowles, Cleveland, Ohio, read a paper on "A Unit of Quantity of Electricity for Use in Electrochemical Calculations." The paper elicited discussion, at the close of which Professor Edward R. Taylor of Penn Yan, N. Y., read a paper on "Some Further Advances on the Closed and Continuous-working Electric Furnace." "It would take less nerve on my part," said he, "with my present experience, to construct an electric furnace that would dwarf the largest blast furnace in existence to-day, than it took to build the furnaces now in use, which are 16 feet in diameter and 41 feet high."

THURSDAY MORNING.

The session of Thursday morning opened with the reading of D. H. Browne's paper on "Pumps and Other Accessories in Electrolytic Plants," by Woolsey McA. Johnson. It was discussed by Dr. Keith, Mr. Johnson and Professor Richards. Henry Noel Potter read Professor John Langley's paper on "Electrochemical Polarization." It was discussed by Alfred Cowles, Carl Hering, Mr. Potter, Professor Richards and Alois von Isakovics. C. J. Reed, secretary of the society, was forced, owing to illness, to return home on Wednesday night, and in his absence his paper on "Phenomena of Electrolytic Conduction" was read by Carl Hering, the discussion being by Messrs. Hering, Johnson, Cowles, Potter and Richards.

A resolution was adopted that the next meeting of the society be held in New York city. Resolutions of thanks to the local committee and the ladies' committee were also adopted. The election of officers (by a mail ballot) will take place before the next meeting, which will be held some time during next April probably.

SOCIAL FEATURES.

While the Niagara convention was mainly devoted to the consideration of papers, etc., the social end was not overlooked, and there was much running about to visit some of the plants and power houses. On Wednesday evening Manager Greenwood of the International Hotel provided an elaborate special dinner, at a special hour, for the members, guests and their ladies, and this was thoroughly enjoyed. The toastmaster of the occasion was Mr. William B. Rankine, vice-president of the Niagara Falls Power Company. Toasts were responded to as follows: "The City of Niagara Falls," Mayor John M. Hancock; "Our Society," Dr. J. W. Richards, Bethlehem, Pa.; "Our Sister Society," Professor Haber of Germany; "Our Foreign Members," Professor Hutton, Manchester, England; "Our Affiliated Societies," Professor Crocker of New York; "Our College Professors," Professor Bancroft of Cornell; "The Ladies," Carl Hering of Philadelphia.

The local committee that did so much to make the convention a success was made up of Niagara Falls electrical men, headed by Charles M. Hall.

1. The report of the first day's session of the convention at Niagara Falls, September 15-18, 1902, was given in last week's Western Electrician.

An Apparent Electrochemical Paradox.[1]

BY CARL HERING.

The writer described a curious experiment which he and Mr. Reed made some years ago in which water was decomposed in visible quantities at voltages far below the theoretical (about 1.45), even as low as about 0.3 volt. This seems to contradict the law of the conservation of energy, as these gases, in recombining, could generate more than this amount of energy, and it would therefore be perpetual motion, which is impossible.

The experiment consisted in electrolyzing acidulated water in a strong N-shaped glass tube, which was sealed at both ends and provided with a bend containing mercury, which enabled the mechanical pressures to be read off. The results were shown in a curve. The pressure reached about 23 atmospheres when the tube exploded. The voltage at the terminals when a constant current passed diminished rapidly and very decidedly to about 0.3 volt at about 16 atmospheres, and then remained practically constant. Allowing for the loss due to resistance, the actual voltage of decomposition was much lower, nearly zero. There was visible gasing during the whole test, showing that water was really being decomposed; the increasing pressures also showed this.

No researches were made to find the correct explanation of this curious result; the intention of the paper was merely to describe the experiment. A possible explanation is, however, suggested, showing how the results need not be inconsistent with Faraday's law, or the law of the conservation of energy. It is based on the assumption that some of the gases probably passed mechanically to the opposite electrode, which they could easily do in suspension, as the electrodes were very close together. These were consumed as depolarizers, so that only a fraction of the theoretical amount of gas was really liberated. This depolarization lowered the voltage. A calculation based on this reduced amount of gas which was actually liberated, on the actual current which passed and on the energy which must be accounted for to conform with theory, would also show that the required voltage need be only very low, the lower, the greater the amount of depolarization.

The paper concluded with a suggestion of an experiment in which water might be electrolyzed in a strong, sealed vessel, which is completely filled so as to leave no room for the gases. Some curious results may then be expected.

1. Abstract of paper read before the American Electrochemical Society at Niagara Falls, September 16, 1902.

Suburban Electric Road at Salt Lake.

An important electric-railway enterprise has been instituted in Salt Lake City by Chicago and Salt Lake capitalists. The Salt Lake and Suburban Railroad Company proposes to build about 45 miles of road throughout the various highways in Salt Lake County. Guy Sterling, the engineer in charge of the work of preliminary surveys, has two gangs of men at work, and is hurrying this portion of the work to early completion. The motive power will be electricity, and will be developed by water, to be obtained from Mill Creek, principally. A cold storage is to be established at Salt Lake for storing all fruits and vegetables carried over the line from farms lying along the line of the road, and the company expects to place an expert on the road who will instruct farmers as to best methods of handling and packing their products.

The road will start at the corner of First South and Second East Streets, in Salt Lake, and the main line will run to Sandy, 12 miles south of the city. Branch lines will run east to Big Cottonwood Canyon, and west across the Jordan River to Redwood Canyon, taking in several towns en route. A fine hotel is to be built by the company in Big Cottonwood Canyon, where a pleasure resort is to be laid out equal to any similar resort west of the Missisippi, as the altitude of the canyon is from 5,000 to 12,000 feet above sea level, the air clear and healthful and the fishing excellent.

After the surveys are completed estimates and contracts will be made for up-to-date equipment. The company is incorporated for $500,000. C. L. Furey of Chicago is president, L. W. Pitcher of Chicago, vice-president, A. W. Taylor of Salt Lake secretary and general manager, and George M. Cannon, cashier of Zion's Savings Bank of Salt Lake, treasurer. The company is incorporated under the laws of Delaware.

Electric Intramural Railway for St. Louis World's Fair.

The report in relation to the intramural railway on the St. Louis World's Fair site, mentioned in the last issue of the Western Electrician, has been authenticated. As stated then, the road will be electrically operated and will be eight miles in length. It will be partly elevated and partly on the surface, and will be built according to plans and specifications prepared by C. V. Weston of the firm of Weston Brothers of Chicago, consulting and contracting engineers. It has not been decided whether the construction of the road will be given to contractors, so that the completed road may be operated by the exposition company, or whether a concession will be granted for its construction, the concessionaire to pay a percentage to the company for the privilege of operating it. The road will pass in front of the main picture of the fair, in order that passengers may be landed on the grand plaza in the main avenue, and this will be accomplished in some way that will serve to keep the road from marring the picture. How this will be done has not yet been determined, but it will probably be effected either by screening it with trees and shrubs, or by erecting a "dummy" facade, behind which the passengers will be discharged. It is the intention to have the road reach every point of interest on the grounds, and at the same time preserve the beauty of the picture

Electric Lights and Telephones for Divers' Operations.

The Wieland Electric Company of Duluth proposes to make an interesting experiment with electric lights and telephones in diving operations on the sunken steamer Thomas Wilson, which lies in about 72 feet of water. The idea is to use the lamps, possibly fastened to the divers' helmets, to illuminate the wreck, or portions of it, while the telephones will give communication with the surface. Current will be obtained from the plant of some adjacent vessel or else from a special storage-battery installation rigged up for the purpose. The idea is that one diver who can see what he is doing and can talk to the surface is worth three groping in darkness and silence. Details of the electrical attachments have not been worked out, but the practical difficulties are not insurmountable, and the plan is under serious consideration and will probably be tried.

DEVELOPMENT OF THE TELEPHONE FIELD.

Chicago Telephone Company Building Three New Exchanges.

For telephonic purposes the Chicago Telephone Company has divided the city of Chicago into 22 office or exchange districts, each of which has or is to have its own office or exchange. At the present time there are only 12 of these exchanges, nine of which are in modern buildings belonging to the company. Of the other three, two are downtown exchanges ("Central" and "Harrison"), installed in large office buildings, while the third is one of the outlying exchanges ("Canal"), occupying a small rented building.

The plan of the company is to build exchange buildings of its own in the outlying districts as fast as possible. Three, including one for the "Canal" district, are at present in course of construction. Until all of the 22 exchanges are installed, the existing 12 exchanges will be overworked.

One part of the city in which the exchanges have been particularly overworked is the South Side. South of Twelfth and east of State Streets there are about 12,000 subscribers, which are at present handled by two exchanges called the "South" and the "Oakland." The "South" exchange takes care of the business of a district bounded on the north by Twelfth Street, on the east by Lake Michigan, on the south by Thirty-fifth Street and on the west by Halsted Street. The "Oakland" exchange handles everything south of Thirty-fifth Street and east of State Street. To help out these two exchanges, two new ones are being built, one called the "Vernon," on which work has just been commenced, and the other, the "Hyde Park," now nearly finished and ready for occupancy.

The "Vernon" exchange is located on the corner of Thirty-fifth Street and Vernon Avenue and will take care of a district bounded by Thirtieth Street on the north, the lake on the east, Forty-first Street on the South and State Street on the west. The "Hyde Park" exchange is located on Fifty-seventh Street, near Madison Avenue. It will handle all the business south of Fifty-first Street and east of State.

The buildings for these two new exchanges and also for the "Canal" exchange were designed by C. G. Hellick, the company's architect. They will follow the general idea of the now existing branch-exchange buildings. They will be two-story brick structures with basements, and will have ground dimensions as follows: "Canal," located on the corner of Nineteenth and Laflin Streets, 50 by 60 feet; "Vernon," 50 by 100 feet; "Hyde Park," 40 by 85 feet. In every instance the switchboard will be installed on the second floor. The "Hyde Park" building is ready for the switchboard, which will be installed by the Western Electric Company.

Poor Bell Service in Seattle.

The Sunset Telephone Company will improve its service in Seattle immediately. Louis Glass of San Francisco, vice-president and general manager of the company, was in Seattle a couple of weeks ago inspecting the lines. He said: "The service of Seattle is very bad, but the business simply grew faster than we could provide for it. At the beginning of the year we had 5,000 subscribers, and we put in switchboard accommodations for 10,000, so as to provide for the growth of the next two years, but now we have passed the 9,000 mark." Others, however, are persuaded that the Bell improvements in Seattle are caused by the fact that the Independent company has recently put in a good plant and is competing vigorously for business.

EXTENSIONS AND IMPROVEMENTS.

The Maryland Telephone Company of Baltimore is increasing its facilities so that it may serve 12,000 subscribers.

The New England Telephone and Telegraph Company has bought land in Jamaica Plain, Boston, on which it will at once erect a brick and stone exchange building.

The Bell company has just completed additional long-distance connections between Jacksonville, Fla., and New York. Jacksonville is now telephonically connected with the outside world by five copper circuits.

The wire for the long-distance telephone line between Nome, Alaska, and Council City has been received at Nome. The line is now in operation as far as Silver Bow, and it is expected the whole line will be in operation before October 1st.

Independent Progress in Buffalo.

The Frontier Telephone Company hopes to get its new system in Buffalo working in three or four months. At present a large force is employed in construction. The plans of the company call for the laying of an extensive conduit system, embracing about 30 miles of trenches and 1,000,000 feet of ducts. Operations along this system are now being carried on in West Ferry Street, Fargo Avenue, School Street and Massachusetts Avenue. A main line is yet to be laid through East Utica Street.

The temporary offices of the company are to be located in a brick building on the west side of Ellicott Street, below East Huron Street. This building is a beehive of industry, and is only rivaled by the activity that is being displayed in the handsome new brick building adjoining, where the permanent offices of the company will be located. It is asserted that the switchboard room at "Central" is the largest in the United States. It will have a capacity of 30,000 subscribers, calling for a large switchboard. At the time the Frontier company placed its switchboard order, the switchboard that it ordered was the largest for which a contract had been made in the United States, but since then progress in other cities has resulted in orders for larger switchboards.

The young lady operators will have very pleasant quarters, a large space being allotted to a suite of rooms. There will be a kitchen, dining room, parlor, retiring rooms, cloak rooms and a small hospital. At the start the company will employ about 100 girls, and the rooms will be fitted as a place where they can seek recreation and rest during the intervals of rest demanded by their work. Arrangements have been made to provide substantial and wholesome meals for them, and the girls will be charged only the actual cost of what they eat.

Ellicott Square, the largest office building in Buffalo, has been wired so that any office in the building may have a Frontier telephone. Up to date the company has secured about 4,000 subscribers, but it expects to start business with between 7,000 and 8,000 subscribers.

NEW COMPANIES.

The Shelbyville Telephone Company of Shelbyville, Del., has been incorporated with a capital of $50,000.

The Union Electric Telephone and Telegraph Company has certified to a change of location from Chicago to Rock Island, Ill.

The Fort Sill, Texas and Oklahoma Telephone Company of Marlow, I. T., has been incorporated with a capital stock of $25,000.

The Custer City Telephone Exchange and Extension Company of Custer City Okla., has been incorporated with a capital of $5,000. The incorporators are C. H. Dean, G. A. Noble, J. C. Storm and T. H. Lindsey.

The Cropsey (Ill.) Telephone Company has been incorporated with a capital of $2,500 to conduct a general telephone business. The incorporators are C. E. Hayward, R. T. Slater, S. R. Williams, H. L. Barnes and E. W. Crum.

The Cornell Telephone Company has been incorporated to operate and maintain a telephone system in Cornell, Ill. The capital stock of the company is $5,000. The incorporators are George Whitham, John F. Snyder, H. W. Smith, C. E. Lishness and Calvin Grant.

The council of Ypsilanti, Mich., recently granted a telephone franchise to an Independent telephone company. By the conditions of the grant the exchange is not to be built until 400 subscribers have been secured. Shelly B. Hutchinson is at the head of the enterprise.

The Welch-Williamson Telephone Company of Welch, W. Va., has been incorporated in that state for the purpose of building a line between the two towns indicated, as well as to some other points. The authorized capital stock is placed at $25,000, and W. J. McLoren, James A. Henchey and others of Welch are interested.

The Kiantone Co-operative Telephone Company has been incorporated with the purpose of constructing and maintaining a co-operative telephone system in the towns of Kiantone, Ellicott and Carroll, N. Y. The officers of the company are: President, A. J. Martin; secretary, E. W. Bucklin, Jr.; treasurer, G. W. Carter.

The St. Louis and Memphis Long-distance Telephone Company has been incorporated at Dover, Del., to construct and operate telephone lines connecting Memphis, Tenn.; Jonesborough, Ark.; Greenville, Greenwood, and Holly, Miss; Jackson, Tenn.; St. Louis and Kansas City, Mo. The capital of the company is $1,000,000.

Long Telephone Spans.

What is perhaps the longest telephone span in the world is placed across the Susquehanna River, connecting the telephone systems of Lancaster and York Counties, Pa. The work was done under the supervision of Col. H. C. Young, the well-known president and general manager of the Columbia Telephone Company, at Columbia, Pa. The line crosses from Chickie's Rock to "The Point," an air-line distance of 3,200 feet. The wire dips to within 35 feet of the water surface, or 122 feet below a straight line between the poles. Owing to the swift current, rocky bottom and ice gorges, the laying of a subaqueous cable was impossible, and the suspended cable was the only means of connecting the two telephone exchanges.

Another long telephone-wire span is across the Connecticut River near Middletown, Conn. It is 1,300 feet long. At Muscoda, Wis., there is an 1,100-foot span of electric-light wires across the Wisconsin River. It has been proposed to string telephone wires across the Mississippi at Fort Madison, Iowa, but in this case there would be two spans, advantage being taken of a sandbar in the river, the longer span being 2,000 feet.

Independent Telephony in Southwestern New York.

On September 10th the Home Telephone Company, an Independent concern, commenced operations in Jamestown, N. Y., with, it is said, 1,000 telephones in operation and still more to be installed before its full list of subscribers is supplied. The company is building connections with the different towns around Jamestown and shortly will give service to Boomertown, Ashville, Blockville, Wattsflats, Westfield, Panama, Sherman, Mayville, Ripley, Brocton, Frewsburg and Dunkirk. All the above are in New York state and in Chautauqua County. Construction work is being pushed on lines to Warren, Pa., and to Olean, N. Y. The completion of these lines gives connection with the Independent Union Telegraph and Telephone Company, operating a large, long-distance telephone system in Western Pennsylvania and making connection possible with points in West Virginia, Michigan, Ohio and Indiana. Another line is to be built to Buffalo to connect with the exchange of the Frontier Telephone Company, which is installing a large Independent system in that city.

Brokers' Estimate of the Old Erie System.

Moors & Cabot, brokers of Boston, have, among other things, the following to say regarding the recently declared dividend of the Western Telephone and Telegraph Company: "A well-developed telephone business is not unlike that of a well-built and well-located railroad, in having control of permanent lines of communication which cannot well be duplicated. Like railroads, telephone companies are public-service corporations, not industrials. They are here to stay and do a regular business year after year, and, unlike industrials, are not dependent on fashions or conditions affecting particular industries. Although the company was organized this year, the business of the Western Telephone Company is the development of many years. The old Erie company, its predecessor, was inadequately financed. But those who are now succeeding to the business are not taking the risk of a new venture, but have secured an established enterprise at their own price."

TELEPHONE MEN.

A. N. Felton of Laporte, Iowa, has gone to Harlan, Iowa, where he will be manager of the Harlan and Avoca Telephone Company.

H. J. Blanchaine of Laporte, Iowa, will go to Newton, Iowa, where he is to be manager of the Jasper County Telephone Company.

Samuel D. Babcock, president of the International Bell Telephone Company, died on September 14th in Lenox, Mass. Mr. Babcock was 81 years old and had been a prominent man in New York financial circles for many years. At the time of his death he was an officer in many companies, principally banking and trust.

Frederick C. Toepleman of Henderson, N. C., general superintendent of the Henderson Telephone Company and Carolina and Virginia Telephone Company, was in Chicago last week. Mr. Toepleman has been in Colorado for rest and recuperation and returns South reinvigorated. His telephone systems, it may be remarked, although Mr. Toepleman does not say so, are among the best in the South.

Long-distance telephone connections are soon to be established between Grand Marais and Whitefish Point, both in the Upper Peninsula of Michigan, on Lake Superior. These will be of great service to life savers in case of disasters, and also will aid the Weather Bureau in the delivering of storm signals.

Indiana Telephone Items.

The Pocket Telephone Company of Lafayette has filed articles of incorporation. The company's capital stock is placed at $18,000. The purpose of the company is to manufacture, lease and install pocket telephones for police and fire-alarm purposes, for interurban lines and other telephone service. The directors are Evan Selby, G. D. Haywood and C. A. Burneet, all of Lafayette.

The New Telephone Exchange at Elwood was put in operation on the 18th inst. At the same hour the toll lines connecting Elwood with Alexandria and Anderson were thrown open to the public and the Muncie line will be opened as soon as the new exchange there is completed.

The directors of the New Long Distance Telephone Company of Indianapolis, at the regular monthly meeting on the 17th inst., declared a 3 per cent. dividend, payable October 1st, to stockholders of record on September 25th. Hereafter, dividends will be paid in quarterly installments. S. P. Sheerin, president of the company, said a 1 per cent. dividend will be paid during January next, and at least a like dividend quarterly thereafter.

Although a message was sent to the telephone girls operating the Evansville exchange that the exchange was on fire, not one removed her helmet or deserted her post. The fire occurred at a time when a great many telephone calls were being received. Unmindful of the clanging gongs of the fire department, the hoarse shouts beneath them and the smell of smoke, the young women bravely stuck to business, and patrons were not in the least inconvenienced because of the fire.

Mayor Covert of Evansville, in his annual message to the council last week, said: "Most people are agreed that there should be but one telephone system, and the surest way to insure but one is to put the city into the business and create a natural monopoly. The telephone business is not a problematical venture, but a proved-up proposition, and money placed in it, particularly under the conditions that prevail here in Evansville, cannot help but bring a satisfactory return. The Independent companies seeking admission here were willing in the first place to go into competition with the Cumberland, pay the city a cash bonus for the right to do business, provide free telephones for the city's use, and all this at a service charge $1 less per month than is allowed under the municipal idea. And on top of this, after all franchises had been rejected, at least two of the companies made a further proposal to do all they had previously agreed to do and in addition pay into the city treasury a percentage of the gross receipts at the end of each year. This, coming from men who have made a life study of the telephone business, who do nothing except install and operate plants, is all the assurance any man with capital to invest could expect as to its safety." F.

Southern Telephone Developments.

The controlling interest in the Hampton Telephone Company of Hampton, Va., has been sold to a corporation or to individual interests, it is not known which. The Bell company denies the report that it is the purchaser. Eighty-five per cent. of the stock is involved in the trade.

Capt. J. T. Reeder of Smithstonia, Ala., contemplates extending the telephone line in which he is interested to Gravelly Springs and Waterloo, giving connection with Nashville, Tenn.

A charter has been granted to the Hampton Telephone Company of Hampton, S. C., which has a capital of $3,000. E. M. Peeples is secretary and treasurer.

C. W. Wing has the contract to erect poles from Jacksonville, Fla., to Palatka for the Bell company. Part of the work including the stringing of wires has been completed.

The Southern States Telephone Company, previously mentioned, which will begin business at Jacksonville, Fla., proposes to have exchanges in all the principal cities of the state. Many exchanges are expected to be built during the next six months.

At a meeting of the local union in New Orleans it was decided to attempt to carry the strike now in effect into every city in the South, where the Cumberland company operates. L.

Telephone News from the Northwest.

Work is being pushed for the construction of the system for the Home Telephone Company, at Ashland, Wis., and it is expected to have it completed by October 10th.

The Hutchinson (Minn.) Telephone Exchange Company has moved its exchange into the new brick building just completed. The exchange has a total of 207 subscribers, with 30 waiting to be connected.

The Jackson Telephone Company will proceed with the construction of its local system at Jackson, Minn., at once. About half of the $20,000 capital stock has been subscribed.

Brown & Mooreland of Wayne, Iowa, have bought the Crawfordsville (Iowa) telephone exchange.

The Mutual Telephone Company of Des Moines figures on installing a new switchboard with a capacity for 5,000 connections. It is proposed to devote a portion of it to party lines for rural service.

The Bell Telephone Company has installed a new switchboard at Burlington, Iowa. The new board has 1,400 connections. R.

Bell Instrument Output.

The American Telephone and Telegraph Company reports the following output of instruments for periods ending August 20th:

	1902.	1901.	1900.
Gross output	84,279	81,144	45,555
Returned	43,034	42,997	27,208
Net output	41,245	38,147	18,347
From December 21—			
Gross output	733,323	607,593	457,164
Returned	303,355	267,807	189,961
Net output	429,968	339,786	267,203
Outstanding, August 20	2,955,574	2,292,602	1,847,708

GENERAL TELEPHONE NEWS.

A recent reform in Paris prevents the operators at a central exchange from interrupting conversation with such questions as "Are you talking?" "Are you through?" etc. Under the new rule, an operator makes the connection and then does not disturb the speakers until she gets the signal to cut off.

A fire recently broke out in the telephone exchange in Wabash, Ind., and, as a result, the telephone service of the town was entirely shut down. The system was the property of the Home Telephone Company of Wabash. The loss by fire amounted to $3,000, partially covered by insurance. The exchange will be rebuilt.

A diving apparatus recently assembled by Ira Blalock, chief electrician of the Florida East Coast Railway Company, for use at St. Augustine, Fla., contained some interesting features. It was provided with a telephone outfit, by which the divers could converse with those above water, and was also rigged with electric lights and electric call bells.

The September issue of the directory of the Chicago Telephone Company differs from its predecessors in size and arrangement. It is now a thinner volume—240 pages—but has larger pages—8½ by 11 inches—with three columns to a page instead of two. A rough calculation shows that the book contains about 55,000 telephone subscribers' numbers.

During the recent German army maneuvers the telephone and telegraph played an important part. Field telegraphs spread fan-like from the headquarters of each commanding general to the extended fronts, and on nearly every elevation telephone stations were established. Generals were advised of the situation in every part of the field and moved their forces about in a manner often quite meaningless to observers, to whom the telephone and telegraph connections were unknown.

MANUFACTURERS AND DEALERS.

The Illinois Electric Specialty Company of 170 East Madison Street, Chicago, is distributing an ingeniously designed mailing folder which sets forth the merits of its I. E. S. pole-changer for telephone work.

The Vought-Berger Company, manufacturer of telephones and switchboards at LaCrosse, Wis., has just moved into its new, large manufacturing plant, occupying three buildings, with a floor space of 20,000 square feet, making its factory one of the largest of its kind in the country. D. T. Foley, formerly superintendent and purchasing agent of the Western Telephone Construction Company, has recently accepted a similar position with the Vought-Berger Company. The company reports many sales of complete equipments and pendant telephones. The Harris-Jewell Telephone Company of Coon Rapids, Iowa, uses pendant telephones exclusively.

A company has been organized at Alma, Mich., to be known as the Michigan Telephone Construction Company. Its business will be the construction of telephone plants, and operations will not be confined to Michigan, as already a contract has been secured to build an 800-telephone plant in Springfield, Mo. The capital of the company is $75,000, fully subscribed. The directors are W. A. Bahlke and G. S. Ward of Alma, Frank R. Messinger of Stanton and Hamlin J. Ward of Big Rapids. W. A. Bahlke is president, G. S. Ward, secretary and treasurer. It is stated that J. B. Ware of Detroit will assume the management of construction and that he expects to leave in a short time for Springfield, where he will remain until the plant is completed, about January 1st.

The Eureka Electric Company of Chicago has just increased its capital stock from $10,000 to $50,000, and papers to that effect have been issued by the secretary of state at Springfield. This speaks well for the progress of the Eureka company during the time that it has been in business, as it is one of the youngest institutions among the larger manufacturers in the telephone field. The apparatus put out by this company embraces everything in exchange appliances, from a small rural toll-board to large-sized exchange apparatus. The company is well situated in buildings at 143, 145, 147 and 149 South Clinton Street, and is just issuing a handsome catalogue, with colored illustrations of its telephone apparatus. This catalogue is, as far as is known, the first colored catalogue to be issued in the telephone manufacturing business.

Electrochemistry at the World's Fair, St. Louis.[1]

By W. E. Goldsborough.

At St. Louis there is in process of development an international exposition in which this society can but be deeply interested. It will be brought to completion and presented for the education of the people of our country and the world at large, just at the time when the electrochemical industries of America will be acquiring that strength which will make them a most important element in our national life. By the officers of the exposition I am commissioned not only to extend to you a hearty invitation to participate in their great undertaking, but to go farther, and assure you that in a most helpful spirit they extend to you assurances of their great desire to place the resources of the exposition at your command to the end of picturing in a way that will attract international attention the true worth and vigor of this infant industry.

In accordance with the provisions of the official classification of the exposition, the products of the electrochemical processes will be shown in several of the exhibit buildings. Manufactures, liberal arts, machinery, mines and metallurgy, as well as electricity, come in for a share in these products. And, indeed, it will be proper to exhibit certain electrolytic processes in the Palace of Liberal Arts, and certain others in the Palace of Mines and Metallurgy; but to electricity, in unrestricted measure, is accorded the privilege of giving expression to all electrochemical operations, whether purely electrolytic in character, whether brought about by electrothermic means simply, or whether attained by a combination of electrothermic and electrolytic methods.

In the Department of Electricity one of its five groups is entirely devoted to electrochemistry.

Class 434 of this group is devoted to primary batteries and storage batteries. In this class, in addition to an exhibit of the finished products, efficiency tests of batteries will be inaugurated and a careful record kept of their performance during the period of the exposition. In addition to these, processes in the manufacture of various types of storage batteries will, it is hoped, be arranged for, in order that this matter may be pictured in a broad way.

Class 435 embraces electrolytic appliances and processes. All forms of electroplating, methods of electrotyping, and, finally, and most important, the applications of electrolysis in the reduction of ores and other related work, find place here. That this class presents the possibility of a most interesting and instructive series of exhibits will be at once recognized. Electrolysis plays an ever greater and more important part in the business of the world each year. It has attained to a well-recognized position. Yet, with increasing emphasis, the work we see about us here at Niagara Falls demands for it an ever broader and more important recognition.

Class 436 deals with electrothermic appliances, and therefore includes all of the electric-furnace applications which we have found pictured in the great local factories on such a large scale. Nothing is more impressive than an inspection of the actual work of the electric furnace. We are, in fact, almost appalled in noting the wonderful results, both in magnitude and industrial importance, which are brought about by the dissipation of electric energy by these means, and its transformation into heat. The electric arc, when applied on a large scale, attracts and rivets the attention not only of the initiated, but the uninitiated as well. It presents the picture of power in a most fascinating way.

Class 437 deals with the application of electricity to industrial chemistry—bleaching powder, disinfection of sewerage water, manufacture of soda, chlorine, chlorate of potash, etc. Much can be done to make the exhibits in this class of great value and interest, not only to students, but to engineers and chemists. Some of the most interesting electrochemical operations find expression in the field of industrial chemistry, and a strenuous effort will be made to show all of its important divisions.

In my judgment a large and fine exhibit in this group will have a most beneficial effect upon the development along electrochemical lines. If to-day the financiers and people of the country generally had great confidence in the ability of electrochemists to carry to a successful issue all that is rightly claimed for electrochemistry and if "electrochemistry" had become as much of a household word among our people as have the technical terms employed in the older and better known branches of industry, it is safe to say that the money which will be investing in and about Niagara Falls within the next few years would, from the very force of the confidence of the general public, be augmented many fold. We at the exposition are not therefore attempting anything that is illogical or unreasonable when we plan to show all of the electrochemical processes I have mentioned in actual operation, and to show as many of them as may be possible on a commercial scale.

In the Electricity Building, as you doubtless know,

1. Abstract of a paper presented before the Niagara Falls convention of the American Electrochemical Society, September 17, 1902. Prof. Goldsborough is chief of the Department of Electricity at the St. Louis Exposition.

space will be free to exhibitors, and provision has been made to supply exhibitors with free power within reason. The installation facilities are also all that can be asked, inasmuch as the railroad lines will be extended right into the Electricity Building during the period of installation, and traveling cranes and movable hoists will be provided over all of the principal aisles in the building.

At the present time the success of the exhibits in the Electricity Department can be said to be assured, inasmuch as a large number of most interesting working exhibits have already been arranged for in the allied branches. A maximum load of 2,000 horsepower will be available for the development of the working exhibits, and without doubt the building will teem with light and activity.

Within the next two years we will have time to give the topic which has been the subject of my talk the careful attention and thought which it needs as well as the strenuous effort and labor which its development deserves. From the interest you have been good enough to manifest in what I have said I feel assured of your helpful co-operation and advice in this very important department of my work, and I hope I have not led you to expect anything that will not be fully realized.

In closing I wish to say that the chief of the Department of Mines and Metallurgy has extended to you, through me, the most cordial assurances of the interest which he takes in this work. It is his desire that in all its details the applications of electricity to metallurgy shall be given the fullest expression.

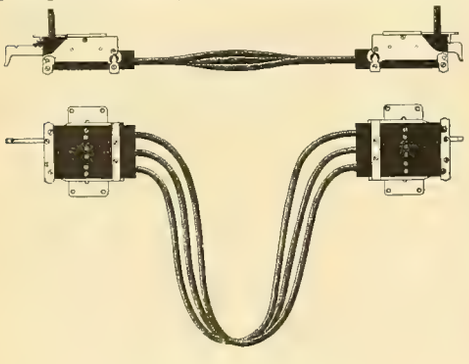
At the conclusion of the address made by Professor Goldsborough Carl Hering of Philadelphia moved, and Professor H. S. Carhart of Ann Arbor, Michigan, seconded, a resolution which was adopted unanimously, and of which this is the substance:

"Resolved, That the American Electrochemical Society hears with great satisfaction the announcement that steps are being taken looking to the organization of a fine and comprehensive exhibit in the groups of electrochemistry, and offers assurances of hearty good will and co-operation in the accomplishment of this much-to-be-desired end."

At the meeting of the convention on Thursday morning, in addition to other business transacted, it was decided to hold the 1904 convention in the city of St. Louis at the exposition. This action was taken in view of an invitation extended to the society through the Business Men's League of the city of St. Louis, which was presented by Professor Goldsborough.

Electric Train Connector.

Among the patents issued last month was one (No. 706,226) for an electric train connector invented by Charles E. Felt and D. A. Kimbark of Chicago. This device is illustrated by the accompanying cut. It is used for making connections between cars for electric-lighting systems, and can be used where any flexible and detachable electric connection is wanted. It is made on the knife-switch principle of contact, to insure a self-cleaning and



ELECTRIC TRAIN CONNECTOR.

perfect contact. One object of the invention is to cause the members to automatically separate, should the connectors be forgotten, when the cars are uncoupled. Another object of the invention is to provide the connector with a "jumper" of the knife-switch design, to connect two of the poles together. This connector has been adopted for use on the Overland Limited trains on the Chicago and Northwestern railway, and also on the Union Pacific railway and the Southern Pacific. It is supplied by the Electric Specialty Company of Chicago.

The Grand Rapids, Grand Haven and Muskegon (Mich.) Railway Company has decided upon a number of improvements and enlargements of its system. The survey will be made at once for a four-mile extension to run from Mona Lake to Lake Harbor, thereby furnishing an outlet to Lake Michigan. This branch road is to be ready for operation next spring. The company's pavilion at Fruitport will also be greatly enlarged and fitted up for use in the winter season.

A Survey of Electrical Patents Granted by the United States.

By Story B. Ladd.

Part III.

Electricity in Agriculture.

Electricity is beginning to be employed in the art of tillage, as shown in the patent to Roberts, 509,556, November 28, 1893. This is analogous to steam plows in its heavy multishared construction, designed for plowing large tracts of level ground.

Electrochemistry.

The commercial use of electrolysis to effect or modify chemical changes may be said to have been entirely developed within the last 25 years. Electrochemical methods are now employed for the production of a large number of elements, such as the alkali and alkaline earth metals, copper, zinc, aluminum, chromium, manganese, the halogens, phosphorus, hydrogen, oxygen, and ozone; various chemicals, including the mineral acids, hydrates, chlorates, hypochlorites, chromates, permanganates, disinfectants, alkaloids, coal-tar dyes, and various carbon compounds; white lead and other pigments; varnish; in bleaching, dyeing, and tanning; in extracting grease from wool; in purifying water, sewage, sugar solutions, and alcoholic beverages. The present low price of aluminum, reduced from $12 per pound in 1878 to 35 cents at the present time, is due to its production by electrical methods. Among the earliest successful processes is that of Cowles brothers, described in patents to Cowles and Cowles, 319,785, June 9, 1885, and 324,658, August 18, 1885, in which a mixture of alumina, carbon, and copper is heated to incandescence by the passage of a current, the reduced aluminum alloying with the copper. This has now been superseded by the Hall process, patent 400,766, April 2, 1889, in which alumina dissolved in fused cryolite is electrolytically decomposed. Practically all the copper now produced, except that from Lake Superior, is refined electrolytically by substantially the method of Farmer's patent 322,170, July 14, 1885. All metallic sodium and potassium is now obtained by electrolysis of fused hydroxides or chlorides, as set forth in patents 452,030, May 12, 1891, Castner, and 541,465, June 25, 1895, Vautin. The production of caustic soda, sodium carbonate, and chlorine by the electrolysis of brine is carried on upon a large scale and will probably supersede all other methods. Nolf's process, patent 271,906, February 6, 1883, and Castner's, 528,322, October 30, 1894, employ a receiving body or cathode of mercury, alternately brought in contact with the brine undergoing decomposition and with water to oxidize the contained sodium. Cranev, patent 520,257, May 22, 1894, employs an iron-wire gauze cathode, in contact with water, but separated from the brine by a sheet of asbestos.

Patent 579,317, March 23, 1897, Constam et al., discloses a process of making percarbonates, for bleaching purposes, and which decompose water at ordinary temperatures with an evolution of oxygen and carbonic acid.

Patent 649,565, May 15, 1900, Acker, relates to a process of manufacturing alkali and a halogen gas which has gone into extensive public use in the production of caustic soda.

Chlorates are also manufactured by the thousand tons by the electrolysis of chlorides. Gall & De Montlaur, patent 492,003, February 21, 1893, separate the electrodes by a diaphragm, subsequently conveying the contents of the negative compartment into the positive. Gibbs and Franchot, 493,023, March 7, 1893, remove the hydrogen cation by copper oxide. See also Gibbs, 665,426, January 8, 1901.

Carborundum, or silicide of carbon, is largely superseding emery and diamond dust as an abradant. It is produced by Acheson, patent 492,767, February 28, 1893, by passing a current of electricity through a mixture of silica and carbon. Calcium carbide, heretofore a rare compound, can now be cheaply produced by the action of an electric arc on a mixture of lime and carbon, as described by Willson, patent 541,138, June 18, 1895. It is used in the manufacture of acetylene gas.

Patent 597,880, January 25, 1898, Horry, shows a continuously operating furnace for making calcium carbide.

The question of electroplating iron vessels with copper instead of sheathing them by thin plates is attracting attention. Suitable methods and apparatus are described by Crane, patent 498,707, May 30, 1893. Metallic tubes, especially of copper, are produced by Elmore's method, patent 442,428, December 9, 1890, in which the copper is condensed by a burnisher while it is undergoing electro-deposition on a rotating mandrel.

Hermite, in patent 294,619, March 4, 1884, produces a hypochlorite suitable for bleaching or disinfecting by the electrolytical decomposition of sodium chloride; Frölich, in patent 487,390, December 6, 1892, uses an ozone apparatus consisting of a dielectric plate, independent electrodes on one face, and a metallic plate on the opposite side of and some distance from the dielectric; Worms and Balé, in patent 361,249, April 12, 1887, describe a process in which they place green hides and tanning liquor in a drum and simultaneously rotate and pass electricity through the drum.

Batteries.

There are 847 patents granted for various forms of secondary batteries. Storage batteries or accumulators, as now practically employed, date from the patents of Faure, 252,002, January 3, 1882, and Brush 266,090, October 17, 1882, and 276,155, April 24, 1883, a paste of active material, lead oxide, being applied to the lead electrodes, which are used in a dilute solution of sulphuric acid.

Among primary batteries, that of Lalande and Chaperon, patent 274,110, March 20, 1883, which employs copper oxide as a depolarizer and an alkaline solution, is noteworthy. There are 978 patents for primary batteries.

Railroad-train Signaling.

A train-order signal device for a locomotive sounds an alarm as the locomotive approaches a stopping point, and follows it up with an application of the air brakes if the engineer does not answer the call. See patents 617,232, De Wallace, January 3, 1899, and 623,503, De Wallace, April 18, 1899. Patent 385,066, June 26, 1888, Parsons, exhibits a means for insuring the passage of wheels with worn or false flanges. Improved signals and devices for interlocking them with associated switches are disclosed in patents 230,418, July 27, 1880, Jackson; 322,283, July 14, 1885, Hambay; 408,616, August 6, 1889, Hambay; 416,162, December 3, 1889, Hambay; and 429,193, June 3, 1890, Hambay.

Switch and signal mechanism adapted to be operated through a cycle of movements and having a minor system of return signaling from each switch or signal to the operating station indicates the set positions of the same and insures their operation in proper order: Dodgson, 647,482 and 647,483, April 17, 1900. Means for assembling the operating levers of a complex plant of switches and signals in a single cabin and interlocking them are shown in patents 226,499. April 13, 1880, Cummings; 230,200, July 20, 1880, Saxby; 240,054, April 12, 1881, Tilden; 273,681, March 6, 1883, Harper; 317,137, May 5, 1885, Johnson; 342,907, June 1, 1886, Hambay: 406,213, July 2, 1889, Hambay; 472,393, April 5, 1892, Pfeil; and 503,530, August 15, 1893, Dutton.

Clutches and Gears.

In the class of clutches 1,314 patents have been issued. Although throughout the class of clutches there have been important improvements, yet the only radical advance in the art is manifested in the magnetic and fluid forms. Prior to 1880 there was no magnetic clutch. In 1881 a British patent, No. 200, was granted to one Imray, which shows the first attempt in this line. This was followed by the United States patent to Veeder, 439,213, October 28, 1890, and that to McLaughlin, 432,209, July 15, 1890, wherein are disclosed magnetic or electric clutches acting to produce a positive binding frictional contact. Willans, in his patent, 473,042, April 19, 1872, went a step further by producing a clutch which performs all the functions of a clutch, but without the usual frictional contact. Hence, in the latter form there is absolutely no wear of the clutch parts, since there is no contact. There have been 19 patents issued for magnetic clutches.

Electric Brakes.

In this sub-class 222 patents have been granted. Electric brakes for electric street railways in which the electric motor is by a movement of the controller instantly transformed into a generator, which may of itself act as a brake, or the generated current may be utilized to apply a brake, are shown in patents to Potter, 546,247, September 10, 1895, and to Case, 548,952, October 29, 1895.

In that type of electric railway brake in which the motor is made to act as a generator and the current therefrom actuates a braking device, a storage battery has been supplied which is automatically thrown into the breaking circuit when the motor has slowed up so that the generated current is comparatively small. See patents 571,409, Sperry, November 17, 1896, and 574,120, Sperry, December 29, 1896. Rail brakes applied to trucks which also carry wheel brakes exert a lifting tendency on the truck, and lessen the tractive effect of the wheel on the rail, so that the wheel brakes must be applied more lightly. By the use of an electromagnetic brake shoe, a pull from the truck to the rail is possible. See patent 616,956, Newell, January 3, 1899; reissue 11,786.

An interlocking of motor-reversing and brake-controlling switches is shown in patent 560,751, Potter, May 26, 1896, so that improper movements of the switches cannot be made.

An electric brake for automobiles, in which the driven wheels and also the steering wheels are each provided with brakes, is embraced in patent 645,903, Sperry, March 20, 1900.

Motor Vehicles.

In this sub-class 513 patents have been issued. A line of invention in which much interest has been taken by the general public of late is the class of motor vehicles or automobile wagons. This is not strictly a new art, but rather the revival and carrying forward of old ideas, and the adaptation of modern devices, such as electric motors and gasoline engines, to vehicles for the purpose of self-propulsion. The late improvements in electric motor vehicles are as follows: Morris & Salom, March 30, 1897, 579,890; Maxim, November 30, 1897, 594,805; Woods, June 29, 1897, 585,371; Knudsen, November 1, 1898, 613,420; Hunter, July 18, 1899, 629,079;

Riker, November 13, 1900, 661,553; and Sperry, February 13, 1900, 643,258.

In electric automobiles several patents have been granted for the direct combination of the propelling motors with the wheels, as in Newman and Ledwinka, 638,643, December 5, 1899, and Whittlesey, 643,854, February 20, 1900.

On account of the short range of electric automobiles, it has been proposed to employ upon the vehicle an explosion engine and a generator of electricity which may be used to charge a storage battery. The generator may be reversible and used as a motor to drive the vehicle. Monson, 654,478, July 24, 1900, and 653,199, July 3, 1900, show this feature.

Separate motors for the driving wheels, for ease in turning, are found in Morris & Salom, 578,651, March 9, 1897. From this the use of the motors for steering followed quite naturally, and this is found in Krieger, 607,997, July 26, 1898, reissued 11,780, October 31, 1899.

Multi-color Printing.

There has been much activity in the art of multi-color printing. A single inventor, Mr. Edward Hett, took out, during the years 1899 and 1900, 76 patents for machines and methods especially intended for multi-color work. The salient feature of Hett's invention is an electrolytically deposited printing surface of zinc which can be developed and used like an ordinary lithographic stone. The coating of zinc is deposited upon a permanent base, and after having been used can be removed by mechanical or chemical agencies without disturbing the base. The following patents to Hett are referred to: 637,560, 637,561, 637,568, 637,596, November 21, 1899; and 662,854, November 27, 1900.

Other important inventions in this art are found in the patents of Spalckhaver, 627,447, June 20, 1899, and 664,592, December 25, 1900, which show multiple printing couples for printing on a plurality of webs.

Electric Typewriters.

Many improvements have been made in recent years in electrical typewriters, examples of which are: Davis, 560,572 and 560,573, May 19, 1896; and Cahill, 566,442, August 25, 1896, and 604,001, May 10, 1898. In this class of machines the impression mechanism is operated by magnets, the circuit being closed by the operator touching the key. The Cahill patents also disclose a permutation system of type-selecting means, which involves fewer keys than the ordinary keyboards of typewriters, the combination of two or more keys being required to operate a single type bar.

Horology.

The main trend of invention in this art is the improvement of electric clocks and time-operated valves and dampers. The electrically operated clocks are not only kept wound as long as the battery lasts, but are once a day automatically set to proper time by a connection through the telegraph lines with the Observatory at Washington. Patents to Gardner, 287,015, October 23, 1883; Gregory, 550,090, February 25, 1896; and Fischer, 595,911, December 21, 1897, fairly illustrate this art. The time-operated mechanisms are intended to turn on and off gas in cities at the proper time, automatically operate stock-feeding devices, turn on and off stove or furnace dampers and electric-light switches, etc. The patents to Schmidt et al., 611,822, October 4, 1898; Gunning, 631,522, August 22, 1899; and Kellogg, 591,169, October 5, 1897, fairly illustrate the recent advance in this art.

Engraving Machines.

In the fine arts a machine and method have been produced which reproduce a picture telegraphically at any distance. A picture in relief is first made by the swelled gelatin or other process; a tracing point is then moved in parallel lines across the undulating surface of the picture, and movements of the tracer are imparted by suitable electrical apparatus to a cutter or engraving tool. Amstutz, 448,404, March 17, 1891, has the first patent in this art.

The method of engraving described by Amstutz in patent 569,595, October 13, 1896, enables an operator to produce in a few minutes from a swelled gelatin photograph a plate ready for the printing press.

Optics.

An invention by Fiske determines the position and distance of distant objects and is described in patent 418,510, December 31, 1889. The purpose of the Fiske invention is to provide a method by which the individual in charge of a gun may direct it upon a given target when the distance of said target is not known to him, and even when he is unable to see the target from the point where he is stationed by reason of fog, smoke, breastworks, or other causes. He accomplishes this object by stationing observers at points distant from the gun itself, which points are at the extremities of a known base line and command a view of the area within range of the gun. The observers discover the position and range of the object by triangulation, and set certain pointers. By means of electrical connections between these pointers and pointers at the gun station, based on the system of the Wheatstone bridge, the latter pointers, or the guns themselves serving as pointers, may be placed in a position to indicate the line of fire.

Electric Buoys.

Some automatically lighted buoys find an important place in the merchant marine and naval services. Some of these carry an electric battery and incandescent lamps, the contact points of the electric circuit being held apart by a soluble non-conductor, which dissolves when the buoy is cast upon the water, allowing the circuit to be completed and the lamps to glow. Instances of such devices are shown in patents to Hichborn, 388,971, September 4, 1888, and Guest and Bates, 512,957, January 16, 1894.

Torpedo Boats.

Electrical devices are extensively used in this type of boat, some of which involve batteries within the boat, and some batteries on shore, which, by means of wires extending therefrom to various electrical devices in the boat, have the function of raising and lowering the same, giving it the proper lateral direction, and, at the opportune moment, firing the torpedo.

Safe Protection.

A leading invention is the construction of safes and vaults to prevent the use of the electric arc in melting or fusing a hole through the safe wall or door. The hardness of the metal is, of course, no hindrance to such an attack. Patents to Shankland, January 18, 1898, 597,694, and December 6, 1898, 615,503, and Holmes, February 21, 1899, 620,073, illustrate types of such safes. Dogging devices for controlling the bolt work of safes have also been patented. Said devices are held normally inoperative by a thermostatic controlling device which upon a rise of temperature of the door will release said dogging devices and permit the same to move into engagement with the bolts. See patents to Curtis, December 28, 1897, 596,294, and Damon, January 15, 1901, 666,185.

Electric Locks.

One form of lock adapted for hotels is shown by patent to H. G. Carleton, August 21, 1900, 656,341. A series of these locks, preferably electrically connected, is employed, one on each room door. Each lock is adapted to be independently operated, and the entire series may also be simultaneously operated from a central point and at the same time an alarm or signal is given in each room, thereby notifying the occupant thereof in case of fire. The same inventor discloses in patent 608,319, August 21, 1898, a form of electric combination lock in which the bolt thereof has no exterior means for moving it, and is secured by a keeper which is adapted to be electrically withdrawn. Within the lock case proper is a combination mechanism for completing the circuit for operating the keeper, and exterior means are employed for operating the combination. An alarm will be given when the combination means is tampered with.

[The end.]

Haberkorn Double-piston-valve Engine.

Since steam has been used for power there has been very little change made from the first generic principles until the Corliss engine was evolved, which created better steam distribution by using the full expansive force and reducing the compression to a minimum. After years of study and experiment the Haberkorn-Haley Manufacturing Company of Fort Wayne, Ind., says it is able to accomplish the same result with its Haberkorn automatic engine and give the same economy in fuel and water consumption and steadiness of speed and also as close regulation, which is very necessary in running electric generators and machinery that has varying loads. The engine, which is illustrated in Fig. 1, is built to run the most exacting class of machinery under varying loads of power and steam and give the greatest power for the least amount of fuel under all conditions. To accomplish this the builder uses two valves (piston type) placed under the cylinder, as shown in detail in Fig. 2, and actuated independently and run in opposite directions. The main-valve eccentric is keyed to the main shaft; the cut-off-valve eccentric is attached to the governor; both are connected to the valves by eccentric rods joined to rocker arms at the top. The valves have the same travel at any stroke. The cut-off valve supplies steam to the main valve, and the main valve admits steam to and exhaust from the cylinder. The governor used is the well-known type of shaft governor with an improvement—a pendulous weight which controls the regulation and closes the cut-off—and works in unison with the governor proper.

The designer of this engine has at all times had in view the detail in design, weight, durability, workmanship, simplicity, perfect adjustments, wearing surfaces, economy of space and regularity of speed, and the simplicity, efficiency and economy of the Haberkorn engine are said to have met fully the expectations desired. The Haberkorn-Haley Manufacturing Company builds three types of engines and uses the same type of valve and governor on all. These types are single-cylinder, belt-connected, single-cylinder with base direct-connected and twin-cylinder belt-connected, from 40 to 700 horsepower. The engines can be adapted to any speed to suit conditions and the purchaser.

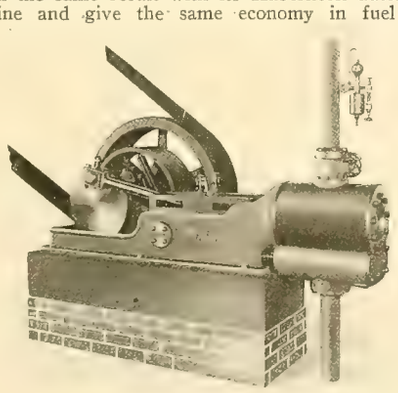


Fig. 1.

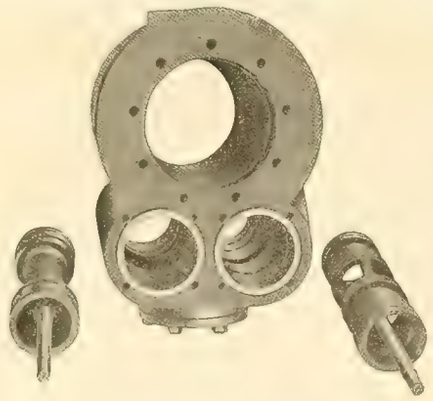


Fig. 2. Detail of Valves and Cylinder.

HABERKORN DOUBLE-PISTON-VALVE ENGINE.

Western Union to Make Extensions in the South.

It is likely that the Western Union Telegraph Company will make several extensions of its lines throughout the South. A party made up of officials of the company is making a tour of the southern states and familiarizing itself with existing conditions and needs. It is made up of Belvidere Brooks, general superintendent of the eastern and southern divisions, New York; J. C. Barclay, chief electrical engineer, New York; C. H. Bristol, general superintendent of construction, New York; S. R. Crowder, electrical engineer for the southern division, Richmond, Va.; G. M. Dugan, superintendent of telegraph of the Illinois Central railroad system, Chicago; C. D. Sherman, general foreman of the New York service; J. M. Stephens, district superintendent at Atlanta, Ga., and others. It is asserted that within the next year no less than 7,000 miles of wire will be strung throughout the southern states.

COMMUNICATIONS.

Electric-light Apparatus Wanted.

To the Editor of the Western Electrician:

I will shortly be in the market for machinery and general construction supplies for the erection and maintenance of an electric-light plant at this place. We will use about 1,000 incandescent lights and about 50 arc lights; that is, we want a machine of this capacity.

We will also need the necessary boilers and engines, and, in fact, all equipment necessary for the proper construction of an up-to-date electric-light plant. ROBERT J. BOONE.

Marianna, Fla., September 16, 1902.

A Question of Location.

To the Editor of the Western Electrician:

To remove any erroneous impression that may have been created, will you kindly note in your paper that my offices are still where they have been for so many years, namely, at 1450 Monadnock Block, where I am engaged in the practice of law and patent law. GEORGE L. CRAGG.

Chicago, September 20, 1902.

[Supplementing this communication, it is fair to state that both Mr. Charles A. Brown and Mr. Cragg are still at 1450 Monadnock Building, awaiting the outcome of the receivership proceedings which have been instituted to determine, among other things, the ownership of certain stock certificates, which Mr. Brown asserts belong to him individually and which Mr. Cragg contends belonged to the firm of Charles A. Brown & Cragg, recently dissolved.—Ed.]

Economical Turn-down Lamp.

A "turn-down" incandescent lamp is placed on the market by the Economical Electric Lamp Company of 123 Liberty Street, New York city. It is devised for use wherever a little light is wanted for a part of the time, the full light being obtained quickly when desired. One type of this combination lamp is shown in Fig. 1. The lamp is screwed into the socket like the ordinary lamp, no change of socket being necessary, as the base is standard. When the current is on the light can be changed without touching the bulb. The small light is obtained by pulling the string with tag marked "Dim." For the large light the string marked "Bright" is pulled.

A feature of this lamp is that it can be used in any style of fixture, in no matter what position the fixture may be, whether upright, downward or from the side, either with open or enclosed shade, as the switch is so arranged that the string can be pulled from any angle, and the strings can be easily reached. The lamp must be screwed tightly into the socket for either light. This obviates the danger of its working loose from the socket by the effect of vibration.

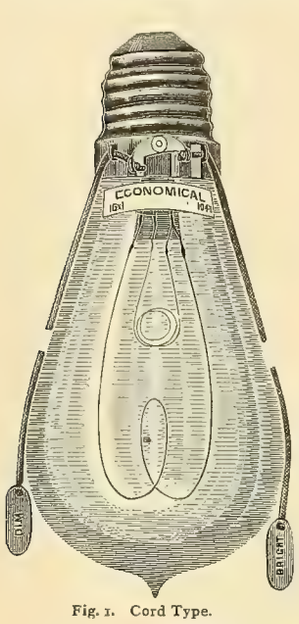


Fig. 1. Cord Type.

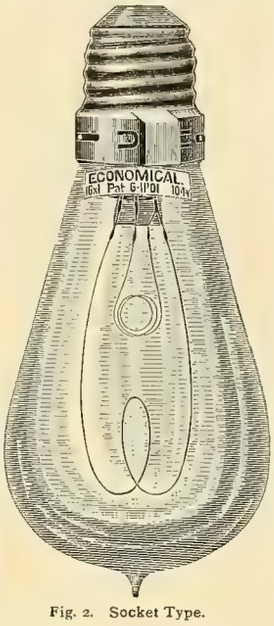


Fig. 2. Socket Type.

ECONOMICAL TURN-DOWN LAMP.

Fig. 2 shows a lamp which serves the same purpose, the variation in light being produced by simply taking hold of the bulb with the fingers and turning it one way or the other. When the base is screwed home into the socket it remains firmly in place, without danger of its being loosened by vibration.

Considerable economy in consumption of current and long life is effected by the use of the lamp. There is said to be an actual saving of 80 per cent. when burning the small filament, while the large one uses the same as the ordinary lamp, and the life is about five times that of an ordinary lamp. The lamps are made with great care, and every lamp is tested as to wattage, candlepower and voltage. They can be delivered in eight and one-half candlepower, eight and one candlepower, 16 and one candlepower, 16 and two candlepower, in all voltages from 50 to 250.

Hawiian Cable Shipped from London.

London advices are to the effect that the Hawaiian section of the American or Commercial Pacific Cable Company's line—2,413 miles in length—has been shipped for San Francisco on board the cable steamer Silvertown. The consignment is expected to reach San Francisco early in December. On reaching that city the vessel will immediately begin laying the cable to Honolulu. The total weight of the Hawaiian cable is about 10,000 tons, and it is from one to three inches in diameter, the protection varying with the depth of the sea and the character of the ocean bed. For shipment the cable was wound on three gigantic spools, each 30 feet in diameter.

Vice-president Ward of the Commercial Pacific Cable Company, who sailed from London on September 19th for New York, had the following to say concerning the cable laying: "The shipment of the cable gives the assurance that the United States may look forward to being in telegraphic communication with Honolulu by the end of this year. The manufacture of the remaining three sections to the Philippines is proceeding at the rate of 50 miles a day, and I am confident they will be finished by March and laid during next summer. Two cable steamers, the Colonia and the Anglia, will lay the line beyond Hawaii. I would like to see the entire project consummated by next Fourth of July."

That Municipal-ownership Challenge.

Readers of the Western Electrician will remember that the National Electric Light Association, at the initiative of H. L. Doherty and James B. Cahoon, ex-presidents of the association, and of other prominent members, officially proposed to the League of American Municipalities, some time ago, a joint investigation, by experts, of the merits of municipal versus private management of electric-lighting plants from the taxpayers' point of view. The association offered to pay half the expense of such an investigation. The league has been backward in accepting the challenge. At its convention in Grand Rapids, Mich., last month, the president, Mr. Ashley of New Bedford, in his presidential address, advocated in general the municipal ownership of public utilities, more particularly water and electric-light plants, and thus committed himself in favor of municipal ownership at the outset. This rendered it somewhat difficult to bring the proposition of the National Electric Light Association before the league, especially as the president was guided to a certain extent by the wishes of Mayor Smythe of Charleston, S. C., the vice-president, who was elected Mr. Ashley's successor as president of the league.

The question of municipal ownership did not come out very strongly at the meeting, although several advocated it, especially the Hon. Ignatius Sullivan, the "labor" mayor of Hartford, Conn., who was perhaps the most rabid municipal-ownership man present at the meeting.

James B. Cahoon, now the secretary of the National Electric Light Association, secured the floor at the end of the morning session on Friday, and, almost following Mr. Sullivan, renewed the proposition to the league in behalf of the association, that it would stand one-half of the expense of a competent engineer and public accountant to the extent of $5,000 for their services; such engineer and accountant or engineers and accountants, to be agreed upon by the presidents of the two associations; they to examine and report on the costs of any municipally operated plants that the president of the league might select, and compare the costs of the same with the published costs of a private plant of similar size and operated as nearly as may be under similar conditions as regards cost of coal, etc., so that the comparisons would be made on the basis of cost per kilowatt-hour, delivered at the lamp.

At the conclusion of the address, in which he went into the subject somewhat more fully, of course, than narrated above, laying particular stress on the subject of uniform accounting, which he informed the league had been adopted by the National Electric Light Association, and which they were at perfect liberty to apply to their plants, Mayor Smythe of Charleston moved that the matter be referred to the executive committee. The president modified it by suggesting that the National Electric Light Association submit its proposition in writing to the executive committee through the secretary of the league, this committee to take the matter up btween now and the next convention and decide on whether it would accept or reject the proposition. The president explained that the reason he did this was because almost all of the members of the league there present were new to the workings of the league and to the proposition submitted and were entirely ignorant of what had gone on before at Syracuse and Charleston. He stated that this would give them a chance to study the subject over and act on it in an intelligent manner.

Mayor Smythe stated further that he had always understood that the league was against committing itself in favor of or against the question of municipal ownership. Lieutenant Cahoon explained to him that the object was not to agitate this question as to the advisability or non-advisability of municipal ownership, but rather to look at it from a straight business point of view, as to whether municipalities could operate plants cheaper than those in the National Electric Light Association could. If it was found that the cities could do so, then private plants must necessarily retire from business and seek investment for their capital in other directions. The association was only anxious to arrive at the true costs of operation of municipal and private plants, when the proper system of costs and a uniform system of accounting was applied to both propositions. It was stated further that the association believed it could operate this class of public utilities cheaper than municipalities possibly could, for the reason that the latter lacked the incentive to economy which was always present in the privately operated plant.

An attack on private plants by Mayor Jones of Toledo was looked for, but he contented himself with a general reference to the subject. The mayor of Waco, Texas, who had a paper on municipal ownership, was not present, and therefore the subject of municipal ownership, per se, did not come up for general discussion in such a way that the negative side could be discussed from the floor.

Rates Low But Not Available.

It is announced from Rome that Mr. Marconi has arranged a tariff with the Italian minister of posts and telegraphs for wireless telegrams between that country and England and America. The charge for such messages to England is said to be fixed at 12 centimes (about 2½ cents) a word, and to America at 60 centimes (about 12 cents) per word. It will thus be seen that the approximate charge for a message between England and America is 9½ cents a word, as against 2½ cents between Italy and England. This agrees with the arrangement Mr. Marconi was reported in February last to have made with the Dominion Government of Canada for the transmission of wireless messages between that country and England at 10 cents a word. "While we think," says the London Electrical Engineer, naively, in commenting on this statement, "Mr. Marconi at this stage of his experiments is somewhat premature in fixing his tariffs for the exchange of commercial messages between the countries named, there can be no doubt that they are remarkably low, and if it were possible for the public to take advantage of them at the present time, the cable companies directly affected would be very hard hit."

Central-station Heating to Be Resumed in Evanston.

The trouble over the acceptance of an amended ordinance, offered by the City Council of Evanston, Ill., to the Evanston Yaryan Company, has been finally settled by the council making some concessions and by the company's agreeing to the ordinance. As soon as the plant can be put in readiness, probably within four or five days, the hot water will be turned into the mains, and the residents of Evanston, who are dependent for their heat on the company's service, will be supplied. In the new ordinance the heating rate is changed from one-third of a cent a cubic foot of contents to 20 cents a square foot of radiation, but the increase is limited to 50 per cent. over the former price. In return for this latter provision the company is not obliged to make extensions to its present plant or build an additional plant before January 1, 1906. The length of the franchise is 30 years from the time of the granting of the original franchise, or 28 years from last May. The company is also granted the privilege of increasing the cost of its lighting service 20 per cent.

Chicago Street-railway Arbitration.

The third member of the board of arbiters which is to settle the difficulties between the employes of the Chicago Union Traction Company and the company was chosen last week. The choice of the third member was left to the arbiters already chosen. William J. Onahan, president of the Home Savings Bank, and formerly city controller, was selected. The completed board now consists of Clarence Darrow, a lawyer representing the employes, Wallace Heckman, another lawyer, representing the company, and Mr. Onahan, the referee or umpire. The principal question that will be submitted to the arbiters is a request by the employes for an increase in wages for electric men from 21 to 28 cents an hour and for cable men from 23 to 30 cents an hour.

Trolley Strikers Enjoined.

Supreme Court Justice J. W. Houghton of Saratoga, N. Y., has, on complaint of President Colvin and other officers of the Hudson Valley Railway, issued a temporary injunction against the striking employes, restraining them from threatening or committing any acts of violence or intimidation against any person remaining in the employment of the company or those wishing to enter its employment, and from picketing the property, roadbed and premises in Saratoga, Washington, and Warren Counties. The defendants are requested to show cause why the injunction should not be made permanent. Protected by the National Guards, the railway company on September 20th managed at irregular intervals to operate trolley cars on the 100 miles of its trolley system, but the passenger traffic was exceedingly light, as riotous demonstrations were feared by the public.

The opening of the Mianus branch of the Greenwich (Conn.) electric railway in a few days will give a continuous trolley line between Boston and New York, with the exception of a 10-mile link between New Haven and Wallingford, Conn. This gap, it is said, will be closed in the near future.

CORRESPONDENCE.

New York Notes.

New York, September 20.—The revised franchise for the Pennsylvania railroad tunnel was approved on Wednesday by the conference committee representing the municipal boards, all the members of the committee voting in the affirmative, with the exception of President Cantor, who withheld his vote, saying that he might wish to hand in a minority report to the Board of Aldermen. At the meeting of the committee there was some discussion on the labor clauses, and Vice-president Green and other officials of the railroad company explained their reason for not agreeing to the clauses.

At a meeting of the Rapid Transit Commission Thursday several residents of the Borough of the Bronx spoke in favor of the east-side tunnel and the Jerome Avenue extension of the tunnel. Chief Engineer Parsons is now preparing plans for these extensions, and it seems likely that the projects will be carried through.

A new tunnel company, under the name of the Hudson and Manhattan Railroad Company, has been chartered in New Jersey, with a capital stock of $100,000. The corporation papers give the company the right to construct a tunnel from Jersey City under the Hudson River to the New York state boundary line, there to connect with "the railroad of any company now or hereafter organized under the laws of the state of New York." It is stated that the new tunnel will connect the Erie, Pennsylvania and Central railroad of New Jersey. There is some speculation as to where it will be built. It is believed from what could be learned of the matter in engineering circles that the proposed tunnell will run underground from the Erie railroad to the southern limit of old Jersey City at Essex Street, from which point it will be constructed under water to the Central railroad.

Circulars have been circulated among the motormen and conductors of the Metropolitan Street Railway Company and the Brooklyn Rapid Transit Company, calling upon them to organize a union for the purpose of obtaining better hours and higher pay. Many of the motormen and conductors threw away the circulars and declared they would have nothing to do with the proposed union. They said they were satisfied with their pay of $2.50 a day, but some dissatisfied men complained that they were working 12 instead of 10 hours a day. It was stated that it will be difficult to organize the men. An old conductor, in speaking of the attempt, said: "President Vreeland has treated us very decently. Some time ago he made arrangements to give the men a pension at the end of 20 years' service in the employ of the railroad. This plan will go into effect on January 1st next. It was entirely voluntary on his part, and shows that he has the interest of his men at heart. About two years ago, when we sent a committee to him to complain that we were doing 12 hours' work, he quickly remedied it by placing us on a 10-hour schedule. Of course, some of the men are compelled at times to work 12 hours, but it is only occasionally, and no one has a right to protest."

An unidentified man was killed by a northbound Madison Avenue car on Wednesday evening. In attempting to escape the motorman boarded a southbound Third Avenue car, and told the motorman to go ahead for all he was worth. The latter complied. A policeman saw the man attempting to get away. He jumped on a Madison Avenue car and told the motorman that there was a man on the Third Avenue car ahead he wanted to catch. The latter put the power on and the car was soon speeding after the other. The tracks of both lines run side by side. The policeman waited until the car he was on got beside the car on which the motorman was attempting to get away. Without waiting for the cars to stop, the policeman stepped from one to the other and arrested the motorman.

Chancellor Maccracken of the New York University, who returned this week from a trip to Europe, found on his desk a letter from the trustees of the estate of Samuel F. B. Morse, the inventor of the telegraph, announcing that Professor Morse, who died 30 years ago, had bequeathed $1,000 to the university for an annual medal for scholarship.

The contract for the extension of the rapid-transit subway to Brooklyn was signed at a meeting of the Rapid Transit Commission last week. By the terms of the contract $1,000,000 must be deposited with the controller at the time of signing to insure the construction of the tunnel, and $1,000,000 more must be deposited when the tunnel is completed to insure its operation.

The William Porter's Sons' Company has passed into the hands of a receiver, Edward G. Benedict. The firm was a dealer in marine lighting equipments.

O.

New England News.

Boston, Mass., September 19.—The Simplex Electric Company is building a new power house in Cambridge, Mass.

The Massachusetts Street Railway Association recently held its annual meeting at Young's Hotel. The following-named officers were elected: President, E. C. Foster; vice-presidents, E. P. Shaw and F. H. Dewey; treasurer, F. H. Smith; secretary, Charles S. Clark. A banquet followed, at which Karl A. Andrus of the Seattle Electric Company spoke on "The Idiosyncrasies of Salesmen," and George W. Palmer of Fall River, Mass., spoke on "Electric Signals."

On September 29th the Massachusetts railroad commissioners will give hearings on the last Legislature's resolves on the value, expense and added safety of equipping electric cars with power brakes; on the advisability of equipping electric cars with jackscrews or other implements to raise them, so that an injured person can be taken from beneath them, and on the value of electric-car fenders.

Many cases of eye trouble are still being treated at the City Hospital which are attributed to particles of steel from the third rail of the elevated railway.

By November 1st the Boston and Northern Railroad Company will have complied with the law compelling electric-railway companies to "vestibule" or enclose the platforms of all winter cars.

The Cheney Brothers have completed the electric power plant which is to run and light their silk mills at South Manchester, Conn. The installation has involved an expenditure of $200,000. The dynamos are run by waterpower two miles distant from the mills.

John W. Cawley, treasurer and manager of the People's Gas and Electric Company of Stoneham, Mass., has purchased the Nantucket (Mass.) Gas Light Company's plant and now owns the entire lighting system of the island, having purchased the Nantucket Electric Company's plant some time ago. Both plants have been unable to meet the demands upon them this summer, and Mr. Cawley proposes to build an electric plant of about 200 horsepower at a cost of about $50,000. Most of the lighting on the island will be done by electricity, the gas being used for cooking and heating.

The Grafton and Upton Railroad Company operates its passenger trains by electricity and its freight trains by steam and President E. P. Usher was before the railroad commissioners last Tuesday, to explain why the company did not have a flagman at road crossings during the passage of the electric trains, as was the case during the passage of steam trains. Mr. Usher said that the electric trains were stopped at crossings, but Chairman Jackson of the board read the statute, which said that companies operating a steam railroad were subject to the same obligations in operating electric cars that they were in operating steam cars, and informed President Usher that the company would have to petition for permission to dispense with flagmen for electric trains.

The State Democratic Convention on Wednesday selected Colonel William A. Gaston as its gubernatorial candidate. Colonel Gaston is chairman of the board of directors of the Boston Elevated Railway Company.

B.

Canadian Intelligence.

Ottawa, Ont., September 20.—Engineers are preparing estimates for lighting the farm buildings of Hon. Thomas Greenway of Crystal City, Man., with electricity. The plant is to have a sufficient capacity to furnish light for the whole village.

Mayor Howland of Toronto, Ont., has become convinced that the new Temiskamingue and Northern railway, the construction of which is about to be commenced, should be built as an electric line, and he has announced his intention of pressing the matter to attain this end. He states that the people of the district through which the railway will pass are extremely anxious to have it run by electric power.

The General Electric Company of Schenectady, N. Y., has over 200 hands at work in its new Ottawa branch, sorting and shipping mica. Within a year machinery will be installed at Ottawa for additional treatment of the mica, which work is now performed at the American headquarters. This work can be done to better advantage and at cheaper rates in Ottawa, hence the decision to transfer operations. The extension of the work in Ottawa, when the plans are fully realized, will call for the employment of over 2,000 hands. All the output of the Canadian mines controlled by the company will be treated at the Ottawa works.

The city treasurer of Toronto, Ont., for the second time since the operation of the electric street railways in that city, has just received from the Toronto Railway Company, as the city's share of the company's earnings for August last, a percentage of 12 per cent. This is due to the fact that the company's year ends with September, and the percentage jumps from 10 to 12 per cent., as soon as the $1,500,000 mark in the railway's earnings for the year are passed. The receipts for August last were $166,355, being $10,000 larger than the earnings of the same month last year, and the city's percentage for the month amounted to $19,962.

B. F. Pearson, R. E. Harris, C. E. Cahan, H. A. Lovett and G. F. Pearson have incorporated the Mexican Light and Power Company. The new company will have a capital stock of $12,000,000. All the incorporators are lawyers residing in Halifax, Nova Scotia. The new company proposes to carry on the business of an electric-light, heat and power company in all its branches, either in Canada or elsewhere. It may construct, purchase and operate electric railways, and has other extensive powers. Authority is given to procure the company to be registered and recognized in any foreign country, and to carry on any or all its operations in Canada or elsewhere.

W.

Southern Developments.

Charlotte, N. C., September 20.—The Memphis Street Railway Company of Memphis, Tenn., will expend $250,000 in building extensions to the growing suburbs of the city—at least the company stands ready to build any extension wherever the same will pay for the outlay.

It is said that plans by Pittsburg capitalists for building electric lines from Nashville, Tenn., to Mt. Pleasant and to Gallatin, Tenn., have been perfected. C. W. Ruth is vice-president of the company which it is said may effect a merger with the Nashville and Columbia electric line.

The Dan River Manufacturing Company of Danville, Va., has definitely selected a site for the large mills to be erected and has let the contract for the dam and power house. It is estimated that the dam and power house will cost $300,000, and that it will require a year to complete the work involved.

The Passenger and Power Company of Richmond, Va., is preparing to expend $50,000 in giving a better light service to the city. This company was recently awarded a contract for five years to furnish the city with light at $35,000 per year.

The Electrical Construction Company of Richmond has the contract for building the new electric plant at Warrenton, Va. The plant will be completed by October 15th.

The council of Memphis, Tenn., has passed an ordinance granting the right to the Equitable Gas Light Company and the Memphis Light and Power Company to merge their interests.

The Bureau of Yards and Docks at Washington, D. C., has authorized the construction of an electric-light plant at the down-stream end of the shore connections on the naval reservation at New Orleans.

The Louisville (Ky.) Street Railway Directory has raised the dividend on the $3,500,000 common stock to a 5 per cent. basis, and has thus provided for a very large distribution of dividends on October 1st.

The Richmond Engineering Company of Richmond, Va., has been chartered to do a general engineering business—electrical, civil, etc. Jas. O. Spear is president. The capital stock is $25,000.

L.

From the Buckeye State.

Cleveland, Ohio, September 20.—A telegram was received here to-day by Henry A. Everett from W. B. Strang in New York, saying that the Grand Trunk Railway Company had purchased the Detroit and Toledo Shore Line. No figures were stated, but as Mr. Strang had instructions not to accept less than $1,600,000 for the property, it is thought that this or a better figure was secured.

The Havana and Jainatos (Cuba) Railroad Company, which has been in process of formation for some time and in which Cleveland and Youngstown men are heavily interested, was organized in New York to-day. The capital stock of the company is $2,500,000, and W. J. Hayes of Cleveland, H. W. Whipple of New York, L. W. Pryor of Cleveland and others are directors. H. W. Whipple is president and W. J. Hayes vice-president.

The annual convention of the Ohio Electric Light Association will be held in Columbus October 14th, 15th and 16th. A. W. Field of that city is the president of the association, and will arrange to entertain the visitors, of whom there will probably be something like 300.

Negotiations are in progress for a settlement of the differences between the Cincinnati Traction Company and the Mandelbaum interests, and it is stated that an agreement has been reached on all the main points by which the Cincinnati, Dayton and Toledo Traction Company will be allowed an entrance into the heart of Cincinnati. It is also said that the proposed arrangement includes the purchase of a large block of stock in the Mandelbaum properties by the Philadelphia people who own the Cincinnati traction business, and that the Miami and Erie Canal Transportation Company is also to benefit in some way by it.

The Cleveland and Sharon Traction Company is capitalized at $1,500,000 and will issue $1,250,000 20-year five per cent. bonds. The line to be built is between Sharon and Middlefield, but through cars will be run to Cleveland over the Eastern Ohio lines. Three buffet cars, 50 feet long, will be provided for the through runs and a porter will be employed for each one. The Francis B. Morgan Engineering Company has secured the contract for building the road.

The Cincinnati, Hamilton and Indiana Traction Company, which J. C. Hooven is promoting, has been granted a 25-year franchise to operate a line from Hamilton to College Corner, on the state line.

It is stated that the Columbus, Delaware and Marion line will soon be completed to Delaware and that a regular service will be inaugurated. Because of the broad-gauge tracks on the Worthington, Clintonville and Columbus road, passengers will be compelled to change at Worthington, but when they are changed the cars will run into the city over the Central Market line.

O. M. C.

Information from Indiana.

Indianapolis, September 22.—The Indianapolis and Plainfield electric road—"Quaker route"—was opened for business on the 15th. The construction of this line is of a character to assure good and rapid service. There is not a curve in the line and the private right-of-way is 100 feet wide. The rails are unusu-

ally heavy and it is the purpose of the company to extend the line into the Indiana coal fields and freight coal to Indianapolis. The overhead construction is the double trolley-wire system. The fare to Plainfield, 19 miles, is 25 cents.

The Evansville-Princeton Traction Company increased its capital stock to $600,000 on the 16th inst., and track-laying is progressing rapidly. The line will be put in service in a short time.

Representatives from four or five counties held a conference in Seymour on the 17th inst., and effected an organization to construct an electric road from Columbus through Seymour, Brownstown, Salem, Paoli, West Baden to French Lick. W. P. Masters of Seymour was elected president. A survey was ordered, the franchises having been secured. While this meeting was in session word was received that a train of 23 cars, loaded with steel rails, had been received at Jeffersonville, and that the work of constructing a line between Jeffersonville and New Albany, to form the southern terminus of the Indianapolis, French Lick and Louisville line by way of the Indianapolis, Greenwood and Franklin line, would be pushed rapidly.

A large batch of contracts, aggregating nearly a million and a quarter dollars, for the construction and equipment of the Indianapolis, Lebanon, Frankfort and Lafayette electric road was awarded by Townsend, Reed & Co., which firm is constructing the line. The contracts were for 10,000 tons of 70-pound rails, placed with the Carnegie Steel Company; three 800-kilowatt generators and 24 motor equipments, with the General Electric Company; 24 interurban cars, with Jewett Car Company, Newark, O.; 1,000,000 pounds of copper wire, with John A. Roebling's Sons Company, Trenton, N. J.; three cross-compound engines, aggregating 4,500 horsepower, with Hamilton-Corliss Engine Company, Hamilton, O.; boilers (3,000 horsepower) with Stirling Company, Chicago.

New capital has been put into the Indianapolis, Greenwood and Shelbyville Traction Company. This company was incorporated a year ago, and prepared considerable grade between Greenwood and Shelbyville over a private right-of-way. There is plenty of money behind the enterprise now and the remaining 19 miles will be constructed rapidly. The company will use 12 miles of the Indianapolis, Greenwood and Franklin line and when completed will be a direct competitor with the Indianapolis, Shelbyville and Southeastern road recently opened to the public.

Last week over a hundred thousand people were brought to Indianapolis to attend the state fair. Of this number two-fifths are said to have been transported by the interurban lines. A perceptible falling off was noticeable in the steam-road traffic compared with previous state-fair weeks.

J. Thomas Roberts is asking for a 30-year franchise for the erection and operation of an electric-light, power and heating plant at Alexandria. His proposition is liberal, making the price of street lamps $75 a year and granting the city the privilege of buying the plant after 10 years, at a fair price.

Municipal operation of an electric-light plant on a low rate is about to swamp the managers of the Mishawaka municipal plant. The rates were fixed at 11 cents per thousand watts, with a 20 per cent. discount. After several years of close figuring the board of works appeals to the council to save the plant from further depreciation by raising the rates, so as to provide for new equipments to supplant old and worn-out machinery. The people oppose a direct tax for the purpose and insist that the concern ought to be made self-sustaining. F.

Northwestern Notations.

Minneapolis, September 20.—The Gas and Electric Company of Waterloo, Iowa, has installed a new 10-horsepower motor, to be used to furnish power for crushing coke for retailing through the city. The scarcity of hard coal has caused a demand for coke.

W. A. Seevers of Oskaloosa, Iowa, offers to furnish $100,000 toward an electric-light plant and water system for Albia, Iowa, if a similar amount is raised there. The proposition contemplates the construction of an electric car line from Albia to Hilton.

The Waterloo and Cedar Falls Rapid Transit Company has completed plans for improvements to be made at Waterloo, Iowa, to cost complete $250,000. There will be machine shops constructed, new rolling stock purchased, and the building of an extension of the line from Denver, Iowa, to connect with the Chicago Great Western railway.

A new ordinance to compel the removal of overhead electric wires in St. Paul is before the Common Council of that city. The present ordinance is ineffective, because there is no penalty attached for violation.

The new municipal electric-light plant for New Ulm, Minn., has been completed and put in operation. The plant uses Nernst lamps, in addition to the older models.

The city officials of Rochester, Minn., tendered a banquet to W. G. Rowen, the retiring superintendent of the city electric-light plant.

The Peninsula Electric Light and Power Company of Calumet, Mich., has awarded a contract to Pendergast & Clarkson of Chicago for the construction of a large addition to its plant, which will cost, complete, about $100,000.

The Winnipeg Electric Company is canvassing St. Boniface, Man., for lighting consumers, and proposes to string wires from Winnipeg. St. Boniface recently voted to construct a municipal electric system. R.

On the Pacific Slope.

San Francisco, September 17.—The Commercial Cable Company, which is preparing to lay a submarine cable between San Francisco, Hawaii and the Philippine Islands, has prepared specifications for its landing station in this city. The new station will be located on the beach near the Cliff House. It will be of thoroughly fireproof construction. The walls are of brick and cement and the roof of tile. The building will be 30 by 14 feet and will contain, besides a testing room, a living room for the operator.

Articles of incorporation of the Etiwanda Power Company have been filed at Los Angeles, Cal. The company is capitalized at $250,000. The incorporators are George Chaffey, N. W. Stowell, J. W. Swanwick, R. Harris and A. M. Chaffey, all of Los Angeles, Cal.

The Cloverdale Light and Power Company has received bids for the electrical apparatus for the new power plant to be installed near Cloverdale, Cal. It is expected that the contract will be awarded within the next few days. The contract includes a 150-kilowatt machine, transformers, switchboard, etc.

Specifications are now out for the electrical work on the Oakland (Cal.) postoffice building. The bids will be opened to-morrow. The work includes the wiring, conduit system and about 700 lights. The contract is expected to amount to about $3,500.

The specifications which were recently issued for the large new power plant of the Oakland Transit Company at Oakland, Cal., have been withdrawn for the present at least. It is understood that the Bay Counties Power Company has made a proposition to furnish the immediate power to the Oakland Transit Company.

John B. Miller, president of the Edison Electric Company of Los Angeles, Cal., in speaking of the serious shortage of electricity which now prevails in Southern California, says: "In order to meet the growing demand, the Edison Electric Company is rushing to completion its several new plants. The plant in Mill Creek Canyon, which will operate under a head of 1,935 feet, will be finished early in the coming winter. The power house is nearly completed, and the machinery, pipe line, etc., are now being installed as fast as they arrive from the East. This plant will add 4,000 horsepower to the available power supply of the company. We are now getting out plans, and will soon ask for bids for machinery to be installed in our new steam-driven plant at Los Angeles. This plant, which will be equipped with the latest and most approved type of apparatus, will have 3,000-horsepower capacity as the first installation. Ultimately the plant will be brought to a capaciy of 6,000 horsepower."

J. V. O'Brien was on August 30th appointed manager of the Western Union Telegraph offices in this city, to succeed the late Thomas H. Reynolds. Mr. O'Brien has been in the service of the company for 18 years. Previous to the death of Mr. Reynolds he acted as assistant manager. E. B. Harrington will act as Mr. O'Brien's assistant. A.

Seattle, Wash., September 16.—On Wednesday last the Seattle Electric Company opened for traffic the Seattle-Renton line. This new line follows the Seattle-Tacoma Interurban tracks as far as Renton Junction, a distance of 10½ miles. From there a branch line, 2½ miles, has been built to the town of Renton. An hourly service will be given all day. This completes the Seattle Electric Company's chain of suburban lines.

The Seattle Electric Company is building two new car barns, one 55 by 120 feet and the other 120 by 240 feet, and a paint shop, 65 by 120 feet, at the corner of Sixth Avenue and Olive Street. For the present the framework will be of wood, but the foundations will be built of sufficient strength to hold brick walls, with which the company expects to replace the wooden ones in the spring. The roofs will be permanent. The rush necessitating the subsequent change of walls is due to a shortage of space. Many of the cars recently received have been left on side tracks, and it is the desire of the officials of the company to get them under cover before the winter rains commence. When completed, the barns will accommodate about 60 cars and will cost the company about $50,000.

The street-railway system of Whatcom and Fairhaven, Wash., has been sold by the General Electric Company to Stone & Webster of Boston. The change will not affect the local management. The street-railway lines of Whatcom and Fairhaven were originally constructed by local men, who invested their entire fortunes in them, and, in addition, borrowed largely of eastern capitalists. During the panic of 1895 the lines were placed in the hands of a receiver and sold under foreclosure to the General Electric Company, the largest creditor.

The Seattle Electric Company has just issued a limited edition of a little pamphlet entitled "Seattle Street Railways." This book contains so many illustrations and so much condensed information that a stranger with one in his hand could visit every point of interest in Seattle without taking a wrong car or asking a single question.

The Seattle Board of Public Works has issued orders that all poles which have been standing more than six months shall be painted at once. All the companies have signified a willingness to comply with the order.

After numerous delays and discussions, a permit has at last been granted to the Seattle Electric Company to extend its system of underground ducts. In all about four miles of conduit and Edison tubing will be laid, and it is estimated that the undertaking will cost somewhere in the neighborhood of $300,000. The work will be in charge of Mark Lowd, an expert, who has been sent here by Stone & Webster of Boston. The excavations will be from four to nine feet deep, and the conduits will contain from six to 60 ducts. It is estimated it will take 6,000 feet of tubing and 200,000 feet of conduits to cover the proposed districts. The ducts will be multiple and square instead of round, as used in many eastern cities. Enough ducts are to be placed to carry the service wires for the next 40 years. L. E. C.

PERSONAL.

S. L. Sly has resigned as manager of the electric-light plant for the city of Shakopee, Minn., and will assume a similar position for the new plant being put in by the city of Jordan, Minn.

George Wolfolk, electrician with the Gas and Electric Light Company of Mankato, Minn., has accepted a similar position with the Gas, Electric and Heating Company of Owatonna, Minn.

Two changes in the faculty of the Armour Institute of Technology are announced. Professor George H. Olnhausen of the University of Berlin, Germany, has been appointed to the department of physics. Professor George S. Gebhardt has been promoted to the head of the department of mechanical engineering, to succeed Professor Charles P. Kerr.

ELECTRIC LIGHTING.

The North Shore Electric Company of Chicago has certified to an increase in capital stock to $500,000.

The Charleston (Ill.) Gas Company has changed its name to the Charleston Gas and Electric Company.

The Village Council of Trenton, Mich., wishes to secure estimates upon a village lighting plant capable of furnishing 60 arc lights and 1,000 incandescent lights for commercial purposes.

The Sparta Gas and Electric Company of Sparta, Ill., has been incorporated with a capital of $25,000. Light, heat and power developments are intended by the company. The incorporators are L. J. Sexton, L. W. Barker and A. M. Barker.

The Lighting Commission of Detroit, Mich., has decided to readvertise for bids for new engines and machinery. Bids were recently advertised for and opened, and it was found that there was a misunderstanding among the bidders, some giving figures on low-speed and some on high-speed engines. It is now decided to call for bids on both types.

Admiral Higginson, in his report to the secretary of the navy upon the combined army and navy maneuvers, comments interestingly upon some of the lessons to be learned from them. He says: "Much valuable knowledge in regard to searchlights has been obtained during these operations, and the general opinion seems to be that they are not so effective as has been supposed. In approaching positions at night the searchlights would flash very often upon the ships, lighting up smokestacks and hull so that large print could easily be read, and everyone supposed the ships had been discovered, but the searchlights would turn away, and evidently the observers had not seen the vessels."

Within a month the following-named new members have joined the National Electric Light Association: Albion (N. Y.) Steam Power Company, Attleboro (Mass.) Steam and Electric Company, Athens (Ga.) Electric Railway Company, Beverly (Mass.) Gas and Electric Company, Brookline (Mass.) Gas and Electric Company, Lackawanna Valley Electric Light and Power Supply Company of Carbondale, Pa., Cohasset (Mass.) Electric Company, Duluth (Minn.) General Electric Company, Doylestown (Pa.) Electric Company, Elwood (Ind.) Electric Light Company, Everett (Wash.) Railway and Electric Company, Lee (Mass.) Electric Company, Lynn (Mass.) Gas and Electric Company, Oneonta (N. Y.) Light and Power Company, Citizens' Light and Power Company of Oil City, Pa., Biscoe Electric Light Plant of Southern Pines, N. C., Telluride (Colo.) Electric Light and Power Company, Walla Walla (Wash.) Gas and Electric Company, Warren (Ohio) Electric Light and Power Company, Westboro (Mass.) Gas and Electric Company, Whitman (Mass.) Light and Power Company.

ELECTRIC RAILWAYS.

It is reported that a plan for the reorganization of the Lake Street Elevated Railroad Company of Chicago will be announced in the early fall. A reorganization has been contemplated for some time, but, until recently, the necessary data were not forthcoming.

The overhead and electrical equipment of the Detroit and Toledo Shore Line, the track and right-of-way of which were recently sold to the Grand Trunk railroad, has been purchased by the Toledo and Monroe railway, and will be used to complete the latter road from Monroe to Detroit, via Flat Rock.

The South Bend and Southern Michigan Electric Railway Company has absorbed the South Bend and Northern Electric Railway Company and has been incorporated with a capital stock of $750,000. The two companies both proposed to build a line of railway from South Bend, Ind., to St. Joseph, Mich., and the consolidation will result in the completion of but one of the lines.

An Elston Avenue trolley car in Chicago jumped the southbound track one night recently, ran across the northbound track, jumped over a gutter and the curbing, broke through a wooden fence and bumped into a house, which it shook from foundation to rafters. There were 50 passengers aboard, mostly women and children. All were thrown into a panic and several of them received injuries.

The New York Times of September 19th contains the following dispatch from Albany, N. Y.: "The Central Cross-town Railroad Company of Buffalo was to-day granted permission by the State Railroad Commission to issue a first consolidated mortgage for $3,000,000. The proceeds are to be applied to refunding former bond issues on the property and for equipping 14 miles of road for underground electric-trolley services."

Shigem Kondo, said to be a representative of the Japanese government, is in Pittsburg, Pa., inspecting the electrical street-railway systems. Before going to Pittsburg Mr. Kondo spent two weeks in New York city, studying the different traction systems in use there. Besides making investigations of the street-railway systems, he is also in a general way getting information concerning all electrical industries.

The Chicago, Milwaukee Avenue and Inland Lakes Tranction Company's franchise, mentioned in the last issue of the Western Electrician, is to go through interesting proceedings in the process of being granted. Peter Hoffman, county commissioner of Cook County, is to put the referendum idea to a test in ascertaining the views of the residents of the townships of Niles, Maine, Wheeling and Northfield, in regard to the proposed trolley road to be built by the company on Milwaukee Avenue from the northern limits of the city to the Cook County line. He asks property owners to write him their opinions as to what conditions should be exacted by the County Board in granting the franchise.

A street-railway and electric-light consolidation is being planned by Philadelphia capitalists, to combine the Philadelphia Rapid Transit, the Philadelphia Electric and the American Railways Companies and the Electric Company of America. The first step in this great combine will be taken when the Rapid Transit and Philadelphia Electric merge under a New Jersey charter, which will be granted to a yet unnamed securities company. The question of merging the Rapid Transit and the Philadelphia Electric, whose combined capital amounts to $55,000,000, was taken up immediately after the successful organization of the new traction system. One company controls the street-railway business, the other has equal privileges in electric lighting. The Widener-Elkins-Mack syndicate is in control.

The Syracuse Railroad Construction Company, which is building a 25-mile electric railroad between Auburn and Syracuse, N. Y., has recently closed a contract with the Westinghouse Electric and Manufacturing Company for two 650-kilowatt, engine-type alternators, delivering three-phase current at 360 volts and 3,000 alternations; also for five 400-kilowatt rotary converters, together with raising and lowering transformers for operating a 15,000-volt transmission line to two sub-stations. A complete switchboard is included, and, in fact, everything for the operation of a complete railway line. The generators are to be direct-connected to two 22 and 44 by 48-inch, cross-compound, horizontal Corliss engines, built by the Westinghouse Machine Company of Pittsburg, Pa. The engines are to receive steam at 150 pounds, are to run at 100 revolutions per minute, and are rated at 1,000 horsepower each, with a maximum rating of 1,800 horsepower.

PUBLICATIONS.

The Faries Manufacturing Company, Decatur, Ill., manufacturer of adjustable lamp holders, shades, portables, electric and combination fixtures, has issued a new catalogue, which contains a complete description of the company's products, with illustrations and prices. The Faries company has increased its line greatly, and the present catalogue is twice as large as any previously issued. The Faries company's business extends to every portion of the United States and many foreign countries, and its products enjoy a most creditable reputation.

TELEGRAPH.

George Gould, soon after having met Clarence H. Mackay recently, is reported as having the following to say in regard to the rumored Western Union-Postal Telegraph consolidation: "The merger is contemplated. It is true that Clarence Mackay is an intimate friend of mine, but the consolidation of telegraph interests in the United States is still far distant."

The organization of the International Union of the Commercial Telegraphers was completed in Chicago on September 21st. Forty-one delegates were present, representing as many cities. The following-named officers were elected: President, I. J. McDonald, Chicago; first vice-president, M. J. Reidy, Boston; second vice-president, J. M. Perkins, San Francisco; secretary-treasurer, A. G. Douglas, Milwaukee, Wis. The next convention will be held in Minneapolis on the third Saturday in September, 1903. The international officers were instructed to apply to the American Federation of Labor for a charter.

A dispatch from Castries, St. Lucia, dated September 22d, states that there was a severe eruption of La Soufriere on the Island of St. Vincent, on Sunday evening. It came without any warning. The cable-repair steamship Newington, which was working about five miles from shore was forced to steam away at full speed. She was followed by a dense mass of debris, and had a narrow escape. The repairing operations on the cable have been suspended indefinitely. The broken cable which was picked up shows signs of submarine volcanic disturbance or severe injuries caused by the debris from the Walliboo River.

SPACE TELEGRAPHY.

The French government has decided to install a wireless-telegraph system on the islands of Martinique and Guadeloupe, owing to the frequent interruption of the cable service there.

It is said that King Victor Emmanuel of Italy has ordered that the Italian armored cruiser Carlo Alberto, on board of which wireless experiments have been under way for some time, be placed at the further disposal of William Marconi for experiments between Europe and America.

Mr. Marconi has submitted plans to the Italian government officials for the erection of a wireless-telegraph station in Italy, to cost $140,000, for establishing connection between Italy and the British and American stations. The scheme will be submitted to Parliament. King Victor Emmanuel has bestowed the Cross of the Order of the Crown on Marconi.

Officers of the United States Signal Corps are said to be working out a new idea in wireless telegraphy in the shape of an apparatus which may be carried on a soldier's back and operated in connection with an aerial arrangement attached to a small, easily charged and manipulated balloon. The first advantage of the system is its extreme portability and convenience.

Report has it that a regular exchange of Marconi wireless messages is proceeding directly across Spain between the Italian warship Carlo Alberto, which is at Cadiz, Spain, and the wireless-telegraph station at Poldhu, Cornwall. It is anticipated that a commercial line between Italy and England will soon be in operation. The Italian station will be on Mount Gargano, which stands in the eastern part of Italy and is about 6,000 feet high.

The German war maneuvers were ended by a brilliant naval feature. The hostile fleet, under the command of the emperor, forced an entrance into the Elbe, the defending squadron being defeated. During the naval maneuvers space telegraphy was used more completely than at any other time since the beginning of the mimic warfare. According to report, it was seen, however, that the wireless system was not absolutely reliable under all conditions.

MISCELLANEOUS.

The Electrical Commission of Duluth, Minn., met recently to discuss the proposed placing of electric wires underground. Mayor Hugo is chairman of the commission, and City Engineer Pattan, secretary. Arrangements were made to look into the legal aspect of the situation, and to obtain all possible information from other cities.

Dr. O. Haab of Zurich, Switzerland, is the inventor of an improved electromagnet to be used in extricating steel and iron splinters from the eye. Dr. Haab's instrument is worthy of note. It is a large one and is operated by a foot switch which opens or closes the magnetizing circuit. The doctor says that of 165 cases operated on, in only 23 did the electromagnet fail. In these 23 cases the splinters were so situated that to remove them would have meant the destruction of the sight.

The United States cruiser Des Moines, which was launched on September 20th, has three-stage compound engines and water-tube boilers. Steam is used at a pressure of 275 pounds and the grate surface is 300 square feet. The vessel has a complete electrical equipment, including two electric winches for hoisting purposes, an engine-turning electric motor, 10 motors for ammunition hoists, incandescent and arc lights and lanterns, ventilating equipment and fans, signals, and so on, all operated by electricity.

California fruit growers are making use of an electric appliance which makes known the approach of frost by the ringing of a bell. The apparatus consists of a battery, a relay coil, a thermometer and an alarm bell, and it is so adjusted that when the mercury in the thermometer falls below a certain point the electric circuit is broken and the bell rings. As the instrument can be set for any temperature, it can be used in hot houses for various crops. It is set to a few degrees above the point of danger.

TRADE NEWS.

A. J. Wise, president of the Bunnell Telegraphic and Electrical Company, 110-120 Beekman Street, New York city, has just purchased the controlling interest in J. H. Bunnell & Co. (incorporated), 20 Park Place, New York city. It is also rumored that Mr. Wise is negotiating for the purchase of one of the largest electrical supply houses in New York city.

BUSINESS.

The R. Connor Company of Marshfield, Wis., has a special lot of poles of various dimensions which it is prepared to dispose of at advantageous terms, as it desires to move these poles, owing to the change of location of its cedar yards.

The Eureka Fire Hose Company of Jersey City, N. J., has decided to adopt an alternating-current system in order to lessen the fire hazard in the presence of inflammable material. The new apparatus includes one 75-kilowatt, belt-driven alternator, furnishing two-phase current at 7,200 alternations and 220 volts; also exciter, switchboard equipment, rheostats, induction motors, etc. The entire electrical equipment has been ordered from the Westinghouse Electric and Manufacturing Company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, September 16, 1902.

709,001. Process of Manufacturing Electrical Conductors. Louis W. Downes, Providence, R. I. Application filed February 17, 1902.

This process of producing insulated electrical conductors consists of covering the conductor with a suitable insulating material and subjecting the insulation to pressure alternately applied and released, thereby compacting the insulation on the conductor.

709,023. Street-sign Illuminating Device. John W. Lieb, Jr., and Joseph H. Tyler, New York, N. Y. Application filed January 10, 1902.

There is an arc lamp, a non-illuminating steadying resistance, an illuminating steadying resistance, and a switching device constructed to establish circuit through the non-illuminating resistance, cutting out this resistance and then cutting in the illuminating resistance. (See cut on next page.)

709,039. Combined Electric and Gas-lighting System. Fred C. Pickett, Kansas City, Mo. Application filed May 25, 1901.

In combination with an initial circuit-closer there is a secondary circuit-closer, a battery arranged between the initial and the secondary circuit-closers, a commutator adjacent to the secondary circuit-closer and operated by the vibration of the armature of the secondary circuit-closer, a sparking coil connected with the automatic lighting and extinguishing device, this sparking coil being also connected with the commutator of the secondary circuit-closer, and a battery interposed between the commutator and sparking coil.

709,040. Railway Signal. Jonathan D. Price, Aurora, Ill., assignor to the Miller Signal Company, Chicago, Ill. Application filed March 21, 1901.

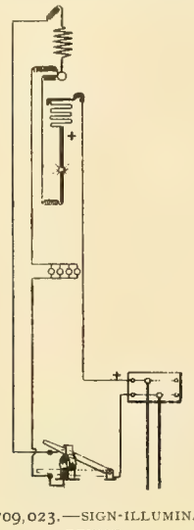
The railroad track is electrically divided into blocks, with insulated track-rail sections. A signal-controlling electric generator is connected with two sections located one in advance of the other to form therewith a local partial circuit. A pole-changer is provided for this local partial circuit, which is normally closed so as to supply an impulse in one direction or the other to the rail sections, depending upon the position of the pole-changer. Means are provided for operating the pole-changer. Other features are a train-carried electrically controlled clear signal and track-engaging conductors for simultaneously engaging the rail sections to conduct the controlling current to the train.

709,052. Electric-railway Signal. Claude D. Seaman, Topeka, Kan., assignor of one-half to C. C. Gardiner, Topeka, Kan. Application filed November 7, 1901.

A single normally closed two-battery track circuit ha

batteries connected with the tracks at the opposite ends of the signal block. A single relay is included in the track circuit, and an alarm circuit is controlled by the armature of the relay.

709,089. Trolley Guard. Edouard Gagné, St. Charles, Canada, assignor of one-half to Paschal Bonneau, Willow Bunch, Northwest Territories, Canada. Application filed April 16, 1902.



NO. 709,023.—SIGN-ILLUMINATING DEVICE.

The trolley guard comprises a U-shaped piece adapted to be removably clamped to the trolley pole and having a pair of upstanding limbs adapted to embrace the opposite sides of the trolley pole end and a transverse piece joining them and adapted to rest against the under side of the trolley pole. A pair of hinged extensions is mounted on transverse pivots at the upper ends of each of the limbs and extends normally above the trolley wheel. A pair of elastic extensible springs is joined at their ends respectively to one of the extensions and the respective limbs at the front and rear sides of the limbs, to maintain the extensions in axial line with the limbs and to permit them to be depressed by front or rear pressure below the trolley-wheel rim.

709,113. Trolley Pole. William Pullman and Charles C. Field, Sodus, N. Y. Application filed December 16, 1901.

The pole has a cam adapted for contact with a fixed base. A pivoted support carries the pole. A locking-bolt holds it in operative position, the lower portion of this bolt being adapted for contact with a fixed point to effect its movement to a releasing position.

709,156. Electric Railroad Switch. James A. Joyce, Cleveland, Ohio. Application filed December 17, 1901.

In a switch with a movable shaft having a switch point on the upper side, an armature is fastened to the shaft, acting in conjunction with a field coil to move the shaft electromagnetically. The shaft and the electrical mechanism are supported and covered by a frame.

709,157. Jar for Storage Batteries. Patrick Kennedy, Brooklyn, N. Y. Application filed January 6, 1902.

Side guards of a soft cushion-like material serve as buffers to keep the plates out of contact with the sides of the receptacle

709,158. Facsimile Telegraph. Edward E. Kleinschmidt, New York, N. Y., assignor to Frederick Kleinschmidt, New York, N. Y. Application filed November 6, 1899.

In this patent 73 claims are allowed. Perhaps the second one gives as good an idea of the invention as can be embodied in a short description. It reads as follows: In a facsimile telegraph, a message-paper feed mechanism, embodying a flat table or platen over which the message paper is adapted to pass in a continuous movement, rollers mounted with relation to the platen, means whereby the rollers may govern the movement of the paper, a constantly rotating stylus-carrier provided with styluses bearing with relation to the table or platen, means for maintaining the styluses normally in contact with the message paper during its passage over the platen, means for elevating the stylus out of contact with the message paper, a contact device mounted with relation to the table or platen normally contacting with the surface of the message paper, and means for turning the rollers of the message-paper feed mechanism independently of the operation of the telegraph machine, whereby when the styluses are raised out of contact therewith the message paper may be manually adjusted.

709,168. Trolley. Frank A. Merrick, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed September 14, 1899. Divided and this application filed December 30, 1899.

Combined with a trolley harp and a wheel journaled therein, are an upwardly pressing spring arm secured to the harp within the fork thereof and a contact shoe at the upper end of the arm fitted to and contacting with the under side of the laterally extending hub of the wheel, the shoe having an elongated longitudinal bearing on the hub, between the dished face of the wheel and the fork-arm, and guarded by its position from the action of stray arcs.

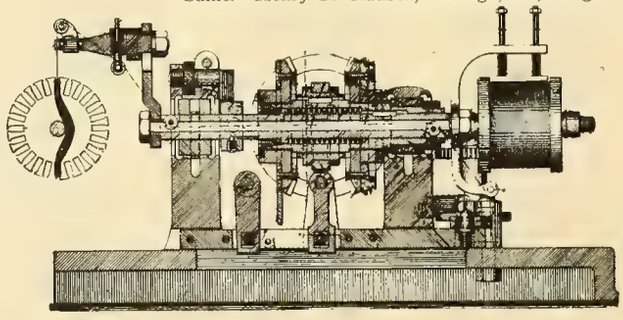
709,179. Machine for Winding Drum Armatures. Henry Schulz, New York, N. Y. Application filed September 17, 1900. Renewed February 20, 1902.

Principal features of this machine are, in combination, means for supporting an armature core, a winding crank supported at right angles to the shaft of an armature core supported by these means, means for rotating the winding crank so that its end moves in a vertical longitudinal plane, around the armature core, and means for feeding the coil-forming wire from the crank to the core. (See cut.)

709,182. Controller for Electric Motors. Emmett W. Stull, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 10, 1901.

Features of this controller are a rheostatic switch having an open-circuit position, a separate series-parallel switch, a magnet or magnets for actuating the series-parallel switch connected in shunt with one of the motor armatures, and means for preventing effective action of the magnet or magnets so long as the motor circuit remains unbroken by the rheostatic switch. Means are also provided for utilizing such action to move the series-parallel switch from its series to its parallel position when the rheostatic switch is moved across its open-circuit position, together with suitable means, as a spring, for returning the series-parallel switch in series position when the rheostatic switch is brought to rest at its open-circuit position.

709,205. Electric Condenser and Method of Making Same. Henry P. Clausen, Chicago, Ill., assignor



NO. 709,179.—ARMATURE-WINDING MACHINE.

to the American Electric Telephone Company, Chicago, Ill. Application filed April 6, 1901.

Superimposed plates of suitable metal and dielectric are arranged in two series, the plates or sheets of each series being flexibly connected together, and the sheets or strips when in place presenting flexible connections on all four sides of the condenser, whereby the superimposed plates or sheets of metal and dielectric of which the condenser is composed can be drawn apart without disconnecting the plates or sheets of one series from the plates or sheets of the other series. (See cut.)

709,216. Electric Hose Coupling. Manson C. Goodwin, Portland, Maine. Application filed January 2, 1902.

This coupling for hose containing electrical conductors is designed to provide an efficient contact while preventing moisture from reaching the contact points.

709,232. Circuit-breaker. Frank A. Merrick, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 21, 1900.

NO. 709,205.—ELECTRIC CONDENSER.

In a circuit-breaker there are provided a chamber of insulating material, a fixed contact extending into the chamber through a wall thereof, a loosely mounted shaft extending through the chamber and carrying a co-operating contact, a handle for manually actuating the shaft in one direction, a spring for actuating the shaft in an opposite direction, and an electromagnetically controlled latch device for normally restraining the action of the spring, the magnet of this device having extended pole-pieces which embraces the chamber to produce a magnetic field therein.

709,234. Electric Clock. Carl J. Moberg, Jersey City, N. J., assignor to Adam E. Schatz, Mount Vernon, N. Y. Application filed May 26, 1897. Renewed January 17, 1901.

The combination is a pendulum-actuating circuit of a circuit-closing lever, a pawl synchronously actuated by the pendulum for actuating the lever, a pawl-carrying device whereon the pawl rests and reciprocates the device preventing engagement of the pawl with the lever while the impulses enable the pawl to reach the carrier, and permitting engagement when the pawl fails to reach thereto and a time train-actuating pawl, this pawl being an attachment of the pendulum-pawl carrier.

709,243. Railway Signal. Jonathan D. Price, Aurora, Ill., assignor to the Miller Signal Company, Chicago, Ill. Application filed September 21, 1900.

Insulated track rail-sections, a signal-controlling electric source connected with two sections located one in advance of the other, an electric source connected with the advance ends of two sections belonging to different track rails, a transient signal with conductors engaging the track, one in advance of the other, and means for changing the pole connections of the first-named electric source, are features of this invention.

709,244. Calculating Machine. Frank C. Rinsche, St. Louis, Mo., assignor to the Universal Accountant Machine Company, St. Louis, Mo. Application filed July 8, 1901.

This machine is, essentially, electrically driven. There is in combination with registering and recording mechanisms a rock shaft for driving them, an arm on the shaft, an electric motor, connections between the motor and the arm for rocking the latter, a device in the motor-circuit accessible to the operator for completing the motor-circuit, means operated by the rock-arm as it approaches the end of the first half of its stroke for breaking the circuit, and means in which power is stored during the second period of operation by the motor, which power becomes effective for driving the rock-arm the second half of its stroke independently of the motor.

709,295. Electrical Self-playing Musical Instrument. Harry E. Beach, Newark, N. J., assignor to G. Howlett Davis, Llewellyn Park, West Orange, N. J. Application filed September 3, 1901.

In a self-playing attachment for musical instruments combined with a bank of magnets, armatures and spring-retracted friction shoes, of adjustable stop devices for each armature of the bank, are adjustable bar or angle piece supporting all of the parts, retracting springs for the armatures wholly supported by the bar, and an actuating roller or drum with reference to which the bar or angle piece is adjustable.

709,327. Telephone-call Annunciator. Zeremba E. Jackson, Atchison, Kan. Application filed March 8, 1902.

By this arrangement telephone calls at subscribers' stations are made known by the dropping of a shutter as well as by the ringing of a bell.

709,334. Lead Fuse for Electric Circuits. Frederick H. Krebs, Copenhagen, Denmark. Application filed October 25, 1901.

A lead fuse plug for electrical plants comprises a hollow body having a conical-shaped opening in its lower end, a lead-wire adapted to be inserted through the opening, and arranged for connection at its upper end with a copper contact, and a contact plate connected with the lower end of the wire and provided with hooks adapted to be fastened to the body by a bayonet joint.

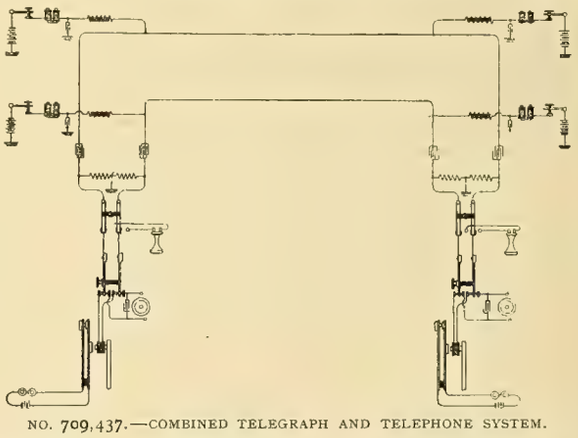
709,351. Telephone Switch. Columbus B. McPherson, Birmingham, Ill. Application filed March 12, 1902.

On a bracket having a plurality of binding posts secured thereto, there is a semi-circular spring switch lever having one of its ends fulcrumed and the other free for oscillatable movement. A lever rest is secured upon the bracket adjacent to one of the binding posts and having a curved bearing face and a stop.

709,427. Ozonizing Apparatus. Alexander Vosmaer, Haarlem, Netherlands, assignor to Company Ozon Maatschappy Systeem A. Vosmaer, Amsterdam, Netherlands. Application filed October 4, 1901.

In an ozonizing apparatus, are combined metal bars of suitable section, insulating supports fixed on the bars, metal rods supported by the insulating supports and having depending points and a horizontally arranged casing, each metal bar with its insulating supports and the metal rod carried by the supports forming a single structure which is loosely placed in the casing.

709,437. Apparatus for Composite Systems of Simultaneous Telegraphy and Telephony. John M. Fell, Arlington, N. J., assignor to the Amer-



NO. 709,437.—COMBINED TELEGRAPH AND TELEPHONE SYSTEM.

ican Telephone and Telegraph Company, New York, N. Y. Original application filed September 16, 1901. Divided and this application filed January 8, 1902.

There are two claims. The first is as follows: In a system of composite and simultaneous telegraphy and telephony, the combination of a metallic or double-conductor telephone circuit; two independent earth-return telegraphic circuits having for their line conductors the two main conductors respectively of the metallic circuit; and impedance devices or electromagnetic resistances interposed between the instruments of the telephone circuit, and the two telegraphic circuits respectively; with a call-signal apparatus connected with the telephonic circuit, comprising a generating and transmitting device at one telephone station adapted to develop and transmit alternating call currents of such potential and frequency as to be obstructed by the impedance devices, and a signal-receiving relay at another telephone station responsive only to the alternating call currents of appropriate frequency. (See cut.)

REISSUE.

12,031. Telephone System. Francis W. Dunbar, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed June 17, 1902. Original No. 689,953, dated December 31, 1901.

Combined with a telephone line and a connection terminal therefor a signal-controlling electromagnet normally connected with the line, a relay for disconnecting the electromagnet from the line, a cord-circuit terminating in a connecting plug and adapted to be placed in conductive relation with the line, a source of electricity associated with the cord-circuit and adapted to be placed in the metallic circuit of the line, and means for closing the circuit of the source through the relay, when connection is made with the line, the relay circuit including a talking strand of the cord-circuit, a main terminal of the connecting plug, a line contact and a portion of the talking limb of the telephone line with suitable return.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, OCTOBER 4, 1902. No. 14

Electric Railways in and Around Detroit.

For two reasons the choice of Detroit as the place of the annual meeting of the American Street Railway Association was a particularly happy one. One is that Detroit is itself so attractive, its people so hospitable, that it has acquired renown as a favored meeting place for all sorts of deliberative bodies, and, with 100 to 200 of these gatherings annually, is well termed the "Convention City." The other reason is that Detroit is one of the most notable electric-railway centers of the United States. The lines radiate in all directions from the center of the city, and in addition to the local service, give connection with over 50 towns and villages in Southeastern Michigan. They include 575 miles of track, and the service given is of the very best. It is the purpose of the present article to describe, somewhat in detail, this splendid system of street and interurban railways.

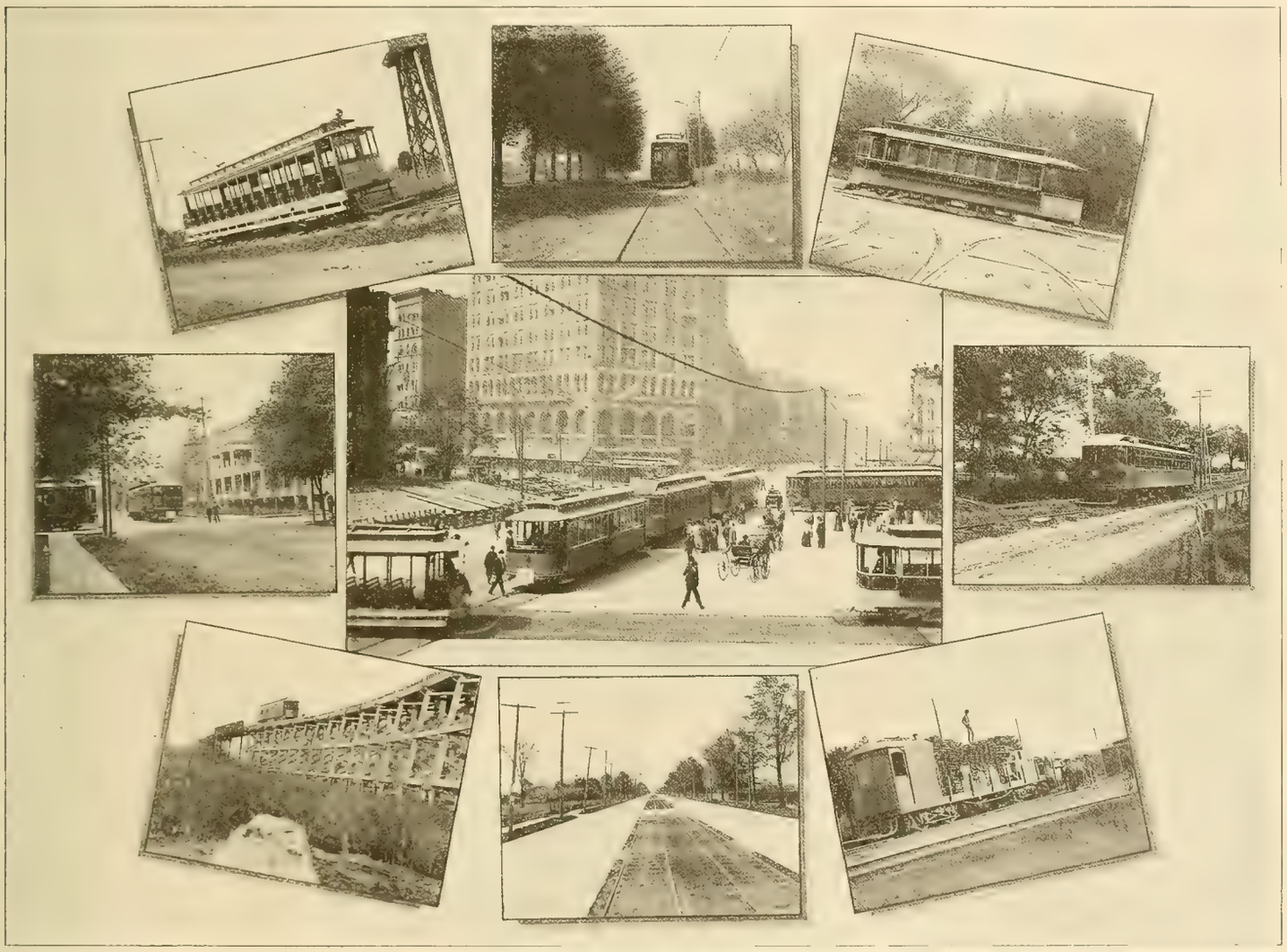


Fig. 1. Standard Interurban Open Car. Fig. 2. View on Wyandotte Line. Fig. 3. Standard Closed City Car.
Fig. 4. View in Mt. Clemens. Fig. 5. Noon Scene in Front of City Hall, Showing Interurban and City Cars. Fig. 6. View on Ann Arbor Line.
Fig. 7. Trestle Near Orchard Lake. Fig. 8. Woodward Avenue in Detroit. Fig. 9. Interurban Freight Train.

ELECTRIC RAILWAYS IN AND AROUND DETROIT.

Historical.

The history of Detroit's street railways dates back to 1863, when the first track was constructed on Jefferson Avenue. The road was built of light strap rails, laid on wooden stringers, and the cars were of the one-horse type. This line was used mainly in transferring passengers between the depots, and although an extension was built in 1864 on Woodward Avenue, the project was not a very successful one. During the next 25 years or more various lines were constructed in the city, most of the extensions being made by the Detroit City Railway Company, which controlled all of the lines during the '80's.

In 1891, a memorable year in Detroit's street-railway history, occurred the well-remembered strike and riots of the company's employes, which were destined to be a stepping stone to the introduction of rapid transit and its development into the present city and interurban system. The men asserted that they were required to work too many hours for insufficient pay, and their differences were finally settled by arbitration, through the efforts of Mayor Hazen S. Pingree. However, public feeling had become so aroused against the company that it sold out to the Detroit Citizens' Street Railway Company, and the announcement was made that the lines were to be changed over for electrical operation and the roads otherwise improved. This promise was virtually carried out, electricity being introduced on many of the trunk lines, and other improvements made. Meanwhile, Mayor Pingree had begun his famous three-cent-fare campaign and after vetoing several franchises sought by the old company was finally successful in seeing a franchise granted to the Detroit Street Railway Company. This franchise, commonly known as the "three-cent-fare franchise," was granted on December 4, 1894. In April, 1895, construction work was begun and the company succeeded in getting 40 miles of railway in operation that year, completing its lines the following year.

The contest between the city and the Detroit Citizens' Street Railway Company had now become so warm that in September, 1894, the ownership of the company's system was transferred from the Detroit proprietors to R. T. Wilson & Co. and others of New York city, who assumed control with Tom L. Johnson (now mayor of Cleveland) as president, J. C. Hutchins as vice president and treasurer, and A. B. DuPont as general manager. Under the new management the old horse-car and old electric systems were speedily transformed to the present efficient system, the whole plant being almost entirely reconstructed during 1895 and 1896.

Previous to 1895 there was constructed a third city system, known as the Fort Wayne and Belle Isle railway. This road ran east and west through the city. It had 23 miles of track, was electrically operated and fairly well equipped. During 1896 the Detroit Street Railway Company was reorganized and became the Detroit Electric Railway. Early in the fall of that year an arrangement was made whereby the operation of the Detroit Electric Railway was taken over by the Detroit Citizens' Street Railway Company. Certain economies were effected by means of this consolidation, it having been found by the Detroit Electric Railway that it could not stand competition on the part of the older line on account of the low fare. The Detroit Electric Railway had been financed and built by Henry A. Everett and the Pack interests.

Early in 1897 the Fort Wayne and Belle Isle line was purchased by the same interests that controlled the Detroit Citizens' railway and was reorganized, becoming known as the Detroit, Fort Wayne and Belle Isle Railway Company. The operation of the three companies was now continued separately, as before, but there was one combined management, and the receipts and expenditures were pooled to the different lines according to their mileage. The systems were operated in this manner until December 31, 1900, when the Detroit United Railway (the corporate name) was organized and purchased all the properties, rights, privileges, fran-

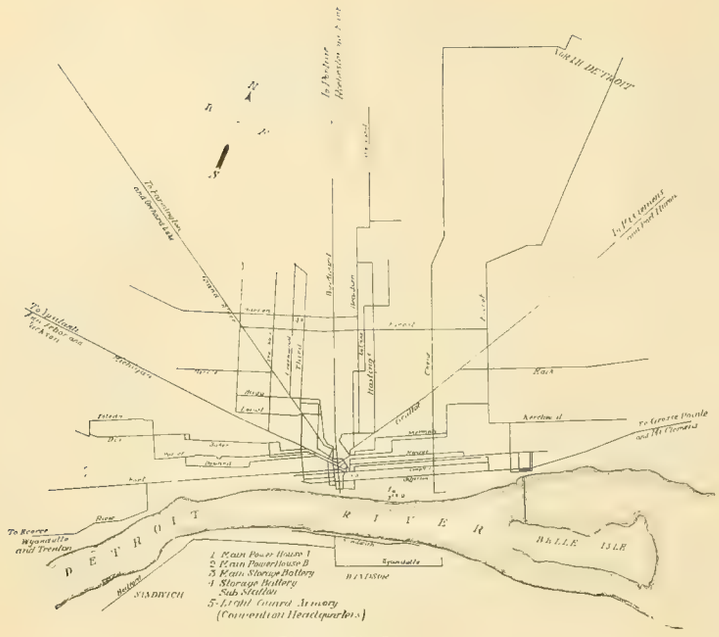


Fig. 10. — City Lines.

Fig. 11. Interurban Roads.

ELECTRIC RAILWAYS IN AND AROUND DETROIT.

chises, etc., of the three companies, together with those of the Detroit Suburban Railway Company, which had been operated for some years before under lease to the Detroit Citizens' Railway Company, and consisted of several small railways that had been built in the suburbs of Detroit as it existed before the last extension of the city boundary. These properties, as now included under the one management, together with the extensions that have been made within the last two years, comprise the present street-railway system of Detroit, as shown by the map on this page (Fig. 10).

Before dismissing this retrospective account, some reference should be made to the negotiations carried on during 1898 by Governor Pingree and Tom L. Johnson for the purchase of the street-railway lines by the city of Detroit. These well-known public men had the property appraised and the franchise valuations determined by experts, and finally the figure of $17,500,000 was arrived at as representing the total value of the properties, which at that time included 185 miles of track. However, before the proposition could come before the City Council, which probably would not have passed it, the proceedings were stopped by an injunction suit brought by a taxpayer, the courts deciding that the city could neither own nor operate street-railway lines that extended outside of the city, as some of the lines did. This ended the last important contest between the citizens and municipal authorities and the street-railway companies of Detroit.

Interurban Roads Purchased.

Soon after its organization the Detroit United Railway began to extend its operations outside of Detroit and take in some of the interurban roads that were then in operation or under construction. The first of these to be purchased was the Wyandotte and Detroit River Railway, which was built about 1892, from Detroit in a southwesterly direction to Wyandotte and Trenton, a distance of 10 miles. This purchase was made in February, 1901.

In 1895 and 1896 Streathern Hendrie and others built and placed in operation an interurban road from Detroit north to Birmingham and Pontiac. The company was known as the Detroit and Pontiac Railway Company. It was purchased by the Detroit United Railway in June, 1901. The road consists of 37 miles of track, Pontiac, the terminus, being 26 miles from Detroit (City Hall).

During 1897 and 1898 the Detroit and Northwestern Railway was built northwest from Detroit to Farmington and Northville, with a branch through the Oakland County lake region to Orchard Lake and Pontiac. The system includes 58 miles of track and was purchased by the Detroit United Railway in May, 1901.

In the years 1897 to 1900 various small interurban railways, which were afterward purchased by the Detroit and Flint Railway, were built from Royal Oak, the junction point with the Detroit and Pontiac line, through Rochester, Orion and Oxford to Flint, about 70 miles from Detroit. A branch was also constructed from Rochester to Romeo, a distance of 12 miles. This system, including about 75 miles of track, was purchased by the Detroit United Railway in August, 1901.

The Rapid Railway Company began the construction of its interurban system from Detroit northeastward to Mount Clemens in 1894. From that time until 1899 various extensions and connecting roads were constructed, the line being extended from Detroit along Lake St. Clair and the St. Clair River to Port Huron, passing through Mount Clemens, New Baltimore, Algonac, Marine City and St. Clair. In 1899 the capital stock of the various companies operating these different lines was purchased by the Detroit and Port Huron Shore Line Railway Company, a New Jersey corporation, all the other companies being incorporated under the laws of Michigan. During 1901 the entire capital stock of the Detroit and Port Huron Shore Line Railway Company was purchased for the Detroit United Railway. In all the other transactions the properties were transferred by deed. In this case, however, the Detroit United Railway interests own the capital stock. The system is operated and managed by its own set of officers, and is known as the Rapid Railway System. It also includes what is known as the Shore Line, a railway built along the shore of Lake St. Clair from Detroit to Mount Clemens in 1897 and afterward sold to the Rapid Railway interests.

The total mileage of the Detroit United Railway system is 379.465 miles. Of this total, 187.87 miles comprise the city lines proper and 191,595 miles include the four interurban roads that are directly controlled by the company. The Rapid Railway System operates over 122.5 miles of track, but part of this includes trackage in the city, the total of its own mileage being 109.57 miles. This latter figure added to the 379.465 miles above, gives a grand total of 489.035 miles of electric railways that are under the one ownership. The only interurban railway running out of Detroit that is not at present controlled by the Detroit United Railway interests is the Detroit, Ypsilanti, Ann Arbor and Jackson Railway, extending west from Detroit through the cities named and terminating at Jackson, with a branch from Ypsilanti to Saline. This road has 86 miles of track, and it is natural to expect that it will eventually be taken over by the Detroit United. It is believed that negotiations looking toward its purchase are already under way. A map showing the routes of the different interurban lines mentioned is given as Fig. 11.

An interesting feature of the extension policy adopted by the Detroit United Railway is its purchase of electric-railway lines in Windsor, Ontario, the Canadian city directly across the Detroit River from Detroit. The companies operating there are known as the Sandwich, Windsor and Amherstburg Railway Company and the City Railway of Windsor, and were purchased in September, 1901. About 13 miles of track are now operated in the city of Windsor. An extension of 12 miles to Amherstburg, a town 18 miles down the Detroit River, is contem-

Fig. 16. ELECTRIC RAILWAYS IN DETROIT.—MAIN STORAGE BATTERY.

plated and will probably be built and placed in operation by next year.

Franchises and Fares.

The Detroit United Railway operates under a number of franchises, the dates of expiration ranging from 1909 to 1928, while one franchise, covering 22.44 miles, is perpetual. Several of these franchises overlap or abut one another on the same streets and are otherwise more or less favorably complicated by extensions, amendatory ordinances and by the fact that the present lines, of necessity, operate under both city franchises and abutting perpetual or long-term franchises granted by townships whose territory has since been brought within the Detroit city limits. The franchises on all of the interurban lines have more than 25 years' life, and more than half the mileage of these lines is on private right-of-way.

Fig. 12. Station A.

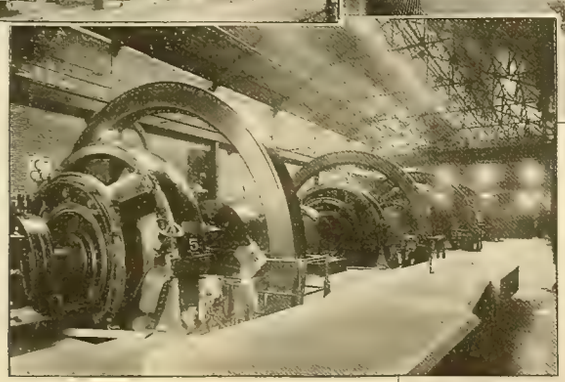


Fig. 14. Engine Room of Station B.

Under the "three-cent-fare" franchise, which covers several cross-town lines, such as Fourteenth Avenue, Belt Line, Sherman, etc.—57.9 miles in all—the railway company is required to sell eight tickets for 25 cents, good between the hours of 5:15 a. m. and 8:00 p. m., and six tickets for 25 cents, good throughout the 24 hours. The cash fare on these lines, as well as on all of the other city lines, is five cents. Transfers are given on these "three-cent" cross-town lines on either cash or ticket fares to connecting lines of this (the cross-town) system, but only cash fares entitle persons to transfer to other connecting lines of the company. On the old Citizens' lines and the Fort Wayne and Belle Isle line workingmen's tickets, eight for 25 cents, are good between the hours of 5:30 and 7:00 a. m., and 5:15 and 6:15 p. m. Transfers are given on cash fares to all connecting lines and on ticket fares to lines of the same original system only. As stated above, the cash fare on all the city lines is five cents, and for this fare universal transfers are given that are good on all lines.

The fares on the interurban lines vary according to the distance traveled, the rates charged running from less than a cent a mile to about 1½ cents a mile. The highest fare charged for any single ride from the City Hall in Detroit to an outlying point is $1, the fare to Flint, a distance of 68 miles. Either Jackson or Port Huron, located 76 and 73 miles, respectively, from Detroit, can be reached for a fare of 90 cents. Round-trip rates are given only on the Rapid Railway System and the Detroit, Ypsilanti, Ann Arbor and Jackson line, the round-trip fare to Jackson or Port Huron being $1.50. Hourly service is given during the daytime to all interurban points, while most of the towns have cars every half hour. All interurban cars pass the City Hall in Detroit. Fig. 5 is a view taken in front of the City Hall at noon, showing five interurban cars bound for different destinations, as well as several city cars.

For purpose of comparison data of the electric-railway and steam-railroad (Michigan Central) passenger service between Detroit and Jackson are given in the following table:

	Steam.	Electric.
Distance	75.6 miles.	76 miles.
One-way fare	$1.52	90 cents.
Round-trip fare	$3.04	$1.50
Running time	2 to 3 hours.	3 hrs. 45 min.
Number of trains or cars daily	8	14

Power Plants.

The electric power necessary for operating the city and interurban lines of the Detroit United Railway is supplied by six generating stations and three storage-battery sub-stations. The city system proper is operated from two of these stations, called stations A and B, respectively. The suburban power houses are known as stations D, E, F and G, while the storage-battery plants, all connected with the city service, are styled stations C, H and J. In what follows the equipment and operation of the city and interurban lines will be treated separately.

Station A is the power house that was originally constructed for the Citizens' Street Railway. Station B was built by the Detroit Railway Company, which was afterward acquired by the Citizens' company. These power houses are situated on Atwater Street, in the central part of the city, diagonally across the street from each other. They are also on the bank of the Detroit River, their location being indicated by (1) and (2) on the map (Fig. 10). The exteriors of the two stations are illustrated in Figs. 12 and 15. The two power houses are located so close together that they are operated almost as one station. To this end the switchboard controlling the two stations is located in station A.

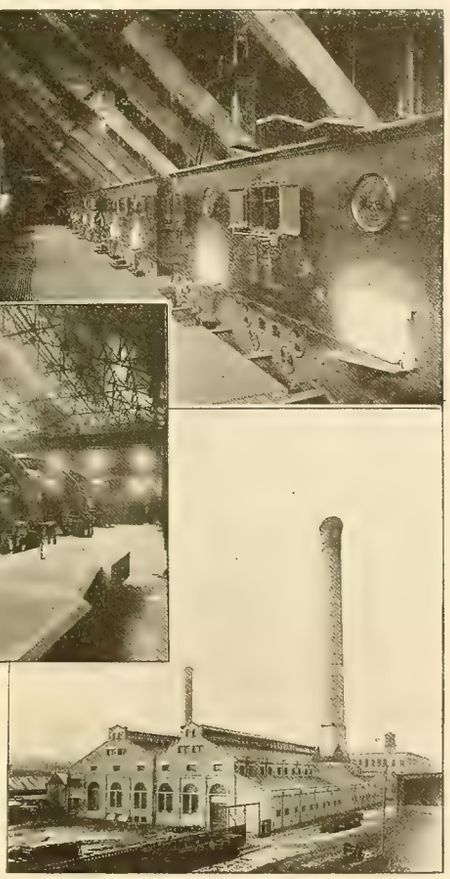


Fig. 13. Boiler Room of Station A.
Fig. 15. Station B.

ELECTRIC RAILWAYS IN DETROIT.—MAIN POWER HOUSES.

Station A.

The building which shelters station A is of brick, with an engine room 243 by 65 feet, and a boiler room 253 by 58 feet in size. The engine equipment consists of four Reynolds-Corliss tandem-compound engines, with cylinders 28 and 52 inches in diameter, and 48-inch stroke. Each engine is direct-connected to a 1,000-kilowatt, 565-volt, direct-current Siemens & Halske railway generator, of the external-armature type. In the boiler room, a general view of which is given in Fig. 13, are located 12 Babcock & Wilcox 250-horsepower water-tube boilers. They are set in batteries of two each, and are fitted with Murphy stokers and Hoppes live-steam purifiers. Each battery has 126 tubes, 18 feet long and four inches in diameter. Thirteen pumps are used for auxiliary purposes. In addition, the boiler room contains a Hunt conveyor, operated by a double 4 by 6-inch engine, for handling the coal and ashes. Slack coal is used as fuel. The stack is built of steel and is self-supporting. It is 180 feet high and has a diameter of 11 feet six inches. A 25-ton hand-power crane spans the engine room.

Switchboard Arrangement.

The switchboard located in this station is 96 feet long and is built of white marble. It consists of 36 feeder panels, nine machine panels, two booster panels, four blank machine panels, and two main instrument panels. The board is equipped with General Electric circuit-breakers and Weston instruments. The bus-bar arrangement of the switchboard is as follows: There are three positive buses; the upper one is fed by the four generators mentioned above in station A, the lower one is connected so that it may be fed by all nine generators and the middle bus is generally supplied from generators 5, 6, 7, 8 and 9, located in station B. The center and lower buses are connected through a switch, which, when opened, permits each bus to be operated independently.

For example, the middle bar can be maintained at a potential of 585 volts by running Nos. 5, 6, 7 and 8 engines, while No. 9 unit, which was built to maintain a voltage of 625 volts, can be run at that potential on the lower bus to feed outlying lines that are not equipped with boosters and also to raise the potential of equalizer wires, so as to assist the heavily loaded sections. The main feeder lines can be connected together so that the night load can be carried on any bar or on either station. The usual arrangement of the buses for everyday service is 565 volts on the top bus and 575 volts on the two lower ones, which are connected together. On Sundays and other days of heavy loads, the top bar carries 565 volts as before, but the others are operated separately, the middle one at 575 volts and the lower one at 625 volts. The booster service at the two stations will be mentioned later in connection with the storage batteries and distribution system.

Station B.

Station B is a brick building, with engine and boiler rooms, each 227 feet long and 67 feet wide. The equipment in the engine room (Fig. 14) comprises two 20 and 40 by 48-inch Reynolds-Corliss engines, direct-connected to 400-kilowatt, 585-volt, Walker generators, two 24 and 48 by 48-inch Reynolds-Corliss engines, connected to 800-kilowatt, 585-volt Walker generators, and a 32 and 64 by 60-inch Filer & Stowell engine, direct-connected to a 1,500-kilowatt, 625-volt Westinghouse generator. All the engines are of the cross-compound horizontal type. The foundations are now being placed for a duplicate of the 1,500-kilowatt unit.

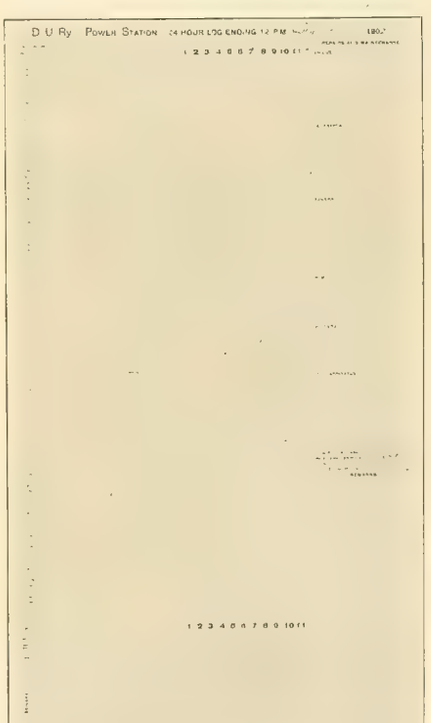


FIG. 17. ELECTRIC RAILWAYS IN DETROIT.—LOAD SHEET OF GENERATORS AND BATTERY.

In the boiler room of this station are installed eight Stirling 300-horsepower water-tube boilers, each with 204 three-inch tubes in lengths of 13 feet 9 inches, 13 feet 10 inches and 16 feet 1½ inches, and eight Stirling 250-horsepower boilers of the same type, except that they have but 192 tubes to a boiler. The boiler furnaces are fed by Murphy stokers, and the gases are discharged through a Green econo-

mizer into a brick stack, 185 feet high, with a 10-foot flue. Twelve pumps serve as auxiliaries.

A gravity oiling system is installed in both power houses, and the piping to and from the tanks, coolers and filters used in this connection is somewhat novel. All the pipes are painted, different colors being used to distinguish different sets of pipes. The supply pipes are painted a light yellow, the returns a dark yellow and the by-passes to the sewer a dark red. As there is quite a multiplicity of pipes this coloring scheme makes it practically impossible to shut off or turn on the wrong valve.

Both stations A and B were erected in 1895. The only adition since then in generating equipment has been the Filer & Stowell-Westinghouse unit. This engine has cross-heads fitted with extensions, so that slippers may be fastened to them by means of studs. With this arrangement the slippers will be retained in case the adjusting screws break. The valve gear is connected straight through, no wrist plate being used, either on admission or exhaust. The low-pressure cylinder head is fitted with a manhole, so that access may be had to the piston without removing the cylinder head. The total weight of the engine alone is 640,000 pounds. Its speed is 75 revolutions a minute.

Storage Batteries.

In connection with generating stations A and B there is a storage battery of Chloride accumulators (Fig. 16) known as station C. This battery was installed in August, 1900, in a brick building, 40 by 80 feet in size, located on Atwater Street, across from station A. It consists of 276 type-G cells, with

FIG. 18. ELECTRIC RAILWAYS IN DETROIT.—STORAGE-BATTERY SUB-STATION.

67 plates to the cell, and has a discharge capacity of 2,500 amperes at 575 volts for one hour. It is charged by a 250-kilowatt motor-driven Western Electric booster, located in station A. This battery was installed principally for use on the peaks of the load and has been in use daily since it was first put in service. It discharges generally a portion of its charge on the morning peak and about its full capacity on the evening peak of the load, which lasts less than two hours, as a rule. It is stated that this particular battery has had as hard usage as any in the United States. How the battery takes the peaks of the load is shown by the diagram (Fig. 17), which is a reproduction of a typical load sheet of the generating and storage-battery plants, the date being September 12, 1902. In this instance the battery was charged from midnight to 1 a. m., was discharged from 6 to 7 and charged again from 7:30 to 9 a. m. The big evening peak commenced at about 4 p. m. and at 6:30 the battery was delivering its full capacity of 2,500 amperes, the total load on the system being 16,000 amperes. From 8 to 12 p. m. the battery was charged again. On this particular day the load sheet showed a total of 311,000 ampere-hours for the 24 hours. The average amperage was 6,479 and the voltage 575. The total engine-hours were 112¾. The lines at the bottom of the sheet indicate the lengths of time the different generating units and boilers were in service during the 24 hours.

The second storage battery, installed by the railway company, station H, was placed at Third and Hancock Streets, in the north central portion of the city, in January, 1901. It consists of 253 G-53 Chloride accumulators in G-67 cells, and one 150-kilowatt motor-driven Western Electric booster, with the necessary switchboard equipment. Fig. 18 is an interior view of the booster and switchboard room of the station. The battery has a discharge capacity of 2,000 amperes at 500 volts for one hour. It has been installed to take care of the variations of the load in that vicinity and on a recent test it was shown that the battery could take fully 80 per cent. of the fluctuations of the load.

The third battery was installed at Ecorse on the Wyandotte-Trenton interurban line in May of this year. It consists of 276 F-15 Chloride accumulators in glass jars. This battery is used as a line battery, there being no booster at the station. It is fed from the main power house (station B) 11 miles distant, by current from the main bus-bars, through a double booster set, consisting of two 200-kilowatt Thomson-Houston generators connected to a Westinghouse motor. The shunt coils of the two generators are connected in series with each other, while the series coils and armatures are in parallel with each other and in series with the 550-volt bus. The booster raises the potential to about 900 volts. A number of different combinations can be obtained with this booster set, and in case it breaks down one of the main generators can be thrown in to take its place.

Before the storage battery was installed at Ecorse a half-hour service was given on the Wyandotte line. The entire line was fed from the main power house and while the voltage at that end ranged from 400 to 950 volts, at the lower end of the line at Trenton, some 18 miles distant, the potential would drop to as low as 200 volts. Now a 20-minute schedule is maintained with practically constant voltage. Thus the problem of taking care of this long line without the building of another generating plant along the road was solved satisfactorily and economically. In its three storage batteries the Detroit United Railway has expended betwen $275,000 and $300,000, and apparently it is well satisfied with its investment.

Overhead Distribution.

Leading out from the main switchboard at station A is a 23,000,000-circular-mil distribution, which supplies all of the city lines. There are two main trunk lines of feeders—one running north and one west, and both distributing through the various sections of the system. A view of these lines coming from station A is shown in Fig. 19. The north trunk lines, consisting of 19 feeders, intersect a 1,300,000-circular-mil cross-town equalizer about three miles from the power house. All feeder lines that cross this equalizer tap on through automatic circuit-breakers, so that in case of trouble any section may be cut out. The equalizer boxes containing the circuit-breakers are marked by signal lights and the handles of the circuit-breakers are brought outside of the boxes, the latter being kept closed by the division superintendent. There are 11 boxes on this equalizer and the largest circuit-breaker, at Woodward and Forest Avenues, has a capacity of 1,500 amperes. The 2,000-ampere storage battery at station H is operated in connection with the cross-town equalizer. The west trunk line, running from the main power house consists of 15 feeders and a portion of it taps into a 500,000-circular-mil equalizer in the same manner as the north trunk.

On the overhead construction, No. 00 round trolley wire is used for most of the lines, there being a portion of No. 0 still in use. The greater portion of the span-wire poles are of iron, with 4½ to five-inch tops, and weigh from 450 to 675 pounds. For the

Fig. 20. Observation Car Yolande.

feeder lines, iron poles weighing about 1,000 pounds each are used. All poles are spaced 110 feet apart. A great deal of the line material and supplies that are used was made in the railway company's own shops. The average feeder cables are 350,000 to 500,000 circular mils in size, although 1,000,000-circular-mil cables are used. All cables in the city are of copper and are insulated. They are supported on the company's own iron feeder shoes. The cross-arms are of iron and are also of the company's own special design. They are insulated by two layers of two-ply rubber belting.

Track Construction.

The standard track construction adopted for the city lines of the Detroit United Railway consists of nine-inch girder rails of the Johnson company's section 98-289, laid with three-inch angle bars for ties on six inches of concrete. The rails are laid with the tread flush with the pavement. They are bonded to two-thirds of the carrying capacity of the rails with Crown S bonds. There are 189 grade crossings with steam-railroad lines and 12 separations, making 201 crossings in all.

Rolling Stock and Car Service.

The company has 876 cars in use or in course of construction. These include 46 suburban double-truck cars, 457 closed single-truck cars, 45 double-

FIG. 19. ELECTRIC RAILWAYS IN DETROIT.—FEEDER LINES LEAVING MAIN POWER HOUSES.

truck closed cars in course of construction, 308 open single-truck and 20 double-truck open cars. All are motor cars, as the company is prohibited by franchise from using trailers. The standard type of closed city car used is illustrated in Fig. 3 on page 221. This car has a feature peculiar to Detroit in that the rear platform is extra large and is provided with a transverse handrail about two feet from the door. The platform is thus divided into two portions, and the passageway in front of the door is rigorously kept free from smokers or other standing passengers. The company built 164 of these cars in its own shops and also nine of the large cars used on the Wyandotte line. Fig. 1 shows the standard type of open double-truck car that the company is beginning to use on the city and some of its interurban lines. These cars are equipped with Brill trucks and two G. E. 40-horsepower motors. Several of the interurban cars are illustrated in the group illustration on page 221. The city cars are fitted with a variety of trucks and motors, the latter including principally the Lorain Steel and Westinghouse types. Wheel hand brakes are used. The color scheme adopted for the city cars is a particularly happy one and is also very serviceable. The body of the car is painted in chrome yellow, with a wide band of orange yellow, and is trimmed with Tuscan red and aluminum stripes. Besides the equip-

Fig. 21. Interior of Yolande.

ELECTRIC RAILWAYS IN DETROIT.

ment mentioned, the company has eight snowplows for city and five for suburban use, five sprinklers, six regular express cars and two milk cars.

The running time for the cars within the three-mile limit from the City Hall is 10 miles an hour and outside of that limit 15 miles an hour is permitted, but the cars are generally run at 14¼ miles an hour. The interurban cars operate at the same speeds within the city, but maintain a scheduled speed of about 19 to 20 miles an hour outside the city, some of these cars being capable of running 50 miles an hour over certain portions of the roads. The regular operation of the company's system requires 182 cars in the city and 30 suburban cars.

This number, referring to the city cars only, is practically doubled during the morning and evening peaks of the load. The regular schedule calls for operating the cars on Woodward Avenue on a three-minute headway, a four-minute headway on Jefferson Avenue, and from three to eight minutes on the other lines. During rush hours a one to two-minute service is given on the main lines.

A special feature of the Detroit street-railway system is the opportunity given visitors of touring the city and seeing the principal objects of interest

A. E. Peters, Assistant Secretary and Purchasing Agent.

F. W. Brooks, Manager Rapid Railway System.

Albert H. Stanley, General Superintendent.

Henry A. Everett, Chairman Board of Directors.

J. C. Hutchins, President.

E. W. Moore, Director.

Irwin Fullerton, Auditor.

Thomas Farmer, Superintendent of Motive Power.

E. J. Burdick, Assistant Superintendent of Motive Power.

Walter Ross, Claim Agent.

OFFICERS OF DETROIT UNITED RAILWAY.

by means of a parlor observation car. This car, shown in Figs. 20 and 21, is called the Yolande, and makes five trips daily. It starts from Cadillac Square, opposite the City Hall, and during a two-hour ride passes through the wholesale and retail districts of the city, and along the most beautiful resident avenues, admitting of a splendid view of Detroit River, Belle Isle and Waterworks Parks. The car is fitted with movable, leather-covered chairs and has seating accommodations for about 50 people. It is handsomely finished in cherry, is provided with large plate-glass windows and is mounted on double trucks. The car was built by the company in its own shops. An attendant is in charge to point out places of interest and give general information. The trips given on this car have become very popular and the car is also in demand for special excursions and parties.

Car Barns and Shops.

At present the Detroit United Railway occupies 11 car barns in the city and has one general repair and construction shop at its Jefferson Avenue barns. At this shop are executed all the repairs to cars, trucks, motors and power-house equipment, all painting and the various other functions usually pertaining to a shop of a large street-railway company.

Arrangements have been completed recently for removing the shops to a site in the southeastern part of the city, bounded by Monroe, Macomb, St. Alban and Dequindre Streets. This block has been occupied by the old Pullman car shops, which are being altered to meet the requirements of the street-railway company. The new shops will be 642 feet long and will consist of two buildings, 70 and 80 feet wide, respectively, located on each side of a transfer pit, over which will travel an electrically driven transfer table, 52 feet long. There will be provided in one building a paint shop, 287 feet long, a fireproof paint store, an oil room, a wood mill, 109 feet long and three stories in height, coal storage, an engine and boiler room, a machine shop and a blacksmith shop. In the second story, over the machine shop, will be located the electrical department, connected with the floor below by means of a 6,000-pound elevator. In the blacksmith shop there will be located a brass foundry, the core oven of which will be two stories high, the upper half being used for baking armatures, fields, etc. All overhead work in the shops will be equipped with air lifts, operated by an air compressor, while electric motors will supply the power for operating the machines.

In the building on the opposite side of the transfer pit will be located a car-erecting shop, 212 feet long, a truck shop, 164 feet long, and an office, 68 by 80 feet, with a storeroom above. At one end of this building and connecting with the city system will be a set of 15 parallel tracks for yard purposes. Tracks will run from the transfer pit into the various shops and a special dummy car is being built to haul or push the cars and trucks onto the transfer table and into the shops. This car will be eight feet four inches long and six feet 6½ inches wide and will be covered. It will be mounted on a single truck and equipped with two motors, and will be operated by the transfer-table man. It is expected that with a force of 250 to 300 men the company will have the facilities in the new shops of building a car a day.

Employes and Publications.

The Detroit United Railway employs about 1,500 men. The conductors and motormen receive 23½ cents an hour and nine hours constitute a day's work. Beginning last January, Albert H. Stanley, general superintendent of the railway, put into effect a general merit and demerit system of discipline. All punishment for neglect of duty, violation of rules and bad conduct is now made by reprimand, demerit marks, or dismissal from the service. A complete record of all the men is kept and all discipline imposed is shown on this record. On the other hand, merit marks are given for excellent conduct, deeds of heroism, loyalty, etc., and these credits are given full consideration in connection with the charges entered against any conductor or motorman.

The publications issued directly and indirectly by the Detroit United Railway for public distribution are a valuable feature of the company's work. One of these is called the Detroit United Weekly and is a little four-page sheet, four by six inches in size. It contains information about the service and also some miscellaneous reading. A bunch of the weeklies is carried on each car in a box, so that passengers can help themselves or have the conductor distribute them. The idea of issuing these little sheets originated with President Hutchins, and it is believed to have had very beneficial results.

The Electric Railway Publishing Company, of which General Superintendent Albert H. Stanley is president, publishes on the first of each month an official guide to the time tables of the electric railways radiating from Detroit and also the Toledo railways and the steamship lines. This guide contains maps of the lines, rates of fares, distances, etc., and is distributed free on all suburban cars, at the hotels in Detroit and towns on the electric lines and at all stations.

Besides these periodicals, the Detroit United Railway and Rapid Railway issue hunters' guides, booklets descriptive and illustrative of the suburban towns and Detroit, circulars in regard to the Yolande observation trips, maps and various other literature, as the season and occasion demand.

Financial and Personal.

The Detroit United Railway's gross earnings for the year ended December 31, 1901, were $2,919,171.36 and the net earnings from operation $1,322,405.76, while the surplus income was $170,129. There were 62,822,749 revenue passengers carried during the year 1901, 17,470,227 transfer passengers and 826,135 employe passengers, making a total of 81,119,111. The average receipts per passenger were 3.54 cents. The car mileage was 16,080,041 and the net earnings per car-mile were 8.22 cents. The passenger earnings for the first eight months of 1902 were $2,196,916.75, an increase of $280,572.79, or 14.64 per cent. over the corresponding months of last year. During the first eight months of last year the expenses amounted to 54.78 per cent. of the gross earnings, while for the corresponding period of this year the percentage was 56.42. The Everett-Moore syndicate is still the controlling factor in the company, although no one person owns a majority of the stock. The company is capitalized at $12,500,000 and has issued $16,980,000 in bonds, while $400,000 worth have been sold to be taken later.

The present officers of the Detroit United Railway are the following-named gentlemen: President, J. C. Hutchins; vice-president, Arthur Pack of Orchard Lake, Mich.; treasurer, George H. Russel; secretary, Edwin Henderson of New York city; assistant secretary and purchasing agent, A. E. Peters; general superintendent, Albert H. Stanley; assistant general superintendent, Harry Bullen; auditor, Irwin Fullerton; superintendent of motive power, Thomas Farmer; assistant superintendent of motive power, E. J. Burdick; superintendent of tracks, John Kerwin; claim agent, Walter Ross; general express and passenger agent, George H. Parker; assistant general passenger agent, John H. Fry. The board of directors is constituted as follows: Henry A. Everett of Cleveland, Ohio, chairman, J. C. Hutchins of Detroit, E. W. Moore of Cleveland, Ohio, George H. Russel of Detroit, J. G. Schmidlapp of Cincin-

nati, Ohio, R. B. Van Cortlandt of New York city, H. R. Newcomb of Cleveland, Ohio, Arthur Pack of Orchard Lake, Mich., and R. A. Harman of Cleveland, Ohio.

Interurban Lines of Detroit United Railway.

Farmington and Orchard Lake Division.

The interurban line of the Detroit United Railway system running to Farmington, Orchard Lake and Pontiac, with a branch to Northville, gets its power from a generating station located at Farmington Junction, 19 miles from Detroit. The power house, shown in Fig. 22, is of brick construction and has engine and boiler rooms, each 120 by 52 feet in size. The engine-room equipment (Fig. 24) consists of three Reynolds-Corliss 26 by 48-inch simple

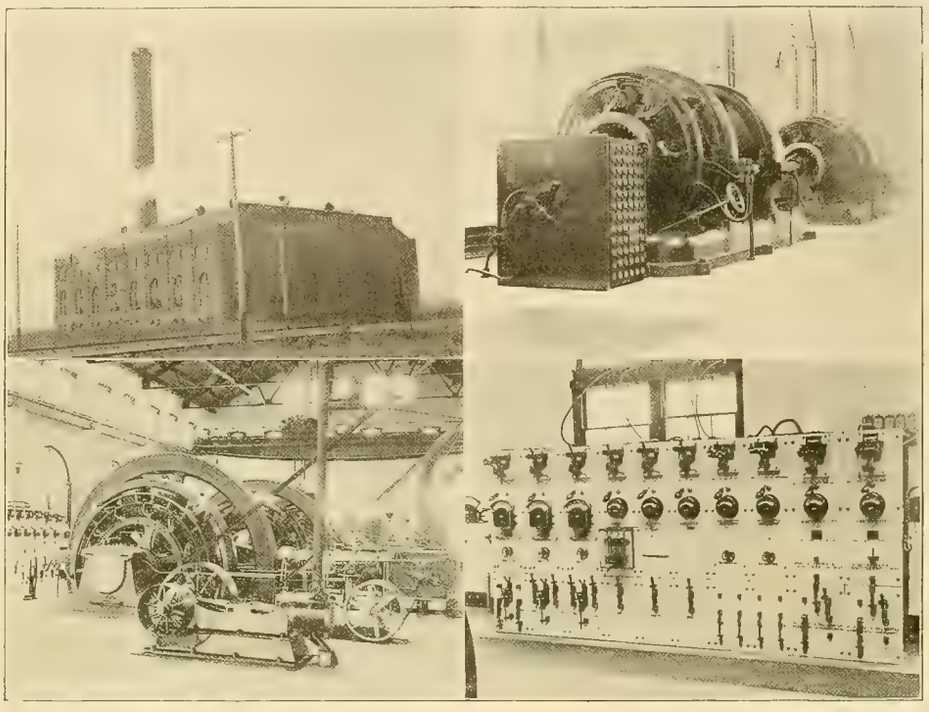


Fig. 22. Exterior of Station.
Fig. 24. Engine Room.
Fig. 23. Booster Sets.
Fig. 25. Main Switchboard.

ELECTRIC RAILWAYS AROUND DETROIT.—FARMINGTON POWER HOUSE ON ORCHARD LAKE DIVISION.

horizontal engines, direct-connected to 400-kilowatt, 650-volt, direct-current Siemens & Halske generators. The boilers are of the Aultman & Taylor water-tube type and of 250-horsepower capacity each. They are eight in number, set in batteries of two each, and are equipped with Murphy stokers. Two 100-kilowatt, General Electric boosters (Fig. 23) are used on increased loads to raise the potential on the two main feeder lines, one of which extends 14½ miles toward Detroit, abutting the Grand River Avenue section of the city system, and the other, 15 miles

FIG. 26. ELECTRIC RAILWAYS AROUND DETROIT. SUB-STATION AT OXFORD ON FLINT DIVISION.

to Pontiac. The switchboard for this station is shown in Fig. 25.

Pontiac Division.

The Pontiac interurban line is fed from a power station located at Birmingham, 18 miles from Detroit. The equipment here consists of two Westinghouse vertical compound engines, 16 and 30 by 18 inches in size, belted to two 250-kilowatt, direct-current, 650-volt Westinghouse generators. A 250-horsepower Babcock & Wilcox water-tube boiler and three 125-horsepower, fire-tubular boilers supply the steam for the engines and auxiliaries. This station feeds 7½ miles north to Pontiac and south about 11½ miles.

There is also situated at Pontiac a station that is only used for emergencies. It contains a 16 by 15-inch Dick & Church and a 15 by 16-inch Ball engine, belted to Westinghouse 100-kilowatt generators, and two Phœnix 125-horsepower boilers. Men are transferred from the company's shops in Detroit to operate this station when needed, no force being kept there.

Flint Division.

On the Flint division, extending from Royal Oak on the Pontiac line to Rochester, Oxford and Flint, with a branch to Romeo, is used the only alternating-current system employed by the Detroit United Railway. The power house is located at Rochester, 28 miles from Detroit, and sub-stations are situated at Oxford and Atlas, 13 and 30.5 miles, respectively, from the power house. The generating equipment at Rochester consists of the following: Two Ball & Wood horizontal tandem-compound, condensing 15½ and 28 by 26-inch engines, direct-connected to 200-kilowatt, Crocker-Wheeler direct-current generators; one Ball & Wood vertical compound, condensing 22½ and 45 by 20-inch engine, direct-connected to a 400-kilowatt, Crocker-Wheeler generator; a 60-kilowatt booster, and a 90-kilowatt, 115-volt, direct-current generator, that furnishes the commercial lighting in Rochester. At present a 250-kilowatt inverted Stanley rotary converter is used to supply the alternating-current transmission system, but a 500-kilowatt Bullock alternator, connected to a 750-horsepower Ball & Wood engine, is now being erected to take care of the alternating load. The boiler equipment consists of four Aultman & Taylor 250-horsepower boilers, and an additional boiler of the same capacity is now being erected.

This power station, in connection with the booster mentioned, supplies a direct-current feeder line extending southward a distance of 14.8 miles. The alternating-current transmission extends northward along the line and consists of two three-phase, 25-cycle, 15,000-volt circuits of No. 4 aluminum wire. The wires are carried most of the way 24 inches apart at the points of an equilateral triangle, with grounded barb wire on top of the poles, the latter being 40 feet long and spaced 110 feet apart. The equipment of each of the sub-stations consists of two 250-kilowatt rotary converters, with the necessary switching arrangements and transformers, the direct-current voltage being 600 and the alternating 360 volts. An exterior view of the Oxford sub-station is illustrated in Fig. 26.

A direct-current feeder is also carried north from Rochester and equalizes with the direct-current feeder from Oxford at a point dependent upon the location of the load. The Oxford station also feeds north and equalizes with the south feeder from

FIG. 27. ELECTRIC RAILWAYS AROUND DETROIT.—LOG-CABIN WAITING ROOM AT PALMER PARK.

Atlas, while the latter feeds north 10 miles to Flint. All direct-current feeders are of No. 0000 bare-copper wires. The Romeo branch is fed by a direct-current 12-mile feeder from Rochester. All trolley wire on this line is of No. 00, Fig.-8 section.

Standard Overhead and Track Construction.

The standard overhead construction that has been adopted for the interurban lines of the Detroit United Railway calls for a No. 00, Fig.-8 trolley wire, supported by iron-tubing brackets from 30-foot cedar poles. The feeder lines are supported on glass insulators, mounted on a two-pin, three-inch cross-arm. A metallic-circuit telephone line of No. 10 copper wire is carried on the poles, with transpositions every 10 poles. The poles are painted black for the first five feet and an olive-green above, the butts being tarred. They are set 48 to the mile. The track consists of five-inch T-rails, set on eight-

FIG. 28. RAPID RAILWAY SYSTEM.—MAIN POWER HOUSE AT NEW BALTIMORE.

inch oak or cedar ties, on four inches of gravel or crushed stone.

Express and Freight Business.

An extensive express and freight business is handled on the interurban lines, the goods being received and distributed at an express depot in the city. This depot was built by the Electric Depot Company, and the expenses are proportioned between the Detroit United, Rapid Railway and Ann Arbor-Jackson systems, all lines using the depot. Six express cars and two extra milk cars are regularly operated by the Detroit United, four express cars by the Rapid, and the same number by the Ann Arbor-Jackson line. A central waiting room and ticket office for all the interurban lines is located at 70 Woodward Avenue, at the corner of Jefferson Avenue, and two blocks from the City Hall.

Detroit and Toledo Connection.

The Detroit and Toledo Shore Line Railroad Company within the last year completed an electric line

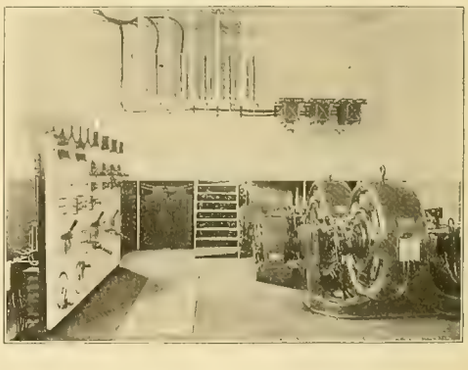


FIG. 30. RAPID RAILWAY SYSTEM.—SUB-STATION AT ALGONAC.

from Toledo to Detroit, with about 60 miles of track, and the road was about to be placed in operation when the Everett-Moore financial crisis came. It was found necessary to dispose of the road, and it has just recently been purchased by the Grand Trunk Railway Company (steam). The overhead equipment has been sold to men interested in the Toledo and Monroe Railway, which will now be extended from Monroe northward to Trenton, connecting with the Detroit United Railway at that point. This will give a through connection from Detroit, Flint, Pontiac and Port Huron with Toledo and its connecting lines, and eventually with Cleveland and Ohio cities when certain proposed lines are constructed.

Rapid Railway System.

The interurban electric railway operating between Detroit, Mt. Clemens and Port Huron, is known as the Rapid Railway System. It covers 122.5 miles outside of Detroit, the longest line operated being

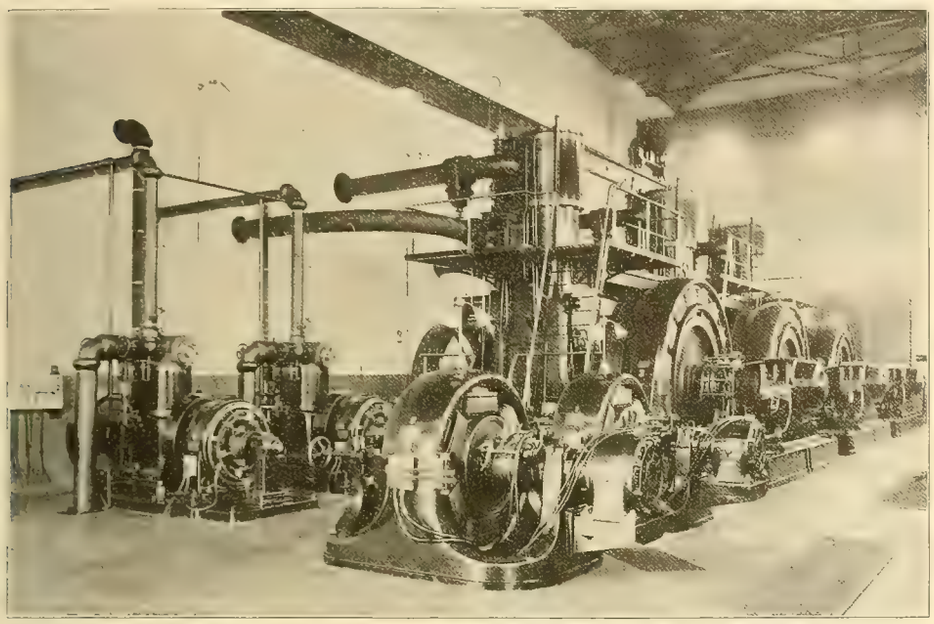


FIG. 29. RAPID RAILWAY SYSTEM.—ENGINE ROOM OF NEW BALTIMORE POWER HOUSE.

from the Michigan Central depot in Detroit to Port Huron, a distance of 73 miles. A city system of 13 miles in Port Huron and the Shore Line between Grosse Pointe and Mt. Clemens (17½ miles) as indicated on the map (Fig. 11, page 222) are included in the system. An hourly schedule is maintained between Detroit and Port Huron and a half-hour service between Detroit and Mt. Clemens on the main line, with an hourly service on the Shore Line.

The generating station for the system is located at New Baltimore, 32 miles from Detroit. An alternating-current transmission system is used with direct-current distribution from six sub-stations. This railway, it is said, was the first to adopt the alternating-current system with steam as the primary power. The main power house is illustrated in Fig. 28, while Fig. 29 gives a view of the engine room. The station has a rated capacity of 1,500 kilowatts, the equipment consisting of three 1,200-horsepower Westinghouse World's Fair-type, compound, condensing engines, direct-connected to three 500-kilowatt Westinghouse alternating-current generators, delivering a three-phase 390-volt current. Two engine-driven 30-kilowatt exciter dynamos are provided. The boiler plant consists of four 450-horsepower Babcock & Wilcox boilers, equipped with Roney stokers, a Green fuel economizer and forced draft. A complete condensing plant is installed.

The alternating current is stepped up to 16,000 volts, for transmission to the sub-stations. These sub-stations are located at the following distances from the power house at New Baltimore: Roseville, 18 miles; Mt. Clemens, 11 miles; New Baltimore (at power house): Algonac, 14 miles; St. Clair, 29 miles; Port Huron, 41 miles. At Roseville and St. Clair the sub-station equipment consists of three 200-kilowatt rotary converters, while each of the other four sub-stations has two 200-kilowatt rotaries. These machines have a direct-current voltage of 600 to 700 and 390 volts alternating. A typical sub-station, that at Algonac, is illustrated in Fig. 30, which shows the two rotary converters, switchboard, transformers, etc. At the New Baltimore sub-station the current for the rotaries is taken directly through the bus-bars from the generators. All of the power-house and sub-station electrical machinery is of the Westinghouse manufacture and was installed by Westinghouse, Church, Kerr & Co.

Two No. 00, Fig. 8 trolley wires are used and the standard feeder cable is 450,000 circular mils in size. The transmission wires are of No. 4 bare copper. The side-pole trolley suspension is used and the track is gravel ballasted and of standard steam-road construction. A telephone system is employed for train despatching, with a station at every turn-out and dispatcher's office at Mt. Clemens.

The rolling stock of the Rapid Railway includes 32 double-truck interurban passenger cars, five double-truck express cars, two double-truck postal cars and 36 flat cars. The city systems in Port Huron and Mt. Clemens are operated with 15 open and 15 closed cars and two baggage cars. The lengths of the interurban cars are from 44 to 52 feet, and the seating capacity of the largest is 52 passengers. The motor equipments vary, some cars having only two motors and some being supplied with four.

An average schedule speed of 30 miles an hour is maintained on the interurban lines and 16 miles an hour in the city. The passenger rates are about 1¼ cents a mile, and freight is handled on regular class rates, under standard railroad classifications. Between Marine City and Chesterfield, a point on the Grand Trunk Railway System, the Detroit and River St. Clair Railway, a company subsidiary to the Rapid Railway Company, operates a steam freight service with three locomotives.

The Rapid Railway System has the following-named officers: President, J. C. Hutchins; vice-president and general manager, F. W. Brooks; treasurer, George H. Russel; auditor, H. S. Swift; general superintendent, W. O. Wood of Port Huron; chief engineer, A. C. Marshall of Roseville.

Detroit, Ypsilanti, Ann Arbor and Jackson Railway.

The Detroit, Ypsilanti, Ann Arbor and Jackson Railway, popularly known as the "Ypsi-Ann" road has a main line extending from the Detroit city lim-

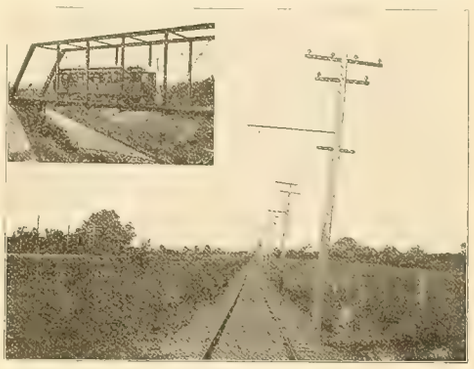


Fig. 31. Trestle over Michigan Central.
Fig. 35. Double Transmission Line.
DETROIT, YPSILANTI, ANN ARBOR AND JACKSON RAILWAY.—TRACK VIEWS.

its through Dearborn, Wayne, Ypsilanti, Ann Arbor, Chelsea and Grass Lake to Jackson, a total distance of 76 miles from the City Hall in Detroit. A branch line, 10 miles in length, is operated between Ypsilanti and Saline, the total length of tracks owned by the company being about 87 miles. The road closely parallels the Michigan Central steam railway for nearly its entire length and competes with the latter, with lower fares and more frequent service.

The main power house of the Detroit-Jackson road is located at Ypsilanti, on the bank of the Huron River. It has a rated capacity of 2,000 kilowatts and supplies an alternating-current transmission to six sub-stations and also direct current for one section of the road. Fig. 32 is a view of the car barn, repair shop and power house at Ypsilanti, the latter being shown at the right and in the rear.

Fig. 33 is a general view of the engine-room equipment, which consists of eight 250-kilowatt generators, direct-connected at 250 revolutions to vertical, compound, condensing Westinghouse engines with cylinders 18 and 30 by 16 inches. Five of these generators are 390-volt, three-phase alternators, with a frequency of 3,500 alternations, or 29 1-6 cycles. The other three machines are double-current generators, the alternating side delivering the same current as the straight alternators, and the direct-current side delivering a 650-volt current. Exciting current is supplied by two 50-kilowatt, direct-current dynamos, directly driven by Westinghouse compound condensing nine and 15 by nine-inch engines.

The boiler plant at Ypsilanti consists of eight 225-horsepower Babcock & Wilcox boilers, set in batteries of two each. They are equipped with Roney stokers and mechanical draft. The boilers are arranged as two duplicate plants of four boilers each, one of which is illustrated in Fig. 31.

The direct-current switchboard in the engine room is provided with three generating, one exciter and two feeder panels, and the alternating board has

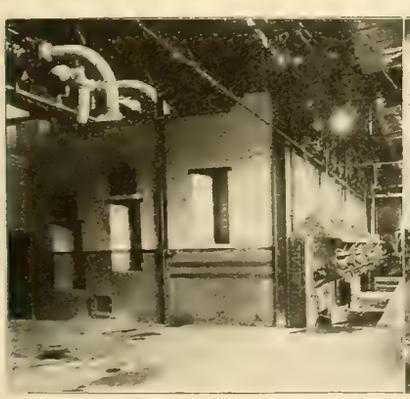


Fig. 31. Boiler Room of Power House.

Fig. 32. Car Barn, Repair Shop and Power House at Ypsilanti.
DETROIT, YPSILANTI, ANN ARBOR AND JACKSON RAILWAY.

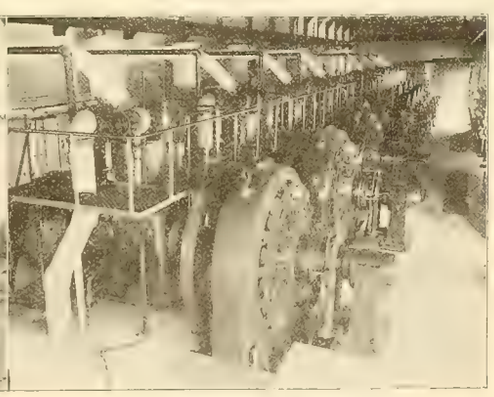


Fig. 33. Engine Room of Power House.

eight generator panels and three feeder panels. The alternating current is stepped up by four (one in reserve) 500-kilowatt transformers to 22,000 volts and transmitted west by two circuits and east by one circuit. The west line consists of a No. 4 wire circuit, transmitting to sub-stations located at Ann Arbor, eight miles, Lima Center, 19½ miles, and Francisco, 30 miles, and a No. 3 wire circuit, transmitting to Michigan Center, a distance of 40½ miles. The east line is made up of No. 4 wire and transmits to Wayne, 12 miles, and to Dearborn, 20 miles. A view of the double transmission line and track west of Ypsilanti is shown in Fig. 35, while Fig. 34 shows one of the interurban cars passing over a high steel bridge, by means of which the Michigan Central tracks are crossed just east of Ypsilanti.

The Francisco sub-station is equipped with a 250-kilowatt rotary converter and three 100-kilowatt oil-insulated transformers. The equipment in each of the other five sub-stations consists of two 250-kilowatt rotaries, three 200-kilowatt transformers and a six-panel switchboard. These rotaries receive 390 volts alternating and deliver 650 volts direct current. The interior of the Ann Arbor sub-station is illustrated in Fig. 36. The exterior of the building, which also includes a waiting room, is illustrated in Fig. 37, and may be taken as typical of the sub-station buildings on the "Ypsi-Ann" line. All of the electrical equipment in the power house and sub-stations is of Westinghouse make.

Aluminum wire of 300,000 circular mils capacity is used for a feeder line from the Michigan Center sub-station, four miles west to Jackson. All the other feeder and transmission lines are of copper. A double No. 00 Fig.-8 trolley is used and the road is equipped with a telephone train-dispatching system.

The company has 27 double-truck passenger cars

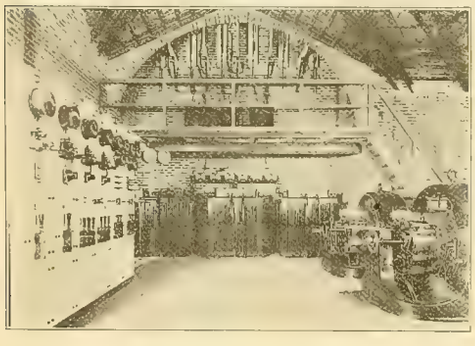


Fig. 36. Sub-station at Ann Arbor.

Fig. 37. Sub-station and Waiting Room, Ann Arbor.

DETROIT, YPSILANTI, ANN ARBOR AND JACKSON RAILWAY.

equipped with four 50 and 75-horsepower Westinghouse motors, four express cars equipped with 38B motors, and 10 single-truck cars for the city lines in Ann Arbor. The largest interurban cars are 52 feet long, weigh 32 tons and seat 56 people. Their average schedule speed is 25 miles an hour and they are operated on a 30-minute headway between Detroit and Ann Arbor and a 60-minute headway between Detroit and Jackson. The company has car barns at Ypsilanti, Dearborn and Jackson, and does all its repairing in its shops at Ypsilanti.

The officers of the Detroit, Ypsilanti, Ann Arbor and Jackson Railway are: President, J. D. Hawks; vice-president and treasurer, S. F. Angus; secretary, F. A. Hinchman; manager, F. E. Merrill; superintendent, S. J. Dill; master mechanic, J. M. Miller. The company is capitalized at $2,000,000 and is bonded for the same amount.

Relation Between Macadam Roads and Electric Railways.

In a paper read before the recent Good Roads Convention in Albany, N. Y., Edward P. North said: "The feeling of antagonism to trolley roads, which destroy a newly made macadam and permanently impair the usefulness of the road for wagons, automobiles and wheels, should not make us forget their great value in distributing population. At the same time the companies exploiting them should be required to join the local authorities in widening all roads used by them. In some parts of Massachusetts the entire cost of widening roads has been thrown on the trolley company. This may not be entirely just. The question, however, should receive the study of this convention, both now and hereafter; for such a distribution of the cost as shall not impede trolley building to the loss of the country inhabitants and real estate values, and at the same time be just to the property owners, cannot be made without consideration."

INTERURBAN ELECTRIC RAILWAYS IN THREE STATES.

It happens, by an interesting coincidence, that the three states—Ohio, Indiana and Michigan—which have witnessed and are witnessing the greatest development of interurban electric railways are the states that are in closest proximity to the city of Detroit, the place of holding the annual convention of the American Street Railway Association next week. It is particularly appropriate, therefore, to review at this time this remarkable growth of electric railroading, which, to some extent invading the domain before reserved exclusively for the steam railroads but in greater part opening up virgin fields of transportation, is destined to have a most marked effect on the future growth and prosperity of the suburban and rural districts of the United States. To what extent the electric motor will supplant the steam locomotive on trunk-railroad lines now existing and hereafter to be constructed is, of course, like everything else in futurity, unknown. But it is known that what is now called the interurban electric railway has amply demonstrated its great value and usefulness all over the country, but more particularly in the three states selected as examples. The extension of electric railways is continuing at a surprising rate, so that the accompanying articles and maps should prove both valuable and interesting.

Ohio.

In a consideration of the development of the electric-railway business of Ohio it is a rather difficult matter to distinguish between the propositions that will eventually terminate successfully and those which will get no further than the paper upon which they have been outlined. Many lines have been projected in the best of faith, but for one reason or another their promoters have allowed them to die, while others have been planned only to be sold at a profit to some competing company. Still others will be taken up and built within the next few years, probably by an entirely different set of men from those who first made the plans. The franchises and right-of-way privileges are usually limited to one or two years, and a large number of them will expire without any work being done. In the accompanying map only those lines which are in operation, under construction or with seemingly good prospects of construction are shown. There are a multitude of others which may or may not get any further along than the incorporation and organization of a company with a nominal capital stock.

A year or two ago it was little trouble to finance a really good proposition, and it looked as if the state would be covered with a network of lines in a very short time, but of late this has become a more difficult task, and money can be secured only on gilt-edged propositions. The financial difficulties of the Everett-Moore syndicate has probably had something to do with this, but the manner in which that syndicate has handled its business since the failure and the figures which the stock in some of its corporations have reached show that the business itself was not at fault, but rather that the syndicate overreached itself for the time being.

Five points in the state may be considered electric-railway centers, with several other intermediate points of more or less importance. The first of the five, for completed, operating and paying roads, is Cleveland. The group of roads that center about Cleveland is made up of the Lake Shore, the Northern Ohio Traction Company, the Cleveland, Painesville and Eastern, the Cleveland, Painesville and Ashtabula, the Pennsylvania and Ohio, the Conneaut and Eastern, the Cleveland, Elyria and Western, the Cleveland and Southern, the Eastern Ohio Traction, and the Cleveland, Richfield and Akron.

In the Toledo group there are eight roads: The Toledo and Monroe and the Shore Line, the Toledo and Western, the Toledo and Bryan Air Line, the Toledo and Indiana, the Toledo and Maumee Valley, the Toledo, Bowling Green and Southern, and the Toledo, Fostoria and Findlay. The Lake Shore also reaches this city, and might be considered with the group in connection with Cleveland.

The Columbus group is also made up of eight lines: Columbus, London and Springfield, Columbus, Delaware and Marion, Columbus, New Albany and Johnstown, Columbus, Buckeye Lake and Newark, Columbus, Grove City and Southwestern, Columbus Railway Company, Scioto Valley Traction Company, and the Urbana, Mechanicsburg and Columbus.

Dayton has six lines, radiating in all directions. They are the Dayton, Springfield and Urbana, the Dayton and Xenia Traction Company (three lines), the Cincinnati, Dayton and Toledo, the Dayton and Western, the Dayton and Northern, and the Dayton, Covington and Piqua.

In all, Cincinnati may be considered to have eight lines, although one of them properly belongs to Dayton. They are the Millcreek Valley Traction Company, the Hamilton, Glendale and Cincinnati lines (which really form one line), the Rapid Railway Company, the Suburban Railway Company, the Cincinnati and Eastern, the Cincinnati Northwestern, the Cincinnati, Dayton and Toledo Traction Company, and the Cincinnati, Georgetown and Portsmouth.

Springfield, Findlay, Norwalk, Akron and some other towns of the state may also be considered as important centers, but they really have become so through their location as connecting points for various lines. The section about Cleveland and Toledo is thoroughly covered with roads and in the central and southwestern portions of the state the building has been going on at such a rate that it will be but a short time until the service will be complete. In the southern and eastern portions there are but few lines. The country is hilly and rough; therefore costly to develop; but it will be only a question of time until promoters will reach it.

It may be well to consider, somewhat in detail, first the properties of the Mandelbaum, or Mandelbaum-Pomeroy syndicate.

The most important of these is the Cincinnati, Dayton and Toledo Traction Company (No. 59 on the map), which has its headquarters at Hamilton. It is a consolidation of the Southern Ohio Traction Company and the Cincinnati Northwestern Railroad Company, through the purchase of which it gained an entrance to Cincinnati within four miles of Fountain Square. The Southern Ohio Traction Company was originally formed by the purchase of the Dayton Traction Company, the Cincinnati and Hamilton Electric Street Railway Company and the Cincinnati and Miami Valley Traction Company. A few months ago the Hamilton and Lindenwald Street Railway Company and the Miami and Germantown Traction Company were combined with it. A short time since the company was defeated in its efforts to keep the Hamilton, Glendale and Cincinnati Traction Company (61) from building its lines into Hamilton, and, in turn, it is now reported that an arrangement has been made with the Cincinnati Traction Company by which its cars will go to Fountain Square, Cincinnati. With this arrangement goes an agreement, it is said, by which the Widener-Elkins-Dolan syndicate will become heavily interested in the Mandelbaum properties. In that event, it is probable that they will be extended and connected up to form a continuous line across the state. The line at present extends from Cincinnati through Hamilton to Dayton, and includes the Hamilton and Dayton systems, with a branch from Miamisburg to Germantown. The officers of the company are as follows: President, M. J. Mandelbaum; first-vice-president, Will Christy; second vice-president, O. V. Parrish; secretary, H. C. Lang; treasurer, F. T. Pomeroy.

Probably the next most valuable property owned by the syndicate is the Western Ohio Railway Company's lines (49), which are now in operation from Lima to Celina, through Wapakoneta and St. Marys on the Grand Reservoir, with a branch extending from St. Marys to Minster. The company also has a line under construction from Wapakoneta to Sidney, and another from Lima to Findlay. There has been some talk that traffic connections would be made with the Toledo, Bowling Green and Southern (6) to reach Toledo, but this syndicate is interested in the Toledo, Fostoria and Findlay Railway Company (7), which now has a short line in operation between Findlay and Fostoria, with a proposed line reaching Toledo. With this built and the line between Lima and Findlay completed, that would give them a good line from Sidney to Toledo. The Clegg-Winters syndicate operates the Dayton and Troy (52), which reaches Piqua, and the Dayton, Covington and Piqua Traction Company (53) also reaches the same point. With a short line from Piqua, connecting this point and Sidney, the southern terminus of the Western Ohio, the line would be complete from Toledo to Cincinnati.

The first interurban road built from Cleveland is the Cleveland, Elyria and Western (12), which was planned by F. T. Pomeroy and others, who, with M. J. Mandelbaum & Co., financed it. It may, therefore, be considered in connection with the other properties in which these gentlemen are interested. Originally intended to reach from Cleveland to Elyria, it is now in operation from Cleveland to Norwalk, with branches to Medina, Wellington and Grafton. It parallels the Lake Shore Electric from Berlin Heights to Norwalk. The Cleveland and Southern (13) is a southern extension of this line from Berea to Wooster. It is completed to Medina

and the remainder is under construction. It would not be a difficult matter to connect these lines with the Western Ohio at Tiffin, and thus give a line into Cleveland from the western portion of the state and also connect Cleveland and Toledo. Another line which may be considered a southern extension of the Cleveland, Elyria and Western is the Cleveland, Ashland and Mansfield (41). It will be about 38 miles in length, but so far no construction work has been done on it. It is said that it is the intention of the promoters to extend this to Marion, where it will connect with a Columbus line, thus forming a through route.

The Springfield and Xenia Traction Company (73) was formerly the Little Miami Traction Company, organized by John P. Martin of Xenia, who intended to extend the line through to Cincinnati. This road passed into the hands of the Mandelbaum-Pomeroy syndicate

to Zanesville. The Urbana, Bellefontaine and Northern (75) is under construction from Urbana to Bellefontaine, and will be extended to Kenton.

H. A. Fisher is engaged in building the Columbus, Delaware and Marion (39), in which J. S. Harshman, J. G. Webb and others are interested. These gentlemen have acquired the Worthington, Clintonville and Columbus line, and the construction between Columbus and Delaware is almost completed. As soon as that portion is in operation, the line from Delaware to Marion will be constructed.

The Columbus, New Albany and Johnstown line (79), promoted by L. P. Stephens, is completed and most of it in operation. It is about 23 miles in length. Another road out of Columbus is the Urbana, Mechanicsburg and Columbus Railway Company (45), which was promoted by General H. A. Axline of Columbus, who is now president and general manager. The road is under construction from Columbus to Urbana.

The Scioto Valley Traction lines (47) are now well-nigh completed from Columbus to Lancaster and from Columbus to Circleville. It is probable that the two main lines of the road will be extended to Portsmouth and Athens. The Columbus Railway Company operates a line (44) to Westerville and a park, which has been built about eight miles out.

The fight that has been made by various people of Cincinnati against the entrance of traction lines has prevented the latter from making the development in that section that might otherwise have resulted. However, it seems that the way has now been opened, and the future will not be so full of difficulties. Lines have been built into the suburbs on all sides and are ready to build to the heart of the city as soon as the petitions to do so are granted. There are but three roads operating any distance out of the city at present. The most important is the Cincinnati, Dayton and Toledo (59), which has already been mentioned. The second is what are now known as the Cincinnati Suburban Traction Company lines (61), which are composed of the Millcreek Valley Traction Company line and the Hamilton, Glendale and Cincinnati Traction Company, a continuation of the first from a point near Cincinnati to Hamilton. Cars have been in operation over these lines for some time, but only lately have they won their suit in the courts to build into the city of Hamilton. The owners of the Cincinnati Traction Company form the new company, which will operate these lines under lease. The cars will go to Fountain Square, Cincinnati, from the terminus of the Millcreek Valley, over tracks owned by the Cincinnati Traction Company.

The Cincinnati, Lawrenceburg and Aurora Electric Street Railroad Company (67) is owned by J. C. Hooven of Hamilton, Stanley Shaffer and others. Its line has within the last year been placed in operation to Lawrenceburg and Aurora, Ind. The Cincinnati and Northeastern (83), in which B. M. Hopkins and others are interested, proposes to build a line from Cincinnati to Dayton, via Middletown, and some construction work has already been done.

The Cincinnati, Georgetown and Portsmouth Railway Company (65) is a steam line, which A. W. Comstock of Detroit and others purchased some time ago, and are now transforming into an electric line. It is the intention to build the line through to Ripley and Portsmouth. There are now 42 miles of track built.

George R. Scrugham is the promoter of three roads about Cincinnati which will form important links to the country towns when completed. They are the Suburban Railway Company (63), with a line under construction from Cincinnati to Bethel, about 26 miles; the Rapid Railway Company (62), building a line from Cincinnati to Lebanon, with a proposed line to Dayton, and the Cincinnati and Eastern Railway Company (64), which has a line under construction from Cincinnati to New Richmond, on the Ohio River, a distance of about 31 miles.

The Cincinnati, Hamilton and Indiana Traction Company (82) has lately been organized for the purpose of building a line from Hamilton through Oxford to College Corner on the Indiana state line. It is expected to connect at the state line with important lines in the adjoining state.

The Dayton and Xenia Traction Company (57) was organized in April, 1901, and is made up of a combination of the lines of the Rapid Transit Company and the Dayton and Xenia Transit Company. Two lines are in operation from Dayton to Xenia and one from Dayton to Spring Valley. The Clegg-Winters syndicate controls the Dayton and Western Traction Company (55), which is in operation from Dayton to Eaton, and the Dayton and Troy Electric Railway Company (52), with a line in operation from Dayton to Piqua, and an extension under construction from the latter point to Sidney. The Dayton, Covington and Piqua Traction Company (53) has a line extending to Piqua through Covington. The Dayton and Northern Traction Company (54) has a line in operation from Dayton northwest to Greenville. The Dayton and Kenton Railway Company (56), of which E. M. Hopkins is president, proposes to build a line from Dayton to Kenton, through St. Paris, DeGraff and other towns. The line on the map is run through straight, as it was impossible to follow it from the description in the incorporation papers. In speaking of the roads about Toledo, the Lake Shore (8) will be omitted on account of the full consideration of it given elsewhere. The Toledo and Western (2) has lines in operation from Toledo to Fayette, Ohio, with an extension under construction to Pioneer, and from Toledo to Adrian, Mich. The Toledo, Fayette and Western Railway Company has recently been incorporated by the same people to extend the road to the Indiana line from Fayette. The Toledo and Bryan Air Line (3) and the Toledo and Indiana (4) are under construction. The Toledo, Bowling Green and Southern Traction Company (6), under the control of the George B. Kerper, and others of Cincinnati, has absorbed the Toledo, Bowling Green and Fremont and the Findlay city lines, which have been connected to form a Toledo-Findlay route.

The Sandusky, Bellevue, Monroeville and Norwalk Electric Railway Company (77) has been under construction for two years, and a portion of it is completed, but it has not been put in operation.

Other lines and proposed lines may be briefly mentioned as follows:

Clyde, Tiffin and Southern Railway Company (9). Line proposed from Sandusky to Upper Sandusky. No construction work done.

Lake Erie, Bowling Green and Napoleon (10). Luther Black and others interested. Short line between Bowling Green and Pemberville in operation. Planned to build from Port Clinton to Defiance.

Tiffin and Port Clinton Railway Company (11). Under control of Kerline Bros., and the greater part is under construction.

Cleveland, Richfield and Akron Transit Company (23). No work done on construction.

Stark Electric Railway Company (25). Line under construction from Canton to Alliance and Salem. Operating from Alliance to Sebring. Controls Alliance street railways.

Akron-Alliance Connecting Railway Company (26). Line proposed connecting Akron and Alliance by direct route.

Salem, Lisbon and East Liverpool Traction Company (27). Proposed line will form a continuation of the Stark Electric Railway from Salem to East Liverpool on the Ohio River.

Conneaut and Southern (29). Proposed line directly south from Conneaut to Youngstown.

Steubenville Traction and Light Company (30). Line in operation from Steubenville to Toronto.

Steubenville, Mingo and Ohio Valley Traction Company (31). Line in operation from Steubenville to Brilliant, down the river.

East Liverpool and Wellsville Railway Company (32). Short line in operation between the two towns.

Wheeling Traction Company (33). Operating lines from Bridgeport to Bellaire, Bridgeport to Martins Ferry and Bridgeport to St. Clairsville.

Mount Vernon and Newark Traction Company (37). Line proposed between the two towns. No construction work done.

Mansfield, Cardington and Delaware Electric Railway Company (40). Proposed line between Mansfield and Delaware. No work done.

Ohio Central Traction Company (42). Lines in operation from Galion to Bucyrus and from Galion to Crestline, with a line under construction from Crestline to Mansfield.

Citizens' Electric Light and Power Company (43). Line in operation from Mansfield to Shelby.

Findlay and Marion Electric Railway Company (48). Proposed line through Carey and Upper Sandusky, connecting Findlay and Marion.

Toledo, Columbus, Springfield and Cincinnati Railway Company (50). Was organized to build a line from the lake to the Ohio River. It is shown on the map from Toledo to Columbus, but from there it is difficult to determine the proposed route. A small strip of grading has been done between Lima and Westminster.

The Xenia and Wilmington Traction Company (58). Proposes to build a line between the towns named, but no work has yet been done.

Ohio River and Interurban Railway Company (68). Short road between Portsmouth and Scioto-ville, in operation.

Camden Interstate Railway Company (69). Operates a line of road from Huntington, W. Va., to Ironton, Ohio. Road will probably be extended up the Ohio Valley and probably down to Portsmouth.

Ohio River Electric Railway and Power Company (70). Operates a line from Middleport through Pomeroy to Racine on the Ohio River.

Wellston and Jackson Belt Line (71). Operates road from Wellston through Coalton to Jackson. Owned by the Hocking Valley Railroad Company (steam).

Parkersburg, Marietta and Interurban Railway Company (72). Line in operation from a point opposite Parkersburg, up the river to Marietta.

Fort Wayne, Van Wert and Lima Traction Company (74). Organized to build a line connecting the towns named. No construction work done.

Defiance, Ottawa, Kenton and Columbus Interurban Railway Company (76). Incorporated to build an electric road from Defiance to Delaware, touching Ottawa, Kenton and Marion.

Lorain Street Railway Company (78). Operating a line from that city to Elyria; also another line, by

28. Adrian and Coldwater Railway.
18. Battle Creek and Coldwater.
35. Caro to Lake Huron.
25. Central Michigan Traction (from Vermontville to Charlotte and Eaton Rapids).
26. Corunna and Durand.
31. Detroit, Ann Arbor and Adrian.
21. Detroit, Howell and Lansing Railway.
13. Detroit, Plymouth and Northville Railway.
6. Detroit and Toledo Shore Line Railroad.
10. Detroit, Ypsilanti, Ann Arbor and Jackson Railway.
2. Flint Division (Detroit United Railway).
30. Grand Rapids, Belding and Ionia Railway.
12. Grand Rapids, Grand Haven and Muskegon Railway.
19. Grand Rapids, Kalamazoo and South Haven Traction.
7. Grand Rapids, Holland and Lake Michigan Railway
16. Indiana Railway.
32. Jackson and Lansing.
33. Jackson to Coldwater.
24. Kalamazoo Traction.
20. Lansing, St Johns and St. Louis Railway.
29. Lansing and Grand Rapids Railway.
37. Manistee, Filer City and East Lake Railway.
17. Michigan and Interurban Railway.
8. Michigan Traction.
23. Michigan, West Shore Traction.
21 Orchard Lake Division (Detroit United Railway).
1. Owosso and Corunna Electric Railway.
27. Pontiac Division (Detroit United Railway).
3, 11, 14. Rapid Railway System.
22. Saginaw Suburban Railway.
9. Saginaw Valley Traction.
15. St. Joseph and Benton Harbor Electric Railway.
4. Toledo, Adrian and Jackson Railway.
5. Toledo and Monroe Railway.
6. Wyandotte and Trenton Division (Detroit United Railway).

INTERURBAN ELECTRIC RAILWAYS IN MICHIGAN.

way of North Amherst, between the same points.

Buckeye Traction Company (80). Formed for the purpose of building a line from Bucyrus to Norwalk, through Annapolis, Chicago and New Washington. No construction work done.

The Springfield and Washington Court House Traction Company (81). Was organized by O. F. Dillman and others to build a line between the two points. No construction work has been done.

Findlay, Kenton, Bellefontaine and Urbana Railway Company (84). Was organized for the purpose of building a road to connect the towns named. It has been granted a franchise in Bellefontaine, and is securing right-of-way.

The Canton-Akron Railway Company (24). Has an excellent line in operation from Akron to Canton and Massillon and south to Navarre. From the latter place to Canal Dover a line is under construction, and only a few days ago a company was incorporated with a capital stock of $600,000 to build a line between these two points.

The Central Market Street Railway Company of Columbus was organized to build lines in the city and to construct a road from Columbus to Portsmouth by way of Lancaster. Its lines in the city are about completed, and it operates the interurban loop which was built by the Columbus, London and Springfield road.

Michigan.

The electric-railway situation in Michigan, as in other states, is constantly shifting, the status of projected lines and roads under construction being largely dependent on local and financial conditions not always under the control of the promoters. Practically all of the interurban lines, and the city systems for that matter, also, are located in the southern portion of the Lower Peninsula, where the larger cities of the state are situated. Naturally, the chief center for this development is at Detroit, with lines radiating to the principal towns in Southeastern Michigan. The situation of these Detroit lines has been set forth at some length on preceding pages in this issue, but a brief review of these interurban roads may be conveniently given here.

The Detroit United Railway, an Everett-Moore property, operates all of the city railway lines in Detroit, covering some 188 miles, and four interurban lines, with 191 miles of track. These interurban lines comprise a line (2) to Flint, 68 miles long, and passing through Royal Oak, Rochester, Lake Orion, Oxford and Atlas, with a branch from Rochester to Romeo; a line (27) to Pontiac, 26 miles, through Royal Oak and Birmingham; another line (21) to Pontiac, 34 miles, through Farmington Junction and Orchard Lake, with a branch to Farmington and Northville, and a line south (6) to Wyandotte and Trenton. The Detroit United Railway also controls the Rapid Railway System (3, 11, and 14), operating northeast from Detroit through Mt. Clemens, New Baltimore, Anchorville, Algonac, Marine City and St. Clair, with a shore line (11) to Mt. Clemens from Detroit through Grosse Pointe.

The only other electric railway now operating out of Detroit is the Detroit, Ypsilanti, Ann Arbor and Jackson Railway (10), which runs west from Detroit through the towns named and also Dearborn, Wayne, Chelsea and Grass Lake, with a branch from Ypsilanti to Saline.

The Detroit and Toledo Shore Line Railroad Company (6) had constructed a line connecting the city systems of those cities, but on account of the Everett-Moore financial difficulties, the road was sold to a steam railroad company. The overhead and electrical equipment will be used by the Toledo and Monroe Railway Company, now operating from Toledo to Monroe (5), to extend its line to Trenton, where it will connect with the Detroit United Railway.

The Detroit, Utica and Romeo Railway Company proposes to build from Detroit through Utica, Disco, Washington to Romeo, 33 miles, with a six-mile branch east to Macomb and Davis.

A road that was proposed some time ago was a line (21) from Detroit, northwest to Farmington, Howell, Fowlerville and Williamstown, and about 11 other towns to Lansing, making a road 85 miles long. Through the financial difficulties of the Detroit Construction Company, of which John Winter of Detroit was president, this road is still on paper.

An important through line, if it is finally built, will be that of the Detroit and Chicago Traction Company, which was organized to construct a line between Detroit and Chicago. This company has franchises and rights-of-way over portions of the distance and has acquired the Jackson and Suburban Traction Company and the Detroit, Plymouth and Northville Railway (13) and is said to be interested in the Michigan Traction Company (8). The Detroit, Plymouth and Northville is to be extended east from Nankin to Detroit and north to Walled Lake. W. A. Boland of New York city is heavily interested in this scheme.

The Michigan Traction Company just mentioned now operates 43 miles of track, connecting Kalamazoo and Battle Creek with a branch from Augusta to Gull Lake. East of Battle Creek, the Michigan and Interurban Railway Company is building a line to Jackson, through Marshall and Albion, and about half of the road is now completed. Connection will be made at Jackson with the Detroit, Ypsilanti, Ann Arbor and Jackson railway, giving connection between Kalamazoo and Detroit, a distance of 150 miles. Other roads projected from Battle Creek, will run to Coldwater (18) making connection with the Adrian and Coldwater railway (28), and to Lansing, through Charlotte. A line is also proposed from Jackson south (33) through Concord and Jonesville to Coldwater. The Toledo, Adrian and Jackson Railway Company (4) plans to connect the cities named, while a branch may be extended by the Ann Arbor road from Saline to Adrian (31).

The Jackson and Suburban Traction Company, also controlled by W. A. Boland, has 20 miles of city and suburban lines, including a road to Grass Lake, paralleling a portion of the Ann Arbor road. The Jackson and Lansing railway (32) is now under construction, and will probably be completed by next spring.

In the vicinity of Saginaw there is now operating the Saginaw Valley Traction Company (9) between Bay City and Saginaw. The Saginaw Suburban Railway Company (22) will connect Flint and Bay City via Saginaw. The Owosso and Corunna Electric Railway Company (1), now operating between those cities, contemplates building east from Corunna about 20 miles through to Flint (26). The Saginaw Southern may build from Saginaw south some 40 miles, through Chesaning to Owosso, thence to Lansing. East of Saginaw there has been proposed a line (27) from Pontiac north through Oxford and Lapeer to Vassar and Caro, while a line (35) would connect Caro with Lake Huron.

Grand Rapids is also being made quite a center for interurban roads. The Grand Rapids, Grand Haven and Muskegon railway (12) was placed in operation early this year, and bears the reputation of being one of the best interurban lines in the country. It is operated by means of the third-rail system. The Grand Rapids, Holland and Lake Michigan railway (7) has been in operation for nearly a year, connecting Grand Rapids with Granville, Zeeland, Holland and Saugatuck, and making connection at Holland with Chicago steamers. South from Grand Rapids, the Grand Rapids, Kalamazoo and South Haven Traction Company (19) is now building an interurban line.

The Hawks-Angus syndicate, which controls the Detroit and Jackson line and the Grand Rapids, Grand Haven and Muskegon Railway, is building the Jackson-Lansing (32) extension referred to above, and plans to build from Lansing to Grand Rapids. This will give a through line across the state. Part

1. Broad Ripple Rapid Transit
19. Chicago, South Shore Electric Railway
12. Cincinnati, Lawrenceburg and Aurora Electric Railway.
22. Evansville and Princeton Electric Railway.
11. Fort Wayne and Southwestern Traction
2. Indiana Electric Railway.
5. Indianapolis and Eastern Electric Railway
6. Indianapolis, Greenwood and Franklin Rapid Transit.
18. Indianapolis, Lebanon, Frankfort and Lafayette Railway.
9. Indianapolis and Martinsville Rapid Transit.
16. Indianapolis and Northern Railway
8. Indianapolis, Shelbyville and Southeastern Traction.
15. Indianapolis and Western Railway
14. Lafayette Electric Railway
17. Logansport, Rochester and Northern Electric Railway.
24. Muncie and Hartford City Electric Railway
20. Muncie and Portland Electric Railway.
13. Richmond Interurban Railway
23. Richmond and Northwestern Traction.
7. Terre Haute Electric Railway.
21. Union City and Portland Railway.
4. Union Traction.
10. Wabash River Transit.
3. Whiting, Hammond and Chicago Railway.

INTERURBAN ELECTRIC RAILWAYS IN INDIANA.

of the road between Grand Rapids and Lansing will be built by the Grand Rapids, Belding and Ionia Railway Company (30), the line running east from Grand Rapids through Ada, Lowell and Saranac to Ionia. A branch of this line will run from Lowell to Belding and Greenville.

Chief interest in the interurban roads of Michigan from an electrical standpoint centers in the Lansing, St. Johns and St. Louis Railway (20), now being operated by steam between Lansing and St. Johns. It is on this railway that B. J. Arnold's single-phase system of electric traction will be installed, and it is stated that the railway, with its electric equipment, is nearly ready for operation.

In the southwestern part of Michigan the only interurban line now operating is the short one between St. Joseph and Benton Harbor (15). The Michigan West Shore Traction Company (23) plans to connect St. Joseph and South Haven, and another line will connect St. Joseph with Kalamazoo through Hartford and Lawrence. The Kalamazoo Traction Company proposes to build from Kalamazoo to Paw Paw, Decatur, Cassopolis and Dowagiac. Along the lake shore the Indiana Railway Company (16) will build a line from South Bend, Ind., to St. Joseph, Mich.

At Manistee, in the northern part of the Lower Peninsula, the Manistee, Filer City and East Lake Railway Company (37) operate 14 miles of road connecting those towns. A road is also proposed which will connect Grand Rapids with Newaygo and Big Rapids, and also one from Traverse City to Old Mission (not shown on the map).

Indiana.

The development of interurban electric railroads in the state of Indiana is noteworthy. There are a score of roads in actual and profitable operation, half as many more under construction and a number of projected lines including at least four interstate trunk line. It is no extravagant assumption to say all will be built within a few years. Four years ago there was but one interurban electric line in operation within the state. The accompanying map shows that nearly 350 miles of line are actually in operation and half as many more under rapid construction. The state is peculiarly adapted to electric railroads, being for the most part level and dotted with numerous thriving towns and cities. The remarkable progress made by agriculture in the last few years prepared the farmer's mind for any development that may be suggested to further advance his interests. Capitalists were encouraged to come forward with projects to connect the farms of Indiana with the city markets by means of electric railroads. The plan received the hearty support of the rural communities, and all the reports from the working lines appear to justify the conclusion that the problem of cheap and rapid transportation for the products of the farm and garden has at last been solved.

Manifestly the service would have to be cheaper and more convenient than that afforded by the steam roads, and, as a matter of fact, it costs less than a third as much to ride on the Indiana electric cars than the regular fare for the same distance on the steam railroads. Packages may be sent cheaply and all sorts of light freight for 20 per cent. less than charged by steam lines.

The Indiana gas belt is literally threaded with electric railroads, and the manufacturers, as well as the farmers, consider themselves beneficiaries. The Wabash Valley corn belt and the Southwest Indiana coal fields are being tapped, and, notwithstanding the immense commercial and social advantages already attained through the existence of the interurban roads, evidences of greater facilities and increased accommodations, with lower rates and more extensive service, are everywhere apparent.

The pioneer, as well as the largest system, is that of the Union Traction Company of Indiana. This system sustains the reputation of being the most extensive electric railway network in the country. Its large and up-to-date power house situated at Anderson, its storage battery and sub-station plants along the line, the former enabling the company to continue to operate its cars in case of an accident to the power-house machinery, its commodious and even elegant passenger coaches, its ample freight cars and freight service, its high rate of speed and low fares—these are some of the features of the Union Traction Company's operation. The company is now operating 136 miles of track, on which it pays the state a privilege tax on a valuation of $13,000 a mile and $2,000 a mile on its rolling stock. The improvements and right-of-way are assessed at $93,000—all this in addition to local taxation by towns and counties. This line runs through 20 or more towns and cities, including four county seats, with an aggregated population of nearly 400,000. This is, of course, exclusive of the rural residents along the line. The company is building extensions or branch lines from Alexandria to Tipton and from Muncie to Portland. It has also acquired by lease the Indianapolis and Northern Electric railroad and is giving the country an exhibition of rapid railroad building. When these extensions are completed the company will have nearly doubled the mileage of its present system, adding 17 towns and cities, including six county seats, with an aggregate population of 300,000, to its service. The Union Traction Syndicate has organized another company with a capital of $1,000,000 for the purpose of constructing a line from Ft. Wayne to Lafayette, by way of Logansport. Surveys are being made and right-of-way purchased and condemned—much of it over the old Wabash and Erie canal bed. When this line is completed and connected with the Indianapolis Northern at Logansport, the Union Traction syndicate will have, by far, the most extensive interurban system in the world.

The Indiana Electric Railway Company owns and operates a profitable line of 44 miles connecting Goshen, Elkhart and South Bend, as well as numerous intermediate towns with a combined population of 100,000 or more. This company is building an extension to Niles, Mich., to connect with a line projected from Niles to St. Joseph. It is also likely to form an important link of a great trunk system reaching across the northern part of the state. The property is assessed at $12,500 a mile.

The Ft. Wayne and Southwestern Traction Company owns and operates 47 miles of road, connecting Fort Wayne, Huntington and Wabash. The power plant is situated at Huntington. A portion of this line is constructed on the old canal tow-path, and pierces the Wabash Valley corn belt. The company is preparing to do a good freight business. Three county seats and a score of prosperous towns together with a populous rural community welcome the facilities afforded by this line. The road is financed principally by Illinois capitalists. W. B. McKinley of Champaign is president. The property is assessed at $7,000 a mile. The company proposes to build an extention from Wabash to Marion by way of Warren and Van Buren. This will provide through connecting trolley lines from Ft. Wayne to Indianapolis.

The Indianapolis, Greenwood and Franklin Electric railroad, running south and connecting the three cities named in its title and a number of intermediate towns, has been in operation three years. Three hundred thousand people are in easy access of this line. The company has done a good freight business for two years and has recently improved its freight facilities. W. G. Irwin is president. The company is assessed $9,000 a mile on its 21 miles in operation. A 20-mile extension is being built to Columbus, where the line will connect with and form a part of a trunk line projected from Indianapolis to Louisville by way of Seymour and West Baden.

The Indianapolis and Eastern Electric railway extends due east from Indianapolis to Greenfield and thence to Knightstown, a distance of 31 miles. An extension is being built to Dublin, where it will connect with the Richmond Interurban line, thereby affording through service to the eastern boundary of the state, where connection may be made with two lines running to Cincinnati and other Ohio cities. The road has been in operation over two years. The road was reorganized in January, Frank Maus Favre becoming president. Spring Lake, a popular resort, is on this line, and the traffic is exceedingly good during the summer months. The road is assessed at $11,000 a mile.

The Indianapolis and Martinsville Rapid Transit Company's road connects Indianapolis with Martinsville, a famous health resort. The system is being operated as far as Brooklyn and only six miles of the 33 miles in the system remain to be completed. The power house is built in the side of a hill at Mooresville and is complete in all its appointments. The road was built by C. F. Smith and promises to be highly successful.

The Indianapolis, Shelbyville and Southeastern electric railroad connects Indianapolis and Shelbyville and intermediate towns and is 29 miles long. The road was built by Townsend, Reed & Co. in 10 months' time and is giving excellent service. The power house, barns and offices are at Shelbyville. The cars are constructed for high speed and in proof thereof have been driven a mile a minute in five-mile tests. The cars are heated by a hot-water system. The road will be extended to Greensburg and thence to Batesville, grading to be done this fall. Ed. K. Adams is president and C. O. Osgood, general manager.

The Terre Haute electric railway extends from Terre Haute to Knightsville, by way of Brazil. There are 36 miles in operation, and the line is being extended to Harmony. The road taps the coal-mining districts, and is a great convenience to those engaged in that industry. This line is to form an important link in the projected interstate line from Indianapolis to Springfield, Ill., by way of Plainfield, Terre Haute, Paris and Decatur. The road is assessed at $9,000 a mile.

The Lawrenceburg, Cincinnati and Aurora Electric Railway Company owns and operates 10 miles of road in the southeastern part of the state, connecting Aurora and Lawrenceburg with Cincinnati. The Indiana portion of this line is assessed at $7,000 a mile. It is not unlikely that this line will be extended to Madison and thence to Louisville.

The Whiting, Hammond and East Chicago Railway Company owns and operates 17 miles of electric road in the northwest corner of the state. Its territory is adjacent to Chicago, and it is doing a good business. The assessed value is $10,000 a mile.

The Richmond Interurban Railway Company is operating 24 miles of road between Richmond and Cambridge City. The line is being extended to Dublin to make connection with the Indianapolis and Eastern line. The line is assessed at $8,000 a mile.

The Indianapolis and Western Electric railroad extends from Indianapolis to Plainfield, a distance of 23 miles. It will be extended to Danville the first of next year. The line will be put in operation in a few days. Albert Lieber is president and principal stockholder.

The Indianapolis, Lebanon, Frankfort, Lafayette and Crawfordsville Electric line is being constructed by Townsend, Reed & Co., and when completed will be the second largest system in the state. This system will connect Indianapolis with the county seats named in its title—all populous and enterprising cities. The line is also dotted with numerous intermediate villages and a frugal rural population. It is being built for high speed. The power house is at Lebanon. That portion of the line between Indianapolis and Lebanon will be completed in 60 days. Tracklaying is now well along.

The Evansville and Princeton Traction Company is putting the finishing touches on a line connecting Evansville and Princeton, a distance of 31 miles. The road will afford service to a populous and rich territory. This line parallels the Evansville and Terre Haute railroad and the latter's managers threaten to equip that portion of its line with elec-

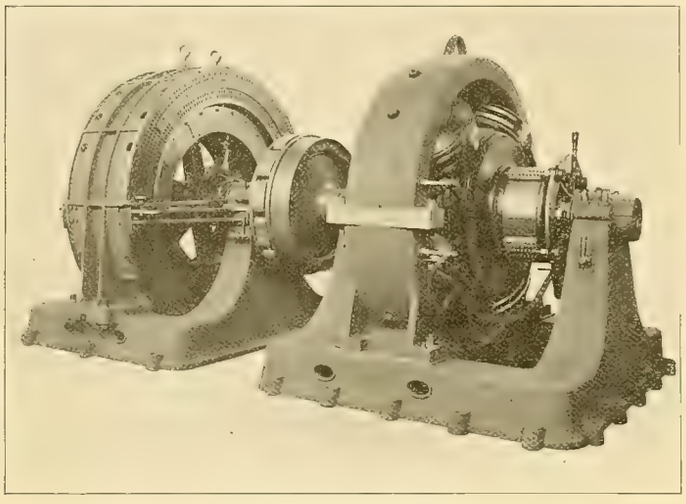


Fig. 1. Oerlikon Motor-generator.

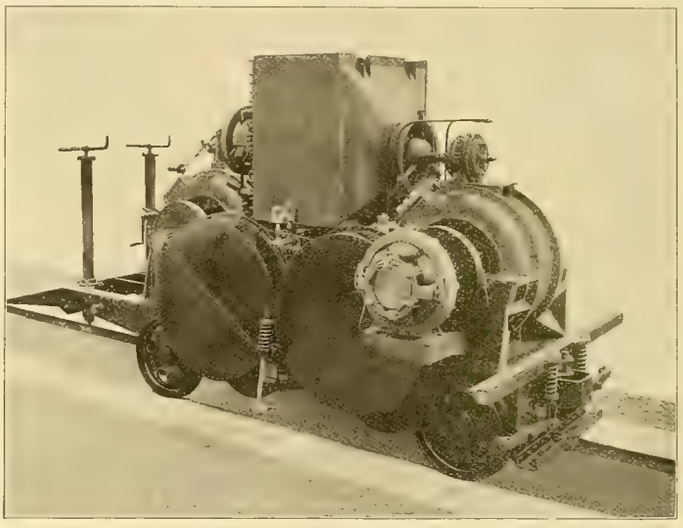


Fig. 2. Jungfrau Polyphase Locomotive.

tricity and operate cars in opposition to the traction company.

The Wabash River Traction Company owns and operates a line between Wabash and Peru—a distance of 20 miles. The company is extending its line to Logansport, thus affording electric service from Logansport to Ft. Wayne, and as lines are projected from Ft. Wayne to Toledo, and from Logansport to Lafayette, Covington and Danville, Ill., it is no stretch of imagination to say that in a few years electric cars will run from Toledo, Ohio, to Covington, along the line that was plied by canal boats from 1844 to 1868. The Chicago and South Shore Electric Railway Company is constructing a line from Laporte to Michigan City.

The Logansport, Rochester and Northern Railroad Company is constructing a line from Logansport to Warsaw, by way of Rochester. The Winona people are constructing a line from Warsaw to Winona Park, which will be operated by the Logansport-Rochester Company.

A number of additional lines have been projected and companies incorporated to build them. Among the more important of these is a trunk line from Indianapolis to Cincinnati by way of Rushville, Liberty and Hamilton, Ohio. The interests that control the local street-car companies at Indianapolis and Cincinnati are said to be behind the scheme.

Indianapolis thinks that it is destined to become the electric-railway center of the Middle West. The interurban terminal problem in that city has been solved in a manner equally satisfactory to the citizens and the numerous companies seeking entrance. A franchise has been granted to the Indianapolis Traction and Terminal Company, for the erection of passenger and freight terminal stations, calling for an expenditure of $1,200,000. Provision is made for the payment to the city by the terminal company of 4 cents on each car entering the city for the first 11 years, 6 cents for the next 10 years, and 10 cents for the concluding 10 years of the franchise. The interurban companies receiving franchises will also pay the city 1 cent for each car entering the city for 31 years. Under these provisions the revenue to the city during the franchises is estimated at nearly $400,000. Two downtown double-track loops will be constructed for the accommodation of the interurban cars. The city has fixed the freight rate to be charged by the companies and reserves the right to regulate the carriage of freight and express matter in reaching the freight terminals. Plans for all these improvements have been drawn and approved and the promoters say that the terminal system, when completed, will be most complete and adequate.

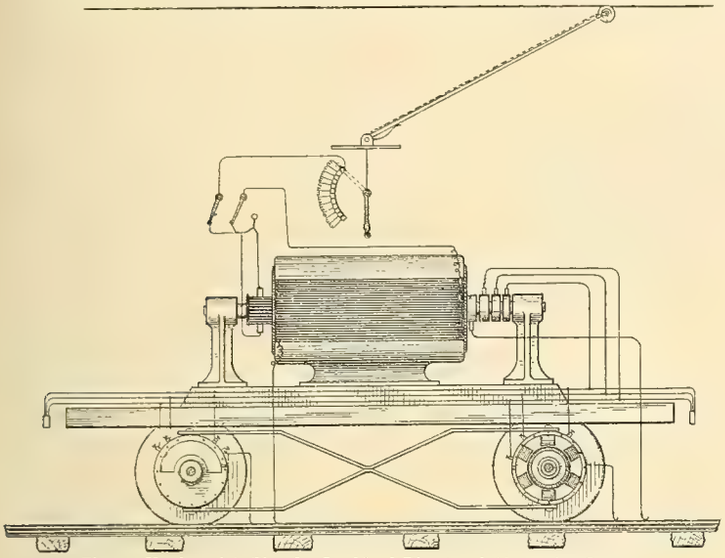


Fig. 3. Vandepoele's Plan for Combined Direct and Alternating Current.

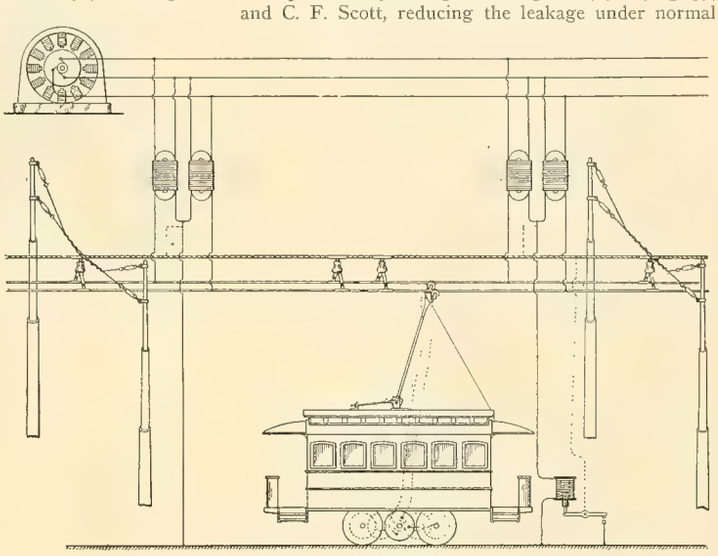


Fig. 5. George Westinghouse's Arrangement.

ALTERNATING-CURRENT RAILWAY SYSTEMS.

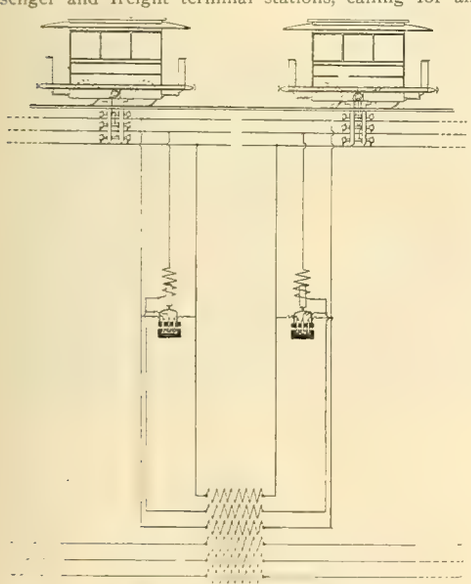


FIG. 4. ALTERNATING CURRENT RAILWAY SYSTEMS.—DU BOIS REYMOND POLYPHASE CONNECTIONS.

Alternating-current Railway Systems.

By Frank C. Perkins.

II. Polyphase Working.

Polyphase alternating currents are found to-day in most practical use in railway work in connection with the direct-current, 500-volt system, being utilized as a means of transmitting the power to long distances, with rotary converters or motor-generators for transforming from two-phase or three-phase alternating into direct current at various sub-stations along the lines.

In 1893 Charles Zipernowsky of Budapest, Hungary, patented in the United States a system of supplying currents to electric railways, it being intended to supply in an economical manner a very extended area with suitable currents of electricity. He says in reference to this system: "To conduct electrical energy to great distances advantageously, it is necessary, as is well known, to use high tensions, and this requirement is for practical reasons only to be met by the use of the alternating current. In the production of continuous currents it is difficult or even impossible to produce such high tensions, as, for instance, 10,000 volts and over, as are required, while, on the other hand, such tensions, as is well known, are practically applicable with alternating currents. Alternating currents of high tension and conducted to great distances are conveniently transformed afterward at the places of consumption into currents of any desired tension."

According to Mr. Zipernowsky's invention, such alternating currents are converted into direct currents of any required tension for the working of motors upon the electric railways. The working consumption circuits are supplied with direct currents by means of alternating-current motors and direct-current dynamos.

A patent of George Westinghouse, Jr., of 1889, provided for a system of electrical distribution, using static transformers, rotary converters or rectifiers and also a storage battery, the battery being charged by the rectifier with electrical connections from the storage battery to an electric locomotive.

In Fig. 1 is shown a modern three-phase alternating-direct-current motor-generator constructed by the Oerlikon Company of Switzerland. Fig. 2 represents the Jungfrau polyphase locomotive built by the same company.

A system of electrical distribution of currents for electric railways, invented by the late C. J. Vandepoele, is shown in Fig. 3. One arrangement is to use high-tension direct currents for transmission, converting at sub-stations along the line to alternating currents for use on the working conductors. Another arrangement is the use of direct currents from the source of supply with a motor-generator upon the train producing a number of independent successive current impulses to multiple current motors.

The alternating-current electric-railway system of C. J. Vandepoele, patented in 1890, uses static transformers upon the car for reducing the potential and supplying the various alternating-current motors on the train. The system of R. V. R. Sill, patented the same year, uses the static transformer on the car for raising the potential for use in the alternating-current car motors, a low potential being provided to the working circuit by step-down static transformers on the transmission line, to avoid the danger of shocks to animals and persons in the vicinity.

Fig. 4 shows a system for railways, patented in America in 1893, by A. Du Bois-Reymond of Charlottenburg, Prussia, Germany. In connection with the use of step-down transformers along the line for reducing the potential of the polyphase currents to the car motors, the inventor provides automatic arrangements, causing the currents to flow only on such portions of the working conductors as are at the time in connection with the vehicle, the object being to avoid the leakage of current and danger from accidental contact, which is present in electric railways where the working conductors are constantly charged with energizing current.

Systems for alternating-current railways have also been patented by George Westinghouse, Jr. (Fig. 5), and C. F. Scott, reducing the leakage under normal circumstances, with automatic devices for supplying full current to the working conductors when the train is passing along a given section of the line.

Another automatic alternating-current railway system to provide means for closing the primary circuits of the transformers as the trains pass, has been patented by Carl Coerper of Cologne, Germany. S. Z. De Ferranti, the well-known Anglo-Italian inventor, has taken out patents in the United States of the same character for obviating the loss due to the primary circuits of the transformers being normally closed along the entire length of the railway line. A drawing showing Ferranti's invention is given in Fig. 6.

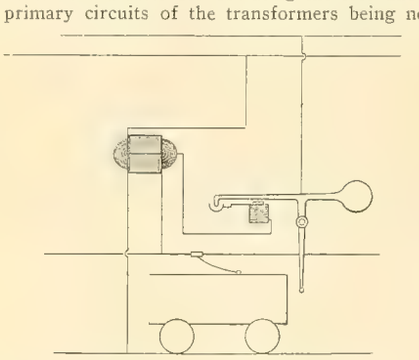


FIG. 6. ALTERNATING-CURRENT RAILWAY SYSTEMS.—FERRANTI S PLAN FOR TRANSFORMERS.

Germany's Electrical Trade with Russia.

In a report of exports to Russia, just given to the public by the German government, it is stated that the value of electrical machinery exported to Russia for the year 1901 was $1,384,500. In 1900 the value of corresponding exports amounted to $1,060,000, thus showing that the Russian market for electrical machinery is improving. J. F. Monaghan, United States consul at Chemnitz, Germany, says that Russia offers a rich field for electrical machinery of all kinds.

The Hudson Valley Railway Company has been able to resume its full schedule of cars, although some of them are still protected by military escort. The striking employes have resolved to continue the strike for an indefinite period, while the managers of the company are equally determined not to yield to the demands of the strikers.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Electric Railways in and Around Detroit. Illustrated. 221, 222, 223, 224, 225, 226, 227, 228
Interurban Lines of Detroit United Railway. Illustrated. 226, 227
Rapid Railway System. Illustrated....226, 227
Detroit, Ypsilanti, Ann Arbor and Jackson Railway. Illustrated....227, 228
Relation between Macadam Roads and Electric Railways....228
Interurban Electric Railways in Three States. Illustrated. 228, 229, 230, 231, 232, 233
Ohio. With map....228, 229, 230
Michigan. With map....230, 231, 232
Indiana. With map....231, 232, 233
Alternating-current Railway Systems. By Frank C. Perkins. Illustrated. Part II....232, 233
Germany's Electrical Trade with Russia....233
Editorial....234
Next Week's Street-railway Convention. Illustrated....235
First Institute Meeting of the Season....235
Electric-railway Roadmasters....235
Sheep Shearing by Electricity....235
Development of the Telephone Field....236, 237
Bell Company's Automatic Telephone Patents....236
Fort Worth Telephone Enterprise....236
Indiana Telephone Convention....236
Indiana Telephone Items....237
Telephone News from the Northwest....237
Big Independent Company Formed....237
General Telephone News....237
The Railroad Telephone....237
No Collect Messages in Buffalo....237
Manufacturers and Dealers....237
Washington, Baltimore and Annapolis Single-phase Railway. By B. G. Lamme. Illustrated. (American Institute of Electrical Engineers.)....238, 239, 240
New Westinghouse Industries at Trafford City, Pa....240
Consolidation of Lighting Interests in Northern California....240
Municipal Ownership in Newton....240
Book Table.—"Electrical Catechism"....240
Natural Gas....241
Messenger Girls and Boys in Chicago....241
Depth of Submarine Cables....241
Electrical Trade with Cuba....241
Central Service Plant for Dwelling Houses....241

DEPARTMENTS.

Correspondence....241, 242
New York Notes....241, 242
Canadian Intelligence....242
From the Buckeye State....242
Information from Indiana....242
Northwestern Notations....242
Southern Developments....242
Old Mexico....242
Personal....242, 243
Electric Lighting....243
Electric Railways....243
Automobiles....243
Power Transmission....243
Societies and Schools....243
Publications....243
Space Telegraphy....243
Trade News....243, 244
Business....244
Illustrated Electrical Patent Record....244

CONVENTIONS AND EXPOSITIONS.

International Association of Municipal Electricians, Richmond Va., October 7th, 8th and 9th.

American Street Railway Association, Light Guard Armory, Detroit Mich., October 8th, 9th and 10th.

Indiana Mutual Telephone Association, Indianapolis, Ind., October 14th.

SINGLE-PHASE railway operation seems to be coming to the front. At the convention of the American Institute of Electrical Engineers in Great Barrington last June Mr. B. J. Arnold announced his electro-pneumatic system, particularly adapted to utilize the single-phase motor, and stated that he had constructed 20 miles of road for his new system, together with the necessary trucks and motor equipments. This road, consequently, should now be well on toward completion. In addition, it is announced that the Westinghouse company is to build a single-phase railway between Washington and Baltimore, about 40 miles long, with a 15-mile branch to Annapolis. This road has been described in a paper presented to the Institute on September 26th by Mr. B. G. Lamme and published in this issue. These are most important developments in the evolution of the electric railway, and deserve, as indeed they are receiving, the careful attention of the electrical engineer.

BERLIN will probably be the place of meeting of the international conference on space telegraphy, which is expected to be held in a few weeks. Germany proposed the conference, and it is believed that the German emperor has some idea that arrangements may be made whereby ships of all nationalities may communicate with each other and with the shore, thereby sensibly reducing the risks of navigation. This seems to be a good idea, but it is said that the Marconi company is opposed to the conference, professing to believe that the proposal is in the nature of an indirect attack upon it. Germany having taken exception to the company's refusal to permit other wireless systems to utilize the Marconi stations. However, it is unofficially announced that Germany's suggestion has met with the general support of the powers, and the congress will undoubtedly be held, as it certainly should be. The conference, if conducted with the sole desire of securing the greatest good to the greatest number by the important invention of space telegraphy, should be fruitful of important results. It should have the hearty support of every civilized nation.

SOME important measurements of the internal resistance and surface resistance of certain insulators are reported by Mr. O. N. Rood in a late issue of one of the scientific journals. The main difficulty experienced lay in obtaining a suitable contact between the electrodes and the insulators. Guttapercha was cemented to tinfoil electrodes by a guttapercha solution, and in other cases a soft amalgam of tin was used. The internal resistance of a plate one millimeter thick and one square centimeter in area was found to be 900,000 ohms in the case of quartz, 18.5 megohms for guttapercha, 55 megohms for ebonite and 133 megohms for mica. Turning to surface conduction, the resistance of one square centimeter between terminals one centimeter long was found to be 1.6 megohms in plate glass, 22 megohms for cobalt glass, 432 megohms for guttapercha, 521 megohms for quartz, about 2,000 megohms for ebonite, and only 51 megohms for mica. It was found that glass has a high surface resistance in comparison with its internal resistance, and in glass condensers it is, therefore, advisable to increase the capacity by increasing the surface rather than by reducing the thickness. More especially, cobalt glass should be used. Mr. Rood has the distinction of preparing a standard resistance said to possess the value of 14,000,000 megohms, which is extraordinary.

INTERURBAN electric railways now play such an important part in the modern life of suburban and rural communities that no anology is needed for the amount of space devoted to their consideration in this issue of the Western Electrician. Ohio, Michigan and Indiana are the states selected as typical of this development, and a comprehensive article, with a map revised to date, is devoted to each state. The result is instructive, showing the great extent of the electric-railway network already existing and the still more ambitious plans for the future. It is evident that while electricity is not in its infancy, electric-railway building is, and no man can predict the magnitude of the maturity thereof.

Of the broadening of country life, both commercially and socially, brought by the "trolley," it is not necessary here to speak at length. With that other great boon to the farmer and the farmer's wife, the telephone, the electric railway is relieving life on the farm and in the villages of its dread and girls to the cities, which sociologists so greatly and girls in the cities, which sociologists so greatly deplore. There semes to be, indeed, a curious correlation between the latter-day development of the electric railway and the telephone. Both—the interurban lines and the great rural telephone movement—received their initial impetus about the same time. In both cases the systems had before been developed in the cities to the neglect of the country. Both were of great benefit in either opening up new avenues of transportation and communication or affording relief from pre-existing monopoly. And, finally, both the interurban railway and the home-owned telephone lines are particularly conspicuous in the states of Ohio, Michigan and Indiana. One might almost see in the coincident advance and reciprocal relations of these two agencies the working of a Divine Providence in relieving the tendency to congestion in great cities, so evident in this and other countries.

DISTINGUISHING characteristics of the conventions of the American Street Railway Association are very large attendance and comprehensive exhibits of the latest machinery and apparatus manufactured for the use of street-railway companies. The thorough-going preparation that has resulted in the conspicuous successes of previous conventions—each one of which has seemed to surpass its predecessors—has been repeated for the Detroit meeting to be held next week, and there is no reason to doubt that the gathering of 1902 will be a profitable and enjoyable one. It is certain that a large number of street-railway and supply men will be present and that every available foot of space, not only in the convention hall but in roofed-over portions of the adjacent streets, will be filled with up-to-date exhibits. The programme is not overloaded, but contains some excellent subjects for discussion. The paper on "Steam Turbines" and the report of the committee on standards should be especially valuable. There is every indication, therefore, of a successful convention. The headquarters of the Western Electrician during the meeting will be Space No. 27, Convention Hall, near the main entrance, and representatives of this journal will be present to extend a cordial welcome to all visitors.

Following the usual custom, the Street Railway Accountants' Association will hold its annual meeting conjointly with the American Street Railway Association.

THERE are several features of Detroit's electric-railway system which will be of interest to the delegates and visitors who attend next week's convention of the American Street Railway Association. One thing to be noted is the size of the system. In the city there are 188 miles of track, affording rapid and cheap transportation to every business, residence, park and manufacturing section. Radiating from the city are electric interurban railways, seven in number, that give frequent and efficient service to all important cities and towns within a radius of 75 miles. These interurban lines cover 387 miles of track, making, with the city system, a total of 575 miles in and tributary to Detroit. The combined system, excepting one interurban line of 86 miles, is operated or controlled by the Detroit United Railway. This company, utilizing the advantages of centralization, has effected economies and made improvements and extensions until now its system is one of the best in the country. No expensive or exceptional engineering constructions are to be found on the company's lines, except some trestles and bridges, but the practical railway man will be interested in the extensive employment of storage batteries, the style of long-rear-platform cars used, the splendid service given, and on the interurban lines the use of alternating-direct-current systems, the handling of freight, express and mail matter, and the successful competition with steam railroads. These and other features pertaining to the Detroit electric-railway system are set forth at some length on other pages of this issue of the Western Electrician.

Next Week's Street-railway Convention.

The twenty-first annual meeting of the American Street Railway Association will be held in the Light Guard Armory (Brush and Larned Streets), Detroit, Mich., on October 8th, 9th and 10th. This association has a reputation for holding great conventions, and the gathering at Detroit promises to be another conspicuous demonstration of the rule. The attendance will surely be very large, hotel accommodations being difficult to procure unless reserved. Both the meetings of the association and the exhibition will be held in the armory, every foot of which that is available for exhibits having been long ago engaged. Diagrams of exhibit spaces and a full list of exhibitors were given in the Western Electrician of August 23d.

The armory will be open for the reception of exhibits Monday, October 6th. Heavy exhibits will be located in the street, which will be partly roofed over. This arrangement was necessary, as the meeting hall is under the main exhibit floor, and foundations for heavy machinery could not be placed.

The programme of the convention, as arranged by Secretary Penington, is as follows:

WEDNESDAY, OCTOBER 8TH.

Eleven a. m.—Meeting called to order by H. H. Vreeland, president.
Address of welcome by Hon. William C. Maybury, mayor.
Calling of the roll.
Invitation extended to join the association.
Address of the president.
Report of the executive committee.
Report of the secretary and treasurer.
Papers—
"Registration of Transfers," by C. D. Meenely, Brooklyn, N. Y.
"The Steam Turbine—Its Commercial Aspect," by Edward H. Sniffin, New York.
"Benefit Associations," by Oren Root, Jr., New York.
"Discipline of Employes by the Merit System," by W. A. Satterlee, Kansas City.
"Electric Express and Package Delivery," by George W. Parker, Detroit.
"Signals for Urban and Interurban Railways," by G. W. Palmer, Jr., Boston.
"The Adjustment of Damage Claims," by Mason B. Starring, Chicago.
Appointment of committees on nomination of officers and selection of next place of meeting.

THURSDAY.—EXHIBITORS' DAY.

The entire day is given to the examination of the exhibits. No convention sessions are held.

FRIDAY.

Continued discussion of papers presented to the association.

Report of committee on standard rules for the government of employes.
Report of committee on standards.
Election of officers for ensuing year.

ENTERTAINMENTS.

Wednesday.—An informal reception will be tendered to the ladies in attendance from 10 a. m. to 4 p. m. at the Hotel Cadillac.

Wednesday Evening.—A general reception will be held at the Hotel Cadillac at 8 p. m.

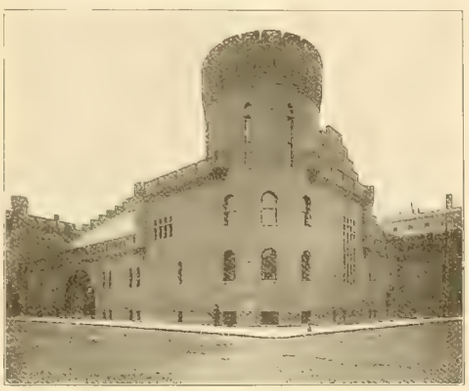
Thursday Evening.—There will be a theater party at the Detroit Opera House at eight o'clock; attraction, "When Johnny Comes Marching Home."

Friday.—A trolley ride will be given to the ladies on Friday morning, leaving the Hotel Cadillac at 10 o'clock for Mount Clemens, via the Rapid Railway and Gratiot Avenue, returning via the Shore Line to the Country Club, Grosse Pointe, where luncheon will be served at one o'clock, returning to the city at 4 p. m.

Friday Evening.—The banquet will be held at the Hotel Cadillac at eight o'clock. Installation of officers-elect at the banquet.

Badges of the association will be honored for passage on all city and interurban lines.

Officers of the American Street Railway Association are as follows: President, Herbert H. Vreeland, New York; first vice-president, Charles W. Wason, Cleveland, Ohio; second vice-president, Elwin C. Foster, Boston, Mass.; third vice-president, H. M. Sloan, Chicago, Ill.; secretary and treasurer, T. C. Penington, Chicago, Ill.; executive committee, president, vice-presidents and Walton H. Holmes of Kansas City, John A. Rigg of Reading, Pa., Daniel B. Dyer of Augusta, Ga., T. J. Nicholl of Rochester, N. Y., and George W. Dickinson of Seattle, Wash.



CONVENTION HEADQUARTERS IN DETROIT (LIGHT GUARD ARMORY).

The association is a very prosperous one and embraces all the leading street-railway companies of the United States. Mr. Vreeland, the president, is perhaps the most prominent street-railway man in the country. The other officers are all men of more than local reputation. Mr. Penington, the secretary and treasurer, has labored with conspicuous success to make the association the power it now is. He has performed the duties of his joint office since 1895, and both by the thoroughness of his work and his likable personality he has endeared himself to the members of the association and to all others who have business with it.

The street-railway men of Detroit have taken hold of the preparations for the convention with a right good will. The general committee is led by Jere C. Hutchins, president of the Detroit United Railway and the Rapid Railway System. Mr. Hutchins is assisted by these chairmen of sub-committees: Exhibits, John H. Fry; publicity, Albert E. Peters; entertainment, Irwin Fullerton; reception, George H. Russel; ladies, Albert H. Stanley; press, Walter Ross. Mr. Fry's duties as chairman of the exhibit committee have been especially onerous, and he is entitled to a special word of praise for the courtesy and urbanity he shows in filling a trying position.

One thing that visitors to Detroit should not forget is the variation between local and standard time. Detroit time is 28 minutes faster than standard Central time. Thus, to be at the theater at eight o'clock the Chicago man must remember to reach his destination when his watch marks 7:32.

The hotel headquarters of the association will be at the Cadillac.

The passenger associations have granted rates of one fare and one-third for the round trip. Special trains will be run from New York and Chicago. The latter will proceed over the Wabash road and will leave the Polk Street station in Chicago at 1 p. m., on Tuesday, October 7th, arriving in Detroit at 7 p. m. A special parlor car will be reserved for the ladies. From St. Louis and the Southwest a special Pullman sleeping car will be attached to the 8:30 p. m. train leaving St. Louis Tuesday, October 7th, via the Wabash railroad, arriving in Detroit the following morning at 9:30 a. m. N. C. Keeran, Wabash city ticket agent in Chicago, will be in charge of the Chicago "special."

H. H. Vreeland, President.

T. C. Penington, Secretary and Treasurer.

John H. Fry, Chairman Exhibits Committee.

AMERICAN STREET RAILWAY ASSOCIATION.

First Institute Meeting of the Season.

On Friday evening, September 26th, the first meeting of the American Institute of Electrical Engineers since the summer intermission was held in New York. The new president, Charles F. Scott of Pittsburg, presided, and delivered an address on "Proposed Developments of the Institute." Mr. Scott reviewed the accomplishments of the Institute and enumerated eight specific ways in which its work may be advanced during the coming year. An abstract of this instructive address may be given in a future issue of the Western Electrician. B. G. Lamme of Pittsburg presented an important paper describing the plans for the Washington, Baltimore and Annapolis single-phase railway. This paper is given elsewhere in this issue.

As chairman of the library committee, W. D. Weaver reported to the Council of the Institute that a large gift of books had been received from Mr. C. O. Mailloux. These books consist of the transactions of scientific bodies in France, Austria and other European countries, as well as bound volumes of French and German scientific journals, and many of them are rare and costly. This gift is in addition to a complete set of the Comptes Rendus from 1835 to 1897 (130 volumes), donated by Mr. Mailloux to the Institute about a year and a half ago. To supplement his generosity further, Mr. Mailloux has announced his intention to subscribe for the Institute library, for the foreign publications embraced in his latest donation of bound volumes that are still current, and to bind the volumes, from time to time, in style uniform with those already donated. It is needless to say that Mr. Mailloux's gifts were accepted with a lively sense of the unselfish liberality of the donor.

Electric-railway Roadmasters.

A new arrangement for the management of its trolley system has been originated by the Toronto Railway Company. Two roadmasters have been appointed on each important line, and they will relieve each other, so that one will always be on duty. There are 39 roadmasters in all, and they will act as motormen and conductors, six being required to relieve the others one day in the week. The instructions notify them that they will have authority over the following matters:

1. Training of all applicants for positions of motormen and conductors.
2. The traffic of the lines to which they are assigned, including running time and interruptions to traffic which may occur.
3. The conduct and personal appearance of the men engaged in the operation of the cars.
4. When available and necessary, charge of the cars which may become disabled.

In regard to this new departure, one of the officials has said: "We have tried to get men, who, while preserving discipline firmly, would discharge their duties fairly, instructing the honestly ignorant and reporting for dismissal only careless, reckless, or dishonest employes."

Sheep Shearing by Electricity.

An electrical invention to be used in the shearing of sheep, has come into the market and promises to make great progress if one can judge from the newspaper reports of its operation during the last year. A recent trial of the apparatus was at Flagstaff, Ariz., and was very successful. It is stated that one of the installations on a southwestern ranch, requiring 16 men to operate it, was able to shear 75,000 sheep in three weeks. The ranchmen say that a force of 48 men would have required twice that time to accomplish the same work. The mechanism resembles a barber's hair clippers or the common horse clippers. The clippers are carried over the sheep by hand, but are operated by electric power. It is said that, so rapid is the working of the clippers, a workman can shear a sheep in three minutes. To do the same work by hand, the best workman would require at least eight minutes.

DEVELOPMENT OF THE TELEPHONE FIELD.

Bell Company's Automatic Telephone Patents.

It is extremely interesting to observe that two of the letters patent issued by the United States Patent Office last week relate to automatic telephone systems and are assigned to the American Bell Telephone Company, the parent Bell company. It would, of course, be jumping at conclusions to assume that this means the eventual adoption of an automatic system by the Bell company, but at any rate the fact shows that the Bell company is paying attention to the development of this type of telephone apparatus. The two patents in question are numbered 709,739 and 709,740. The first patent is issued to Albert M. Bullard of Somerville, Mass., the application being filed on November 16, 1900. In describing the invention in the patent specification, which contains four sheets of drawings and 10 pages of description, the inventor says:

"The invention has especial reference to automatic telephone exchanges whose source of electromotive force for connections, disconnections, signals and conversation is located at the central station. It includes, however, mechanisms and details of mechanisms located at each subscriber's station and mechanisms and details of mechanisms located at the central station, whose use is not limited to an exchange in which the force of electromotive force for all the purposes enumerated is located at the central station.

"A leading object of the invention is provision for the expansion or enlargement of the exchange. So, too, great rapidity in forming connections between subscribers has been attained.

"The invention is an improvement upon an automatic telephone-exchange system jointly invented by Malcolm C. Rorty and myself which forms the subject-matter of an application for a patent filed August 9, 1900, serial No. 26,441. Accordingly, many of the features of the joint application, more especially those relating to the circuits, necessarily appear in the present description, some of them without modification. The principal features which distinguish the present invention from the said joint invention and from others of the general character of the present invention are, first, the use of alternating-current waves to actuate selecting and connecting mechanism at the central station in synchronism with mechanism under the control of the operator at a sub-station; second, the use of alternating current for both synchronizing and actuating, selecting, and connecting mechanism at the central station, and mechanism at the sub-station; third, the use of a device at the sub-station which moves in synchronism with a similar device at a distance, the former adapted to break the circuit through both when it has moved its arm or pointer a predetermined distance, thereby stopping the arm or pointer of the distant device at a corresponding point of travel; fourth, an alternating-current generator, located at the central station and adapted to send out its current to the subscribers' stations for the purposes of selection and connection; fifth, to facilitate the process of selection, the division of each subscriber's number into two parts—the first part representing the hundreds and the second part representing both the tens and units—and the employment of an independent mechanism to select each part; sixth, in actuating the selector, the use of several (rather than one) waves or cycles of alternating current per each subscriber's contact point in the multiple, and a self-centering selector arm, in order to compensate for slight deviations from perfect synchronism.

"The apparatus employed at each sub-station includes transmitting and receiving telephones, a bell, a condenser, a telephone lever, or similar switching device, a circuit-breaker and hand switches. With the exception of the last two, these devices are of familiar construction. Each subscriber has what is commonly called a 'metallic' circuit, or two line wires leading to the central station. For talking purposes they are strictly in metallic circuit; but, as in many other telephone exchanges, use is made of both line wires in grounded circuits for other purposes. A novel feature consists in the momentary connection of both sides of the subscriber's line to ground for a purpose not attained by grounding simply one side or by simply bridging the line.

"The apparatus at the central station includes an alternating-current generator common to all the subscribers for making connections and for signaling, and a battery common to all the subscribers for conversation and to assist in making connections. Each subscriber is also represented at the central station by a selecting and connecting mechanism, the selecting device of which is in two parts (corresponding to the division of the subscriber's number), herein termed the 'hundreds-selector' and the 'tens and units selector,' and also by relays and other electromechanisms for operating his said selecting and connecting mechanism and for forming testing, signaling and talking circuits. Each subscriber, as in other exchanges of the same general character, is further represented at the central station by a number of multiple contacts, with a separate one, of which any other subscriber may make electric connection by his respective selecting and connecting mechanism. These multiple contacts are normally in connection with the talking circuits of the subscribers represented by them; but the selector arms belonging to each subscriber's selecting and connecting mechanism are not normally in connection with the talking circuit of said subscriber."

The other patent mentioned, No. 709,740, is issued to Albert M. Bullard of Somerville and Malcolm C. Rorty of Dedham, Mass., the application being filed on August 29, 1901. This invention has special reference to automatic telephone exchanges designed to supply facilities for intercommunication in small communities, where all of the possible subscribers may be accommodated by a small number of sub-station circuits, some or all of which may be party or poly-station circuits. The specification contains six sheets of drawings and 20 pages of descriptive material. In the introduction the inventors recite the electrical mechanisms and circuit arrangements necessary for an effective automatic telephone exchange apparatus and also for such a system with party lines. Reference is made to the application previously filed by the inventors (mentioned above in the first patent) and the respects in which this invention may be regarded as an improvement on that system are mentioned. Then the following general description of the new apparatus is given:

"Our invention realizes a simple but exceedingly effective and reliable automatic telephone-exchange apparatus for a limited number of main or sub-station circuits, which is particularly well adapted for poly-station lines and which perfectly meets the several requirements hereinbefore recited. Its sub-station circuits when arranged for talking are metallic or consist of paired conductors throughout—that is, through the switching mechanism, as well as in the line portions—and the selecting and connecting devices of each circuit comprise two movable or active terminals of said circuit representing, respectively, the two main conductors thereof and adapted to move into juxtaposition to fixed or passive terminal contact members successively of all other circuits of the exchange arranged in pairs and to make contact with the pair of points constituting the fixed terminal members of the circuit with which communication is desired when that pair is reached. The selective motion of the movable terminals is due to successive interruptions or intermissions of the main-line current acting through appropriate electromagnetic-motor mechanism, the said interruptions being produced by the operation of any suitable periodic circuit-breaker at the sub-station, making the selection, and the connecting motion thereof is dependent upon the operation of other electromagnetic mechanism irresponsive to the selecting-current interruptions, but responsive to the establishment in the circuit of a steady current, which occurs when the circuit-breaker having ceased to operate the circuit is closed through the sub-station telephone apparatus.

"We employ ordinary magneto-generators and polarized bells for sending and receiving call signals, and at each station provide in association with said generator two keys, which are to be alternately manipulated according as the bell to be rung is that of another station on the same circuit or is that of a station on another circuit, connected through the central station. The call bells of all stations have their magnets connected in earth branches from one side or conductor of their respective main circuits, a condenser being included in each such earth branch in the usual manner, and the balance of the circuit is maintained by associating with each bell branch a corresponding earth branch from the other side of the circuit containing similarly a condenser and an artificial impedance of like value to that of the bell magnet.

"Our invention also comprises the provision for each circuit of means for balancing on one side of the circuit the resistance on the other of the central-station relays controlling the selecting and connecting magnets and for regulating, when two sub-stations of unequal resistance are united to form a through circuit, the amount of current supplied to each.

"It comprehends also means whereby when communication has been established through the central station between two sub-station circuits the call generator at the sub-station, which has originated the connection when operated, is enabled to ring the bells at the sub-stations of the other circuit without at the same time ringing the bells or operating call-signal devices at the remaining stations of its own circuit.

"Another important feature of our invention is an improved means of protecting both circuits concerned in forming a compound circuit for through communication from intrusion or from being interrupted or interfered with by a third circuit during the pendency of such communication, the call-originating circuit receiving such protection from the outset of its selecting operation and the call-receiving circuit as soon as connection with its fixed terminals is established. This means involves the normal detachment of the movable terminals of each sub-station circuit from the main conductors of such circuit and their control by a differential testing or discriminating relay, which, if the desired line be disengaged, is excited by the passage of current through but one of its coils, and, becoming operative, acts as an electromagnetic switch to attach the said terminals to their corresponding main conductors, but which should the line wanted be already occupied, remains quiescent and inoperative, maintaining the normal detachment of the said movable terminals. Both coils of the relay under such conditions are traversed by currents each acting in opposition to and neutralizing the magnetizing effect of the other on the common core. These non-interference devices are accompanied by means for producing distinctive signaling currents, which traverse the line and produce in the receiving telephone at the calling station a sound signal indicative of the busy condition of the wanted circuit. Moreover, when under the conditions of our present invention, any two sub-station circuits are united for through communication there is constituted an improved talking circuit conductively continuous throughout.

"For each sub-station circuit there are at the central station two inductance or choking coils, a balancing resistance, a testing and discriminating relay, a connecting relay, and a selecting and connecting mechanism governed by said controlling relay and comprising a selecting magnet, a retaining-pawl magnet, a connecting magnet, a selector arm and certain associated switches or circuit-changers, the said selector arm and switches being under the joint control of said magnets.

"Assuming that all of the main circuits of the exchange are poly-station circuits, or may at any time become so by the installation of additional stations, it may be said that the apparatus at all of the sub-stations of all the subscribers' circuits is alike. At each station there are the usual call-sending and call-receiving appliances. For the call generator, a magneto generator developing an alternating current is preferably employed. A polarized call-bell has a condenser in series with it. The bell is grounded on one side and at the other is connected by a branch through the condenser to a particular one of the main-circuit conductors, while the generator, which also has one of its terminals grounded, is normally an open circuit, but is brought into connection when operated with one or the other of the main-circuit conductors as the call is to be sent to a station of the same or of another circuit. The usual transmitting and receiving-telephone apparatus and gravity switch are also employed."

Fort Worth Telephone Enterprise.

The growth of the Independent telephone movement in Texas continues at a rapid rate. For the most part, the local exchanges in the principal cities and towns of the state, as well as the new toll lines which are operated as Independent concerns, are backed by Ohio capital, C. N. Haskell of Ottawa, Ohio, being a large stockholder in nearly all these companies. A new set of telephone people is about to enter the Texas field, however, and it is said that it has no connection with Mr. Haskell and his companies. The new invaders have just organized and taken out a charter under the laws of this state for the Fort Worth Telephone Company. This corporation has a capital stock of $304,000 and its principal office is located at Fort Worth, Texas. The charter states that it is the purpose of the company to build and operate a telephone and telegraph line, but it is not stated where this line is to run. The incorporators are Joseph L. Dunn, John M. Crane, William Drury, H. A. Fuller, F. C. Johnson, John B. Yeager, F. M. Kirby and J. Frank Nuss, all of Wilkesbarre, Pa.; Martin Casey, Sidney L. Samuels and F. B. McElroy of Fort Worth.

Indiana Telephone Convention.

The Indiana Mutual Telephone Association will hold its annual meeting in Indianapolis, beginning at 10 a. m. on October 14th. There will be forenoon and afternoon sessions on that day. In the evening the association will be entertained by the New and New Long-distance Telephone Companies of Indianapolis. Important business is to come before the convention, and there will be interesting addresses by prominent telephone men. The railroads entering Indianapolis make a rate of one fare for round trip for that day. A large and enthusiastic meeting is anticipated. The exact place of meeting and the programme in detail will be announced later. L. A. Frazee of Connersville and H. B. Gates of Indianapolis are president and secretary, respectively, of the Indiana Mutual Telephone Association.

The Home Telephone Company of Jackson, Tenn., has won out in injunction proceedings brought by the Cumberland company to restrain the Home company from placing its wires on the same side of the street with the Cumberland company. The Home company, however, has been required to give a bond of $3,000 to protect the interests of the Cumberland company.

Indiana Telephone Items.

The Monroeville Home Telephone Company has been incorporated; capital stock, $10,000. The company will erect telephone lines and telephone exchanges in Allen County, and reserves the right to extend its service into other counties. The directors are S. E. Metzer, G. E. Speke, S. B. Walters and others.

The Home Telephone Company of Wabash, whose exchange was destroyed by fire two weeks ago, has resumed business.

The Chicago Telephone Supply Company, with a capital stock of $500,000, of which $50,000 is represented in Indiana, filed articles of incorporation with the secretary of state on September 26th. Henry L. Briggs of Elkhart is named as the company's state agent.

The Brownstown Telephone Company has been sold to Henry Rust, Will Robinson and Elmer Brown. The purchasers will make extensive improvements and extend the system.

The entire system of the Home Telephone Company at Peru was rendered useless on the morning of September 26th by a fire that started from a candle burning the main switchboard. It will require 10 days to restore the system to its usual service.

Two suits were filed against the New Telephone Company at Indianapolis to recover damages for personal injuries in each case. They are somewhat similar and involve the liability of the company for negligence upon the part of its workmen. One plaintiff asks for $250 for injuries sustained to his three-year-old daughter, who, while watching the linemen in an alley in the rear of his home, was struck on the head by an insulator thrown up to the lineman, who failed to catch it. The other suit is based on a charge of negligently throwing a defective glass insulator to the earth, where it struck plaintiff, to his injury. F.

Telephone News from the Northwest.

The Ord Independent Telephone Company has filed articles of incorporation, with $10,000 capital. A new exchange will be installed at once. Already over 200 subscribers have been secured.

The Iowa Telephone Company has installed a new switchboard at its office in Burlington, Iowa. It is a central-energy board, with all the latest improvements.

The Central Minnesota Telephone Company has begun work rebuilding its local exchange at Park Rapids, Minn. The new poles are being placed in the alleys, instead of the streets, and a modern switchboard is to be put in place.

The Wisconsin Telephone Company has plans out for contractors to figure the cost of erection for a local exchange building at Oshkosh, Wis. The building will be modern in every respect and will cost $16,000.

The council of St. Paul is considering an ordinance requiring the removal of all overhead wires in the underground district within six weeks, under penalty of $50 fine or 60 days in the workhouse.

An automatic telephone exchange will be put in for Ashton, Iowa. A Clark switchboard has been secured.

The Eddyville (Iowa) Telephone Company has filed articles of incorporation with a capital stock of $15,000.

The Burt Telephone Company of Burt, Iowa, has filed articles of incorporation, the capital stock being $15,000. R.

Big Independent Company Formed.

The International Telephone Company, which proposes, it is said, to fight the Bell company, has filed a trust deed at Wilmington, Del., for $100,000,000. The company was recently incorporated in Delaware with $1,000,000 nominal capital, and application may be made in a few days for an increase of capital to $200,000,000. The deed of trust is signed to cover a bond issue. According to newspaper report, the company, which is now operating in Louisiana, claims to have plants and patents which will enable it to operate systems at one-fifth the present cost, and proposes to do business on a basis of two cents for each call.

GENERAL TELEPHONE NEWS.

The Bell Telephone Company of Philadelphia has decided to issue 40,000 shares of new stock at par, present holders having the right to subscribe at the rate of one share for every five now held.

The capital stock of the New York and New Jersey Telephone Company has been increased from $9,375,000 to $12,500,000, and the new stock is offered to shareholders at par in proportion to their existing holdings.

A recent Philadelphia dispatch is to the effect that the Keystone Telephone Company (Independent) will make an effort to enter New York, Boston and Chicago within a few months. The promoters of the plan refuse to discuss details, but one of the company's financial agents said: "New York and Chicago will have an Independent system under way within 12 months." It is also stated that the Keystone State Company is about to open its long-distance service, which will give it connection with Pittsburg, Buffalo, Baltimore and other cities.

The Railroad Telephone.

It has been pointed out from time to time that the telephone is fully adapted to train dispatching on steam railroads. Moreover, this statement is borne out by the fact that telephone systems are now in practical use by some of the large railroad systems, such as the Illinois Central and Delaware, Lackawanna and Western. In an interesting article on this subject in the Railroad Gazette, C. A. Hammond remarks as follows:

Why use a complex and artificial method of communication when a simpler and more direct can be employed? What is simpler or more natural than to call an employe into your presence, dictate to him an order, which he writes out and reads over to you, and receives your "O. K." sanction? This, a good telephonic apparatus virtually does. You call your operator; he may be a mile away, or a hundred; it's all the same to you when his voice sounds in your ear, and he is practically in your immediate presence while the conversation lasts. You are both intelligent enough to appreciate the value of a systematic method, and to submit to good discipline and rules. You invariably read to him, per telephone, your printed or written order, numbered and dated; he invariably writes down the order from your dictation, or fills in the proper blanks in his forms (a duplicate of yours) as you direct; he numbers and dates the order, and attaches your signature to it, as so instructed; he then reads it over carefully to you, word for word, per telephone, awaits your "O. K." or "Complete," writes it on the order, with the exact time added, and certifies to your said approval over his own signature. He then delivers the order to the person addressed, with manifold copies to other employes equally concerned, and takes their signed receipt that they have received, read and understood the order so delivered. This receipt he forwards to you (keeping his own copy) and the transmitted order also is returned to you by the employes receiving it, and you compare the same with your own copy of the original order, which you have read, per telephone, to the operator in the first place.

Such a method Mr. Hammond says he used for many years with success and satisfaction, and though differing slightly from the procedure under the Standard Code, it worked well; and of the thousands of orders so issued, there was scarcely a single error, and never any mistake in the essential particulars, although occasionally an "operator" would be encountered who had had, perhaps, little experience either in railroad work or with the telephone; but he was trained to do precisely as he was told, and to obey the rules. The discipline was rigid and severe, not less so with the sender than the receiver. The rules for transmission of telephone orders were fully and minutely set forth, and numbered, in the book of rules; if, in the handling of the telephone, or in the process of taking down an order, numbering, dating or signing it, repeating it back, getting "O. K." etc., the "operator" betrayed any carelessness or ignorance of the rules applicable to the case in hand, he was brought to book instanter, referred to the rule he was careless of, reprimanded or admonished, and made to proceed, step by step, in the path marked out for him, all the while the conductor, perhaps, might be waiting at his elbow for the necessary order allowing him to proceed. But these cases were exceptional; as a rule, the employes took a commendable interest in their work, and the system followed was equal to any emergency.

There never was the least trouble with the transmission of the words of the order, including number, address and time, even though the line worked poorly, and at first more or less induction was present, though afterward with improved metallic circuits, the latter annoyance was almost wholly eliminated. Still, "O. K." has been unhesitatingly given, even to the faintest whispered repetition, when it was clearly perceived that it was perfect, even though the closest attention of the whole mind was necessary to be sure of it. Of course, if the line failed before "O. K." could be sent, those two momentous letters could not be written on the order by the operator or agent, and it was marked "void," and so forwarded to the despatching office in the next morning's returns. The operator was required to reply "Good day" to the sender's "Good day," before hanging up the telephone.

Given, therefore, a perfect medium for the transmission of spoken words to any reasonable distance, the main thing necessary to good service is to insure accuracy and care in the process of transmitting and recording the message, and to fix beyond question the responsibility of all parties concerned; these are three—the sender, the receiver, the executor. The despatcher's responsibility is two-fold: To prepare a safe and proper order, adequate to the case in hand, and to be sure he gets a perfect repetition back to him before he authorizes "O. K." or "Complete." The receiving agent's responsibility is, first, to repeat the telephoned message by reading the exact words as he has written them; second, not to affix the "O. K." or "Complete" until he has clearly heard it from the despatcher, then certifying the fact over his own signature, and, third, to make correct and seasonable delivery to the executor, and obtain from him his signature acknowledging the receipt of the order and that he has read and fully understands it.

An important advantage of the telephone is the ease with which a situation can be quickly reported, preliminary to issuing an order, and in explanation of the case requiring it, and other items of information that can be brought out by a quickly spoken conversation, with five times the speed of a telegraphic colloquy, while bringing the parties personally into touch with each other, almost as if they were in the same room together. This, of course, applies more especially to cases where trains are reported by their conductor, direct, who, then, in taking a train order, acts as the receiving agent, also getting his receipt from his engineer, to whom his order is addressed. This would require that trainmen, as well as station agents, should be thoroughly conversant with the rules for transmission of train orders by telephone, which, however, involve no more difficulty than those pertaining to their other duties.

Though Mr. Hammond used a "single-order" system, he says there is no reason whatever why the telephone should not be equally available for the double-order method, with no less advantage, and perhaps with less disadvantage than by telegraph. By having a series of printed forms, like those set forth in the Standard Code of Rules, for the different kinds of train-orders, the despatcher simply calls to the operator to use form No. ——, and then reads his order, stopping long enough at each blank for the receiver to properly fill it in, and then the whole order is repeated from the beginning, with all the printed and written words in regular course. This would save much time and insure greater accuracy.

On the whole, says Mr. Hammond, we must conclude that the telegraph retains its hold on account of cheapness, wider distribution of its wires, disinclination of officials to get out of the ruts, and a preference for methods to which they have become accustomed; but that the telephone, properly installed and properly used, is intrinsically the better instrument, more useful in a variety of ways, more flexible, and, if a good method is followed, a time-saver as well; and time is not merely money—it is life. But there are incidental advantages in a telephone system, which may often prove of the highest importance. It takes a bright young person scarcely less than a year to learn the Morse sounder, while he, or anyone, learns the telephone in five minutes. Thus, an intelligent conductor can report his own train wherever he can find the connecting instruments, and, if necessary, take a train order to himself and engineman—why not? Or, as has doubtless occurred to anyone thinking of the subject, with the extra set of instruments, forming a part of his train equipment, he can, in case of unusual delay, wreck or break-down between stations, go to the nearest marked telegraph pole (say every tenth one) where wires are brought to a locked box within reach, and establish communication with headquarters and receive orders.

It is said that revolutions never go backward. The electrical revolution began with the telegraph, 50 or 60 years ago, and in the last half of that period has surprised us with the telephone, the electric light, the electric railroad, and the electrical transmission of power. Before some of us are 50 years older, we shall be talking with the ends of the earth as we now talk to one another across the breakfast table.

No Collect Messages in Buffalo.

The Bell Telephone Company of Buffalo has issued this notice to its subscribers: "It has been claimed by subscribers that the practice of reversing city messages has become an annoyance rather than a convenience. In order that this company might learn the wishes of the large senders and receivers of collect messages, a careful canvass has been made of those interested, and it has been found that a large majority are in favor of the discontinuance of collect messages. We have, therefore, decided to adopt the expressed wish of the majority, beginning on October 1st, and from that date collect messages will be discontinued. Our records would indicate that you are interested in this decision, and we trust that, if it should prove a temporary inconvenience to you, you will bear in mind that in the operation of a large telephone system questions of this nature must necessarily be decided in accordance with the expressed wish of the majority."

MANUFACTURERS AND DEALERS.

The Central Telephone and Electric Company of St. Louis, Mo., announces that it has established an office in Chicago at 59 West Jackson Boulevard. The office is in charge of C. E. White, who will carry a full line of samples and be able to take care of any intending customer for either instruments or supplies.

The property of the Western Telephone Construction Company was sold on September 24th in the office of Frank Wean, referee in bankruptcy, Chicago. The assets of the corporation were bid in by Louis P. Scoville, an attorney, representing A. E. Ziehme, for $27,500. There was only one other active bidder. It is stated that the conversion of the assets of the Western Telephone Construction Company into cash will enable the trustee to pay almost 50 per cent. in dividends to the creditors. The plant of the company is at Winthrop Harbor, near Waukegan, Ill.

Washington, Baltimore and Annapolis Single-phase Railway.[1]

By B. G. Lamme.

The Washington, Baltimore and Annapolis Railway is a new high-speed electric line extending from the suburbs of Washington to Baltimore, a distance of about 31 miles, with a branch from Annapolis Junction to Annapolis, a distance of about 15 miles. The overhead trolley will be used, and schedule speeds of over 40 miles an hour are to be attained. This road is to be the scene of the first commercial operation of an entirely new system of electric traction.

The special feature of this system is the use of single-phase alternating current in generators, transmission lines, trolley-car equipment and motors. It constitutes a wide departure from present types of railway apparatus, and while retaining the best characteristics of the present standard direct-current motor system, the use of alternating current makes it possible to avoid many of the bad features.

The standard direct-current railway equipment possesses several characteristics which fit it especially for railway service. These characteristics have been of sufficient importance to overbalance many defects in the system. In fact, a far greater amount of effort and engineering skill has been required for overcoming or neutralizing the defects, than for developing the good features possessed by the system. By far the most important characteristic possessed by the direct-current system is found in the type of motor used on the car. The direct-current railway motor is in all cases a series-wound machine. The series motor is normally a variable-field machine and it is this feature which has adapted the motor especially to railway service. Shunt-wound motors have been tried and abandoned. All manner of combinations of shunt, series and separate excitation have been devised and found wanting, and in many cases the real cause of failure was not recognized by those responsible for the various combinations. They all missed to a greater or less extent the variable-field feature of the straight series motor. It is true that a variable field can be obtained with shunt or separate excitation, but not without controlling or regulating devices, and the variation is not inherently automatic, as in the series motor.

Polyphase and single-phase induction motors do not possess the variable-field feature at all, as they are essentially constant-field machines. They are equivalent to direct-current shunt or separately excited motors, with constant-field strength, which have been unable to compete successfully with the series motor. The variable field of the series motor makes it automatically adjustable for load and speed conditions. It also enables the series motor to develop large torques without proportionately increased currents. The automatically varying field is accompanied by corresponding variations in the counter electromotive force of the armature, until the speed can adjust itself to the new field conditions. This feature is of great assistance in reducing current fluctuations, with a small number of steps in the regulating rheostat. Any increase in current, as resistance is cut out, is accompanied by a momentary increase in the counter electromotive force, thus limiting the current increase to a less value than in the case of a constant-field motor.

Next to the type of motor, the greatest advantage possessed by the direct-current system lies in the use of a single current or circuit, thus permitting the use of one trolley wire. The advantages of the single trolley are so well known that it is unnecessary to discuss them. For third-rail construction, the use of single current is of even greater importance than in the case of the overhead trolley. It is seen, therefore, that it is not to the direct current that credit should be given for the great success of the present railway system, but to the series-type of motor and the fact that up to the present time no suitable single-phase alternating-current motor has been presented.

Some of the undesirable features of the direct-current railway system should also be considered. The speed control is inefficient. A nominally constant voltage is supplied to the car, and speed control is obtained by applying variable voltage at the motor terminals. This variation is produced by the use of resistance in series with the motors, with a loss proportional to the voltage taken up by the resistance. By means of the series-parallel arrangement, the equivalent of two voltages is obtainable at the motor terminals without the use of resistance. Therefore, with series-parallel control, there are two efficient speeds with any given torque, and with multiple control there is but one efficient speed with a given torque. All other speeds are obtained through rheostatic loss, and the greater the reduction from either of the two speeds, series or parallel, the lower will be the efficiency of the equipment. At start, the rheostatic losses are always relatively large, as practically all the voltage of the line is taken up in the rheostat. For heavy railroad service, where operation for long periods at other than full and half speeds may be necessary, the rheostatic loss will be a very serious matter.

The controlling devices themselves are also a source of trouble. An extraordinary amount of time and skill has been expended perfecting this apparatus. The difficulties increase with the power to be handled. The controller is a part of the equipment which is subjected to much more than ordinary mechanical wear and tear, and it can go wrong at any one of many points. The larger the equipment to be controlled, the more places are to be found in the controller which can give trouble. The best that can be said of the railway controller is that it is a necessary evil.

Another limitation of the direct-current system is the trolley voltage. Five hundred volts is common at the car and 650 volts is very unusual. By far the larger number of the railway equipments in service to-day are unsuited for operation at 600 volts, and 700 volts in normal operation would be unsafe for practically all. The maximum permissible trolley voltage is dependent upon inherent limitations in the design of motors and controllers. The disadvantages of low voltage appear in the extra cost of copper and in the difficulty of collecting current. In heavy railroad work the current to be handled becomes enormous at usual voltages. A 2,400-horsepower electric locomotive, for example, will require between 3,000 and 4,000 amperes at normal rated power and probably 6,000 to 8,000 amperes at times. With the overhead trolley these currents are too heavy to be collected in the ordinary manner, and it is a serious problem with any form of trolley or third-rail system which can be used. It is evident that for heavy service, comparable with that of large steam railways, a much higher voltage than used in our present direct-current system is essential, and the use of higher voltage is destined to come, provided it is not attended by complications which more than overbalance the benefits obtained.

A further disadvantage of the direct-current system is the destructive action known as electrolysis. This may not be of great importance in interurban lines, chiefly because there is nothing to be injured by it. In city work its dangers are well known, and very expensive constructions are now used to eliminate or minimize its effects.

From the above statements it is evident that an alternating-current railway system, to equal the direct-current, should possess the two principal features of the direct-current system, viz.: A single supply circuit and the variable-field motor, and to be an improvement upon the direct-current system, the alternating-current should avoid some of the more important disadvantages incident to the present direct-current railway apparatus.

The system must, therefore, be single-phase. The importance of using single-phase for railway work is well known. The difficulties and complications of the trolley construction are such that several alternating-current systems have been planned on the basis of single-phase supplied to the car, with converting apparatus on the car to transform to direct current, in order that the standard type of railway motors may be used. Such plans are attempts to obtain the two most valuable features of the present direct-current system. The polyphase railway system, used on a few European roads, employs three currents, and therefore does not meet the above requirement.

The motor for the alternating-current railway service should have the variable speed characteristics of the series direct-current motor. The polyphase motor is not suitable, as it is essentially a constant-field machine, and does not possess any true variable speed characteristics. Therefore it lacks both of the good features of the direct-current railway system. A new type of motor must, therefore, be furnished, as none of the alternating-current motors in commercial use is adapted for the speed and torque requirements of first-class railway service. Assuming that such a motor is obtainable for operation on a single-phase circuit, the next step to consider is whether the use of alternating instead of direct current on the car, will allow some of the disadvantageous features of the direct-current system to be avoided.

The direct-current limits of voltage are at once removed, as transformers can be used for changing from any desired trolley voltage to any convenient motor voltage. Electrolytic troubles practically disappear. As transformers can be used, variations in supply voltage are easily obtainable. As the motor is assumed to have the characteristics of the direct-current series motor, speed control without rheostatic loss is practicable when voltage control is obtained. This combination, therefore, allows the motor to operate at relatively good efficiency at any speed within the range of voltage obtained. If the voltage be varied over a sufficiently wide range, the speed range may be carried from the maximum desired down to zero, and therefore, down to starting conditions. With such an arrangement no rheostat need be used under any conditions, and the lower the speed at which the motor is operated, the less the power required from the line. The least power is required at start, as the motor is doing no work and there is no rheostatic loss. The losses at start are only those in the motor and transforming apparatus, the total being less than when running at full speed with an equal torque. Such a system, therefore, permits maximum economy in power consumed by motor and control. This economy in control is not possible with the polyphase railway motor, as this motor is the equivalent of the direct-current shunt motor, with which the rheostatic loss is even greater than with the series motor.

The use of alternating current on the car allows voltage control to be obtained in several ways. In one method a transformer is arranged with a large number of leads carried to a dial or controller drum. The Stillwell regulator is a well-known example of this type of voltage control. This method of regulation is suitable for small equipments with moderate currents to be handled. The controller will be subject to some sparking, as in the case of direct-current apparatus, and therefore becomes less satisfactory as the car equipment is increased in capacity. Another method of control available with alternating current is entirely non-sparking, there being no make-and-break contacts. This controller is the so-called "induction regulator," which is a transformer with the primary and secondary windings on separate cores. The voltage in the secondary winding is varied by shifting its angular position in relation to the primary. With this type of voltage controller, very large currents can be handled, and it is especially suitable for heavy equipments, such as locomotives. It is thus seen that there is one method of control available with alternating current, which avoids the inherent troubles of the direct-current controller. The induction regulator is primarily a transformer, and all wear and tear is confined to the supports which carry the rotor. Therefore the objectionable controller of the standard direct-current system can be eliminated, provided a suitable alternating-current motor can be obtained. This ideal type of controller is not applicable to the polyphase-railway motor, in which speed control can be obtained only through rheostatic loss. The polyphase-control system is even more complicated than the direct current, as there must be a rheostat for each motor, and two or three circuits in each rheostat. It is thus apparent that by the use of single-phase alternating current with an alternating-current motor having the characteristics of the direct-current series motor, the best features of the direct-current system can be obtained, and at the same time many of its disadvantages can be avoided.

This portion of the problem therefore resolves itself into the construction of a single-phase motor having the characteristics of the direct-current series motor. There are several types of single-phase alternating-current motors which have the series characteristics. One type is similar in general construction to a direct-current motor, but with its magnetic circuit laminated throughout, and with such proportions that it can successfully commutate alternating current. Such a motor is a plain series motor, and can be operated on either alternating or direct current and will have the same torque characteristics in either case. Another type of motor is similar in general construction to the above, but the circuits are arranged in a different manner. The field is connected directly across the supply circuit, with proper control appliances in series with it. The armature is short-circuited on itself across the brushes, and the brushes are set at an angle of approximately 45 degrees from the ordinary neutral point. The first of these two types of motors is the one best adapted for operation in large units.

This is the type of motor which is to be used on the Washington, Baltimore and Annapolis railway. Several motors have been built and tested with very satisfactory results, both on the testing stand and under a car. The results were so favorable that the system was proposed to the Cleveland Engineering Company, representing the Washington, Baltimore and Annapolis railway, and, after investigation by its engineers, it was adopted. A description of the apparatus to be used on this road will illustrate the system to good advantage.

Single-phase alternating current will be supplied to the car at a frequency of 16 2-3 cycles per second, or 2,000 alternations per minute. The current from the overhead trolley wire is normally fed in by one trolley at approximately 1,000 volts. Within the limits of the District of Columbia two trolleys are employed, as by Act of Congress the use of rails as conductors is prohibited in this district, presumably on account of electrolysis. In this case the trouble, of course, will not exist, but the contracting company has been unable to obtain permission for the grounded circuit.

The alternating current to the car is carried through a main switch or circuit-breaker on the car, to an auto-transformer connected between the trolley and the return circuit. At approximately 300 volts from the ground terminal a lead is brought out from the auto-transformer and passes through the regulator to one terminal of the motors. For starting and controlling the speed, an induction regulator is used with its secondary winding in series with the motors. This secondary circuit of the regulator can be made either to add to, or substract from the transformer voltage, thus raising or lowering the voltage supplied to the motors. The regulator, therefore, does double duty. The controller for direct-current motors merely lowers the voltage supplied to the motors, but cannot raise it, but an alternating-current regulator can be connected for an intermediate voltage, and can either raise or lower the motor voltage. In this way the regulator can be made relatively small, as it handles only the variable element of the voltage and the maximum voltage in the secondary winding is but half of the total variation required.

In the equipments in question, the range of voltage at the motor is to be varied from approximately 200 volts up to 400 volts or slightly higher. The transformer on the car will supply 315 volts, and the secondary circuit of the regulator will be wound to generate slightly more than 100 volts when turned to the position of its maximum voltage. This voltage of the regulator is about one-fourth of that of the motors at full voltage. The regulator can con-

1. A paper presented at the meeting of the American Institute of Electrical Engineers in New York, September 26, 1902.

sequently be made relatively small, in comparison with the motor capacity of the equipment. It has been found unnecessary to use much lower than 200 volts in this installation, as this allows a comparatively low running speed, and approximately 200 volts will be necessary to start with the required torque. The greater part of this voltage is necessary to overcome the electromotive force of self-induction in the motor windings, which is dependent upon the current through the motor and is independent of the speed of the armature.

There will be four motors of 100 horsepower on each car. The full rated voltage of each motor is approximately 220 volts. The motors are arranged in two pairs, each consisting of two armatures in series, and two fields in series, and the two pairs are connected in parallel. The motors are connected permanently in this manner. Since voltage control is used, there is no necessity for series-parallel operation, as with direct-current motors. To ensure equal voltage to the armatures in series, a balancing or equalizing action is obtained by the use of a small auto-transformer connected permanently across the two armatures in series with its middle point connected between them. The fields are arranged in two pairs, with two fields in series and two pairs in multiple. This parallels the fields independently of the armatures, which was formerly the practice with direct-current motors. It was a defective arrangement with such motors, as equal currents in the field did not ensure equal field strengths in the

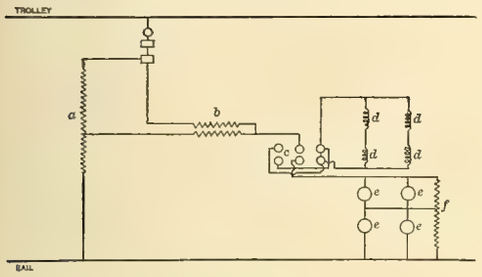


Fig. 1. Car Equipment.

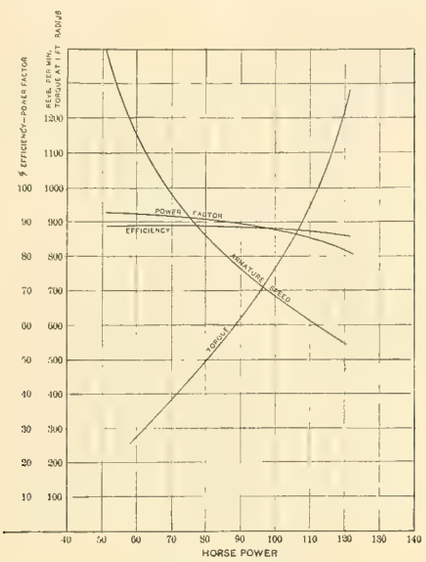


Fig. 2. Test of Motor.

WASHINGTON, BALTIMORE AND ANNAPOLIS SINGLE-PHASE RAILWAY.

motors, and the armatures connected in parallel, therefore, would be operating in fields of unequal strength, with unequal armature currents as a direct result. With alternating currents in the fields, the case is different. The voltage across the fields is dependent upon the field strengths, and the current supplied to the fields naturally divides itself for equal magnetic strengths. The chief advantage in paralleling the fields and armatures independently is, that one reversing switch may serve for the four motors and one balancing transformer may be used across the two pairs of armatures. The ordinary direct-current arrangement of armatures in series with their own fields can be used, with a greater number of switches and connections.

The general arrangement of the auto-transformer, regulator, motors, etc., is shown in Fig. 1. Here (a) is the auto-transformer, (b) the induction regulator, (c) reversing switch, (d) field of motors, (e) armature of motors and (f) equalizing transformer.

The induction regulator or controller resembles an induction motor in general appearance and construction. The primary winding is placed on the rotor, and the secondary or low voltage winding on the stator. The rotor also has a second winding, which is permanently short-circuited on itself. The function of this short-circuited winding is to neutralize the self-induction of the secondary winding as it passes from the magnetic influence of the primary. The regulator is wound for two poles, and, therefore, is operated through 180 degrees in producing the full range of voltage for the motors. One end of the primary winding of the regulator is connected to the trolley, and the other to a point between the regulator and the motors. It thus receives a variable voltage as the controller is rotated. There are several advantages in this arrangement of the primary in this particular case. First, the regulator is worked at a higher induction at start, and at lower induction when running, the running position being used in these equipments for much longer periods than required for starting. Second, when the motors are operating at full voltage the current in the primary of the regulator passes through the motors, but not through the auto-transformer or the secondary of the regulator. This allows considerable reduction in the size of auto-transformer and regulator.

The motors on the car are all of the straight series type. The armature and fields being connected in series, the entire current of the field passes through the armature as in ordinary series direct-current motors. The motor has eight poles, and the speed is approximately 700 revolutions at 220 volts. The general construction is similar to that of a direct-current motor, but the field core is laminated throughout, this being necessary on account of the alternating magnetic field. There are eight field coils wound with copper strap, and all connected permanently in parallel. The parallel arrangement of field coils assists in equalizing the field strength in the different poles, due to the balancing action of alternating circuits in parallel. This arrangement is not really necessary, but it possesses some advantages and, therefore, has been used. With equal magnetic strength in the poles, the magnetic pull is equalized even with the armature out of center.

The armature is similar in general construction to that of a direct-current motor. The fundamental difficulty in the operation of a commutator type of motor on single-phase alternating current lies in the sparking at the brushes. The working current passing through the motor should be practically no more difficult to commutate than an equal direct current, and it is not this current which gives trouble. The real source of trouble is found in a local or secondary current set up in any coil, the two ends of which are momentarily short-circuited by a brush. This coil encloses the alternating magnetic field, and thus becomes a secondary circuit of which the field coil forms the primary. In the motors of the Washington, Baltimore and Annapolis railway, this commutation difficulty has been overcome by so constructing the motor that the secondary or short-circuit current in the armature coil is small, and the commutating conditions so nearly perfect that the combined working and secondary currents can be commutated without sparking. This condition being obtained, the motor operates like a direct-current machine and will give no more trouble at the commutator than ordinary direct-current railway motors. Experience covering a considerable period in the operation of motors of 100-horsepower capacity indicates that no trouble need be feared at the commutator.

An extended series of tests was made with these motors at the Westinghouse shops at East Pittsburg, both in the testing room and under a car. Fig. 2 shows curves of the speed, torque, efficiency and power factor plotted from data from brake tests.

It should be noted that the efficiency is good, being very nearly equal to that of high-class direct-current motors. The power factor, as shown in these curves, is highest at light loads and decreases with the load. This is due to the fact that the power developed increases approximately in proportion to the current, while the wattless component of the input increases practically as the square of the current. The curve indicates that the average power factor will be very good. The calculations for the Washington, Baltimore and Annapolis railway show that the average power factor of the motors will be approximately 86 per cent.

The average efficiency of these equipments will be much higher during starting and accelerating than that of corresponding direct-current equipments, as rheostatic losses are avoided. When running at normal full speed, however, the efficiency will be slightly less than with direct current. This is due to the fact that the alternating-current motor efficiency is slightly lower than the direct current, and in addition there are small losses in the transformer and the regulator. The alternating-current equipments are somewhat heavier than the direct-current, thus requiring some extra power, both in accelerating and at full speed. Therefore, for infrequent stops the direct-current car equipment is more efficient than the alternating-current, but for frequent stops the alternating-current shows the better efficiency. Tests on the East Pittsburg track verified this conclusion. But the better efficiency of the direct-current equipment with infrequent stops is offset with the alternating-current by decreased loss in the trolley wire, by reason of the higher voltage used, and by the elimination of the rotary-converter losses. The resultant efficiency for the system will therefore be equal to or better than that of the direct-current.

In the Washington, Baltimore and Annapolis railway contract the guarantee given by the Westinghouse Electric and Manufacturing Company states that the efficiency of the system shall be equal to that of the direct-current system with rotary-converter sub-stations.

There is one loss in the alternating-current system which is relatively much higher than in the direct-current. This is the loss in the rail return. Tests have shown that at 2,000 alternations it is three to four times as great as with an equal direct-current. This would be a serious matter in cases where the direct-current rail loss is high. But the higher alternating-current trolley voltage reduces the current so much, that the alternating-current rail loss is practically the same as with the direct-current at usual voltages. In many city railways the direct-current rail loss is made very low, not to lessen waste of power, but in order to reduce electrolysis. In such cases the alternating-current rail loss could be higher than direct-current, thus decreasing the cost of return conductors. More numerous transformer sub-stations, with copper feeders connected to the rails at short intervals will enable the rail loss to be reduced to any extent desired. As a frequency of 2,000 alternations per minute is used, the lighting of the cars and the sub-stations was at first considered to be a serious difficulty, due to the very disagreeable winking of ordinary incandescent lamps at this frequency. Two methods of overcoming the winking were tried, both of which were successful. One method was by the use of split phase. A two-phase induction motor was run on a single-phase 2,000-alternating circuit, and current was taken from the unconnected primary circuit of the motor. This current was, of course, at approximately 90 degrees from the current of the supply circuit. A two-phase circuit was thus obtained on the car. Currents from the two phases were put through ordinary incandescent lamps, placed close together. The resulting illumination a few feet distant from the lamps showed about the same winking as is noticed with 3,000 alternations. With two filaments in one lamp the winking disappears entirely. A three-phase arrangement would work in the same way.

A much simpler method was tried which worked equally well. This consisted in the use of very low-voltage lamps. Low voltage at the lamp terminals allows the use of a thick filament with considerable heat inertia. Tests were made on lamps of this type at a frequency of 2,000 alternations, and the light appeared to be as steady as that from the ordinary high-frequency incandescent lamp. The low voltage is not objectionable in this case, as a number of lamps can be run in a series, as in ordinary street-railway practice, and any voltage desired can readily be obtained, as alternating current is used on the car.

There will be an air compressor, driven by a series alternating-current motor, on each car, for supplying air to the brakes and for operating the driving mechanism of the controller. The details of this mechanism are not sufficiently near to completion to permit a description of it. The method used will be one which readily allows operation on the multiple-unit system.

The generating station contains some interesting electrical features, but there is no great departure from usual alternating-current practice. There will be three 1,500-kilowatt single-phase alternators. These are 24-pole machines operating at 83 revolutions and wound for 15,000 volts at the terminals. They are of the rotating-field type, with laminated magnetic circuits and field coils of strap on edge. The field coils are held on the pole tips by copper supports, which serve also as dampers to assist in the parallel running. The armatures are of the usual slotted type. The armature coils are placed in partially closed slots. There are four coils per pole. The proportions of these machines are such that good inherent regulation is obtained without saturation of the magnetic circuit. The rise in potential with non-inductive load thrown off will be approximately four per cent. An alternative estimate was furnished for the generators proposing 20,000 volts instead of 15,000. The simplicity of the type of winding used, and the low frequency, are both favorable for the use of very high voltage on the generator. As 15,000 volts was considered amply high for the service, the engineers for the railway considered it inadvisable to adopt a higher voltage.

There are to be two exciters, each of 100-kilowatt capacity at 250 revolutions. The exciters are wound for 125 volts normal. The armature of each exciter has, in addition to the commutator, two collector rings, so that single-phase alternating current can be delivered. It is the intention to use the exciters as alternators for supplying current to the system for lighting when the large generators are shut down at night.

The main station switchboard comprises three generator panels, one load panel, and three feeder panels. High-tension oil-break switches are to be provided, operated by means of controlling apparatus on the panels. The switches, bus-bars and all high-tension apparatus will be in brick compartments separate from the board. In each generator circuit there are two non-automatic oil-break switches in series; and on each feeder circuit there are two overload time-limit oil-break switches in series. The two oil-break switches in series on the same circuit can be closed separately and then opened to test the switches without closing the circuit. With the switches in the closed position they are both operated at the same time by the controlling apparatus, to ensure opening of the circuit, and to put less strain on the switches, although either one is capable of opening the load. There will be nine transformer sub-stations distributed along the railway line. Each station will contain two 250-kilowatt, oil-cooled lowering transformers, supplying approximately 1,000 volts to the trolley system. Two transformers are used in each

station so that in case of accident to one transformer the station will not be entirely crippled.

It is the intention of the railway company to operate a direct-current road already equipped with the direct-current system. The present direct-current car equipments are to be retained, but the current will be supplied from a rotary-converter sub-station fed from the main system of the Washington, Baltimore and Annapolis railway. As this system is single-phase, it is necessary that single-phase rotaries be used in the sub-stations. There are to be two 200-kilowatt 550-volt rotary converters. These are 4-pole, 500-revolution machines. The general construction of these machines is very similar to that of the Westinghouse polyphase rotary converters. The armature resembles that of a polyphase rotary except in the number of collector rings, and in certain details of the proportions made necessary by reason of the use of single phase. The commutating proportions are so good that any reactions due to the use of single phase will result in no injurious effect. The field construction is similar to that of a polyphase rotary. The laminated field poles are provided with dampers of the "grid" or "cage" type, a form used at present in the Westinghouse polyphase rotary converters. The dampers serve to prevent hunting, as in the polyphase machines, and also to damp out pulsations due to single-phase currents in the armature. The damper acts to a certain extent as a second phase. Each rotary converter is started and brought to synchronous speed by a small series alternating-current motor on the end of the shaft. The voltage at the motor terminals can be adjusted either by loops from the lowering transformer or by resistance in series with the motor, so that true synchronous speed can be given to the rotary converter, before throwing it on the alternating-current line.

From the preceding description of this system and the apparatus used on it, some conclusions may be drawn as to the various fields where it can be applied to advantage. It is evident that a good field for it will be on interurban long-distance lines such as the Washington, Baltimore and Annapolis railway. On such railways, high-trolley voltage and the absence of converter sub-stations are very important factors.

For heavy railroading also, this system possesses many ideal features. It allows efficient operation of large equipments at practically any speed and any torque, and also avoids the controller troubles which are ever present with large direct-current equipments. It also permits the use of high trolley voltage, thus reducing the current to be collected. In this class of service the advantages of this alternating-current system are so great that it is possible that heavy railroading will prove to be a special field for it.

For general city work, this system may not find a field for some time to come, as the limitations in the present system are not so great that there will be any urgent necessity for making a change. It is probable that at first it will be applied to new railways, or in changing over steam roads rather than in replacing existing city equipments. One difficulty with which the new system will have to contend, is due to the fact that the alternating-current equipments cannot conveniently operate on existing direct-current city lines, as is the present practice where interurban lines run into the cities. It will be preferable for it to have its own lines throughout, unless very considerable complication is permitted. When the alternating-current system applied to interurban and steam railways finally becomes of predominant importance, it is probable that the existing direct-current railways will gradually be changed to alternating-current as a matter of convenience in tying the various lines together.

As was stated above, alternating-current equipments cannot conveniently be operated on direct-current lines. It does not follow, however, that the motor will not operate on direct current. On the contrary, the motor is a first-class direct-current machine, and if supplied with suitable control apparatus and proper voltage it will operate very well on the direct-current lines. This would require that the motors be connected normally in series, as the voltage per motor is low. A complete set of direct-current control apparatus would be needed when the alternating-current equipment is to be run on direct current, and considerable switching apparatus would be necessary for disconnecting all the alternating-current control system and connecting in the direct-current. The complication of such a system may be sufficient to prevent its use, at least for some time to come.

In some cities, very strict laws are in force in regard to the voltage variations in various parts of the track system. The permissible variations are so small in some cases that an enormous amount of copper is used for return conductors; and in some cases special boosters are used in the return circuits to avoid large differences of potential between the various parts of the track system. The object in limiting the conditions in this manner is to avoid troubles from electrolysis. The alternating-current system will, of course, remedy this.

For city work, it is probable that voltages of 500 or 600 would be employed instead of 1,000 or higher. The transformers and controllers can be designed to be readily changed from full to half voltage, so that low voltage can be used on one part of the line and high voltage on another. As the car equipments of such railways are usually of small capacity, it is probable that speed control will be obtained by means of a transformer with a large number of leads carried out to a control drum, rather than by means of the induction regulator, as the latter device is much more expensive in small units. This is chiefly a question of cost, and if the advantages of the induction regulator are found to overweigh the objection of high first cost, then it will be used even on small equipments.

In the Washington, Baltimore and Annapolis railway, the generators are wound for single phase. In the case of large power stations with many feeders, the generators may be wound for three phase, with single-phase circuits carried out to the transformer sub-station; or three-phase transmission may be used, with the transformers connected in such a manner as will give a fairly well-balanced three-phase load.

There are many arrangements and combinations of apparatus made possible by the use of alternating current in the car equipments, which have not been mentioned, as it is impracticable to give a full description of all that can be done. But enough has been presented to outline the apparatus and to indicate the possibilities of this new system which is soon to see the test of commercial service.

New Westinghouse Industries at Trafford City, Pa.

The remarkable growth of the affiliated Westinghouse industries was recently signalized by the creation of a new city and the building of another Westinghouse manufacturing plant. The new industrial center is located about 17 miles east of Pittsburg, on the Pennsylvania railroad, and is to be known as Trafford City. Extensive factory sites have been laid out here to provide for the overflow of the several Westinghouse industries, a number of which have already used up all the available building room at their present locations and are still pressed for space. The first of the Westinghouse companies to erect buildings in the new city is the Westinghouse Foundry Company, which is at present putting up an extensive and model foundry plant and pattern shop.

In laying out the city provision has been made, not only for the factories that are to be erected there, but also for homes and all modern improvements and comforts for the men who are to work in the factories. The latter will be located on a farily level area between the Pennsylvania railroad and the residence portion of the city, which will be reached from the railway station by a steel viaduct 1,100 feet long. The residence district has been laid out upon hillsides and a generally level plateau, high enough above the factory sites to render it free from smoke and dirt.

The new town is connected with Pittsburg by the Pennsylvania railroad, and, in addition, a street-railway line has been built, connecting with the Pittsburg Railways Company's line at Wilmerding, 2½ miles distant.

The factory site, located in a bend of Turtle Creek, provides room for nine factory buildings, each about 200 feet by 800 feet. A system of railway yards and tracks serving this area has been laid out in a very thorough manner, providing a track alongside of each building and transversely through each end. The storage tracks, in connection with this, occupy an area of about 300 feet by 200 feet. This system of tracks is connected with the main line of the Pennsylvania railroad by the Turtle Creek Valley branch of the latter. It is also to be connected with the towns of Wilmerding and East Pittsburg, where the works of the Westinghouse Air Brake Company, the Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company are located, by an interworks railway, which will be operated by the Westinghouse interests.

The pattern shop and storage building, which has already progressed well toward completion, is a steel and brick structure, 605 feet long and 80 feet wide, with a height to the eaves of the roof of 47 feet. The pattern shop occupies 160 feet at one end of this building.

The foundry building is 611 feet eight inches long and 184 feet three inches wide outside of the brick walls, which are 36 feet high at the eaves and 80 feet at the peak. As in the case of the pattern shop, the foundations are built of concrete and the superstructure of steel and brick. The foundry is divided transversely into three bays, the center bay being 80 feet three inches wide between centers of columns, runways being provided for traveling cranes of 80-foot span and 150 tons lifting capacity. The cranes will be electrically driven. At the middle of one of the side bays, where the cupolas are located, is a charging floor about 50 feet square, constructed entirely of steel. The melting equipment of the foundry will consist of two air furnaces, each having a capacity of 30 tons, and three cupolas capable of melting 18 tons per hour each. This will enable a casting weighing as much as 100 tons to be easily poured, and the casting can afterward be lifted out of the sand by one of the 150-ton traveling cranes.

The plans for the buildings were prepared under the supervision of the Westinghouse Machine Company, for which the Westinghouse Foundry Company will supply castings. The Security Investment Company of Pittsburg, Pa., is the financial agent and general contractor for the entire works, and Messrs. James Stewart & Co. of St. Louis, Mo., and Pittsburg, Pa., are the managers of construction.

Consolidation of Lighting Interests in Northern California.

The Bay Counties Power Company now has transmission lines extending over a dozen counties in the northern part of California. The service rendered by the company has been generous and satisfactory from the start and the company has found a good demand for its service, both as regards light and power. It furnishes power to almost the entire street-railway system of Alameda County. The net revenue is good, and is steadily increasing, as the monthly reports show. In July dividends of 20 cents per share were inaugurated, to be paid monthly. As there are now 36,000 shares of stock out, these dividends call for the disbursement of $7,200 every month.

The same parties that have engineered this enterprise also control the California Central Gas and Electric Company, which buys its electric current for light and power from the Bay Counties Power Company and makes its gas from a process of its own and entirely from California fuel oil. This company supplies gas and electricity to a great many towns throughout Butte, Yuba, Napa, Yolo, Nevada and Sonoma Counties, and has reduced the rates for both illuminants.

The same parties, which include John Martin and Eugene de Sabla, Jr., of San Francisco and R. R. Colgate of New York city, are also at the head of another and still larger corporation. This was incorporated some time ago with a capital of $30,000,000 and is known as the California Gas and Electric Corporation. This organization has already secured options on the plants of the Oakland Gas, Light and Heat Company of Oakland, having a capital of $3,000,000 and $1,000,000 in outstanding bonds, and the Sacramento Electric Gas and Railway Company of Sacramento, with a capital of $2,500,000 and $2,100,000 in outstanding bonds.

It is now generally believed that the California Gas and Electric Corporation will eventually absorb or at least become the controlling factor in the properties and franchises of the Bay Counties Power Company and the California Central Gas and Electric Company, and thus practically place the whole business of lighting the principal cities and towns in the northern part of the state under a single corporation.

Municipal Ownership in Newton.

[From the Newton (Iowa) Daily Herald.]

If there is any one thing on earth more exasperating than another it is to endure darkness when you have paid for light. There has been 40 or 50 days this summer when it was practically impossible to see anything a large part of the day, due to thick clouds and darkness. Yesterday afternoon this office had to use tallow candles for several hours and the work was delayed unreasonably.

What has always seemed queer to us is that under municipal ownership we cannot have what we want and what we pay for. When the old Thomson-Houston plant was in Newton the light service was excellent. Some attention was paid to consumers. You could get wiring done when you wanted it, and you could find a light without striking a match to locate it. As soon as the Thomson-Houston plant was out of the way the light service began to grow inferior. It has never improved. As a matter of fact, it gets worse and worse all the time. It is and has been so wretched that nothing but local patriotism has prevented the people from rising up in righteous indignation and wrecking the seemingly worthless plant in toto.

BOOK TABLE.

ELECTRICAL CATECHISM. Five Hundred and Thirty-three Plain Answers to 533 Practical Questions About Electrical Apparatus. 1902. New York: Hill Publishing Company. Pp. (5½ by nine inches), 210, with 246 illustrations and five tables. Price, $2.

This book has been compiled from the issues of Power, with the aim of reaching the needs of the average central-station or isolated-plant engineer. For this reason, as stated in the preface, the author has not attempted "to cover the entire electrical field, but rather to make the treatment of principles and practice in what might be termed the 'heavier' branches of electrical engineering more exhaustive than is usual in a work of this kind." The subject matter is put to the reader in "clear every-day phraseology." This does not mean that it is merely elementary, for it goes quite deeply into theory and practice. Chapters six, seven, eight and nine treat on the theory of alternating currents and alternating-current generators. The transformer, motor (synchronous and induction), rotary converter and electric light are taken up, in the order named, in the next four chapters. The last chapter (15) deals with the Nernst lamp. Although the catechetical method of presentation is not the most time-saving, still there are many persons whose attention is arrested and held by it. The writer has put his subjects in a good, logical sequence, which, to a beginner, means much. The information given in the book is correct, up-to-date, and of much value. The index is well arranged and seems quite complete.

Natural Gas.[1]

The consumption of natural gas has continued to increase, although the pressure, except in the new fields of West Virginia, has continued to decline, necessitating the expense of compression in order to market an increased production from the declining fields, which expense must continue to increase as the pressure declines and the distance to the source of supply increases.

The value of natural gas consumed in the United States in 1901 was $27,067,500, which, at 15 cents per 1,000 cubic feet, is equivalent to 180,450,000,000 cubic feet. If it were possible to store this gas in a cube, the density throughout being equal, its sides would be 5,530 feet in length, or 250 feet greater than the sides of a cubic mile. If 20,000 cubic feet of natural gas be taken as equal to one ton of coal, 8,458,600 tons of coal, valued at $3.20 per ton, would be required to yield the sum of money for which the natural gas sold.

The value of the production for 1901 was greater than that of 1900 by $3,368,826, or over 14 per cent. It also exceeded that of 1899 by $6,992,627. It may also be interesting to note that the value of the 69,389,194 barrels of petroleum produced in the United States during 1901 was $66,417,335, and that the value of the natural gas amounted to 40.7 per cent. of the value of the petroleum for the same year, and that, further, when the fuel value of the coal and wood displaced by natural gas in 1900—which amounts to $32,445,156—is considered, this estimated displacing value of natural gas is nearly 49 per cent. of the entire value of the crude petroleum produced in the same year.

There were 10,297 wells producing natural gas at the close of 1901, of which number 74 were not turned into the gas mains, and 2,088 producing wells were drilled in the same year; there were 453 dry holes, or non-producers, and 1,084 were abandoned. In 1900 there were 10,293 producing wells, of which number 24 were shut in; 1,759 wells were drilled in the same year; 359 were dry holes and 991 were abandoned. There were very nearly 800 miles of pipe laid during 1901, the mains varying from two inches up to 20 inches. This brought the total up to 21,848 miles of natural-gas mains of from two inches to 36 inches diameter in use at the close of 1901.

During the year 1901 there was an unusual amount of consolidation of the older companies, and there were organized also a number of new companies with large capital, with a view chiefly of utilizing the great areas of high-pressure gas territory in Lewis, Harrison, Marion and Wetzel Counties of West Virginia, by the construction of larger and longer pipe lines, so as to market this increased production in Western Pennsylvania and Ohio. This involves the outlay of many millions of capital.

As a source of power natural gas stands at the head of the list for economy among the fuels, both as to expense of installation and expense of operation.

It has been supplying the power for a very large number of factories and operations in the gas belt, and lately it has been extensively applied in creating the power by which the natural gas itself is compressed from a low to a high pressure when the original pressure has failed and the pipes are insufficient to deliver the necessary quantity of gas at the well pressure. A number of these compressors work up very close to 1,000 horsepower, with an economy that enables eight to 10 cubic feet of natural gas to develop a horsepower for an hour, a saving of from 40 to 50 per cent. over high-duty steam engines.

It is estimated that fully 1,000,000 domestic fires are supplied by natural gas, and that 4,000,000 people are furnished with this ideal fuel and light.

Companies or individuals to the number of 1,545 report the use of natural gas in manufacturing establishments of various kinds, numbering in all 5,742, including 102 iron and steel works and 219 glass works.

Messenger Girls and Boys in Chicago.

The Illinois District Telegraph Company is once more employing boys to deliver messages, in spite of its protestations that it would never do so. These boys, however, are mostly above the age of 16 and are nearly all new to the employment of the company. The girls still hold their places, and, according to one of the officials of the company, will continue to do so, the boys being employed for night work and the delivery of messages to places where a girl could not go with propriety. From now on, all boys employed in the day work of the company must accept pay on a commission basis. The girls will continue to be paid by the day.

One of the organizers for the Federation of Labor now proposes to organize the girls into a union, the reason given being that the girls are dissatisfied with their pay. It is said that the girls have been approached regarding the formation of a union, and have looked upon the proposal with favor. If they are organized into a union, they will affiliate with the union of the messenger boys.

1. From a bulletin furnished by the United States Geological Survey (Charles D. Walcott, director).

Depth of Submarine Cables.

Some interesting information in relation to the nature of the ocean beds as pertaining to submarine-cable laying has recently been published. Some portions of the Atlantic cables are over three miles below the surface, and this is not necessarily the extreme depth, for the cable may, and probably does, pass from the top of one submarine hill to another, without drooping materially into the deep valleys between. The greatest known depth of the sea is 40,236 feet, or 7 3-5 miles, found in the South Atlantic, about midway between the island of Tristan d'Acunha and the mouth of the Rio de la Plata. Soundings have been made to the depth of 27,480 feet in the North Atlantic, south of Newfoundland, and about 34,000 feet, or nearly 6½ miles, is reported south of the Bermudas. Even such enormous depths as these need not hinder cable laying, so far as the theory is concerned, but in practice, for reasons of economy in maintenance and otherwise, it is found best to take advantage of favoring conditions in the ocean's bed. To illustrate, says Lippincott's Magazine, all of the cables between the United States and Europe run up along the coast until they reach the neighborhood of Newfoundland before starting across to their destinations in Ireland and France. The reason for this is found in the range of submarine tablelands, forming an ideal cable bed, which lies between the three latter countries. In past years immense portions of this submerged territory have been plotted and mapped by various governmental and private expeditions, and this knowledge is constantly being added to. It becomes particularly valuable in economic cable laying.

Electrical Trade with Cuba.

The State Department has issued its last summary of the commerce of the Island of Cuba. The balance of trade between Cuba and the United States during the American occupation was decidedly in favor of the former, although not to so great an extent as in previous years. During this period Cuba, while importing $45,000,000 worth more than she sold, yet exported more than $37,000,000 to the United States in excess of her purchases from the latter. It is to be noted, however, that the ratio of import from the United States is materially greater than it was during the Spanish regime.

The total import value of telephone, telegraph and other electrical instruments during the entire period of occupancy only amounted to $101,250, the major portion, $87,691, coming from the United States. Of the remainder, $7,395 was from France, $3,792 from Germany, $1,426 from the United Kingdom, $506 from Spain, $299 from Belgium, $137 from Mexico and $4 from Switzerland.

The total importation of incandescent electric lamps was $21,219. Of this amount $16,335 was imported from the United States, $2,194 from France and $1,812 from Germany, while Austria-Hungary supplied $390; United Kingdom, $210; Belgium, $167; Switzerland, $70, and Spain, $50.

The total importation of electrical machinery was $240,647, of which the United States again led with $221,064; France, $13,441; United Kingdom, $4,057; Germany, $877; Belgium, $610; Spain, $277; Austria-Hungary, $171, and Mexico, $150.

Central Service Plant for Dwelling Houses.

An interesting project for the building of 96 houses with central service plant is on foot in Birmingham, Ala. S. Montgomery Smith of that city, who is the projector of the enterprise, says that success is now assured. He writes to the Manufacturers' Record as follows: "All but a small portion of the capital is now pledged, and application for charter for the Modern Dwellings Company is now being prepared. Mr. W. C. Weston, the architect of the several large office buildings now in course of construction here, has designed the plans, which comprise 12 eight-room houses, 16 seven-room houses and 68 six-room houses, each having spacious halls and porches, modern bathrooms, oak floors and finish. All are to be supplied from the service plant with hot and cold filtered water, steam heat and electric light. Gas ranges will be in the kitchens and there will be but one fireplace, and that with gas log. No coal is to be used about the premises. Sixty-four of these houses front on four small parks. All service pipes are carried through the alleys. The service building provides laundries, storage rooms, a heated playroom for children and a swimming bath. The rates of rental are $35, $40 and $45 per month, including heat, light and water. T. C. Thompson & Bros. are to superintend the construction. The total cost of the improvement will be $354,000, of which $180,000 is in stock and $174,000 in mortgage loan."

The gross earnings of the Twin City Rapid Transit Company of St. Paul and Minneapolis, Minn., for the second week of September, 1902, are $69,101, as against $66,416 for the same period last year. This shows an increase in business amounting to $2,685. For the periods of the two years extending from January 1st through the second week in September the gross earnings were as follows: 1902, $2,495,277; 1901, $1,183,708, showing an increase for this year amounting to $311,569.

CORRESPONDENCE.

New York Notes.

New York, September 27.—One of the propositions considered by the Board of Estimate on Friday was an application of Borough President Cantor for an appropriation of $250,000 for the construction of pipe galleries in the subway of the Rapid Transit railroad in Broadway, between Ann and Morris Streets. A letter was read from the Merchants' Association recommending the plan. All the members of the board were said to be in favor of the plan, and as soon as the correct method of raising the money is decided upon the appropriation will be made.

Mayor Low has announced that he will work earnestly to have granted to the Pennsylvania Railroad Company the right to run its proposed tunnel under the Borough of Manhattan to the new terminal property purchased by the company at Thirty-fourth and Thirty-fifth Streets. The Board of Aldermen will meet on October 7th, and he is in hopes of having a public hearing on the question and having the Rapid Transit Commission act on the ordinance before that time. At a recent meeting of the Central Federated Union President Cantor was given a vote of thanks for his efforts to get the labor clauses inserted in the tunnel contract.

At a meeting of the Rapid Transit Commission on Thursday the board briefly considered four suggestions made by President Swanstrom of the Borough of Brooklyn. These propositions are as follows: To build tunnel No. 2 from the Battery to and along Hamilton Avenue; to connect the terminus of East River Bridge No. 3 with the Atlantic Avenue tunnel by a spur from Flatbush Avenue; that this tunnel be extended to connect with the Brighton Beach railroad at Prospect Park; that an extension of this tunnel be carried by way of Fourth Avenue to Fort Hamilton, and under the Narrows, making a junction with the Hamilton Avenue tunnel. On motion of Mayor Low the subject was referred to Chief Engineer Parsons for a report on the practicability of the schemes and their cost, as a whole and by sections.

It has been definitely decided to establish a station on the Rapid Transit railway at Central Park West and One-hundred-and-fourth Street. This station will be the only one between Broadway and One-hundred-and-third Street and Lenox Avenue and One-hundred-and-tenth Street. The roadbed at Central Park West and One-hundred-and-fourth Street is about 50 feet below the street level, and access to the new station will be had by means of elevators.

The announcement has been made that the trains on the Sixth and Ninth Avenue lines of the Manhattan elevated-railway system will be run by electricity on and after October 15th. More than 500 men are now engaged in the work of connecting the third rail.

The annual report of the Brooklyn Rapid Transit Company for the fiscal year just ended shows the gross earnings to be $11,525,202, a decrease of $222,371, and the net earnings $3,808,073, a decrease of $808,420, over the preceding year. The deficit for the year was $129,156, an increase of $426,376. The report that Jacob L. Greatsinger intended to resign the presidency of the company was denied by the officials.

The American Electric Vehicle Company of Newark, N. J., has been placed in the hands of a receiver by Vice-chancellor Emery. The company was incorporated in New Jersey on December 13, 1899, with a capital of $6,000,000. The application for the receivership was made by John R. Hardin, counsel for George F. King of East Orange, one of the stockholders. George P. Lister of Hoboken is the president and treasurer of the concern. Mr. Hardin's plea says that the assets of the company are more than $57,000 and the liabilities specified are $42,000, and notes aggregating $37,500. The bill also avers that the company is being sued for $2,000 damages by John W. Newbury. Charles J. Roe of Jersey City, suggested as temporary receiver by Mr. Hardin, was appointed.

The Subway Construction Company has recently placed a contract with the Otis Elevator Company for an escalator, or moving stairway, to be installed at the Manhattan Street station of the new rapid-transit road. At this point the subway crosses the Manhattan Valley on a viaduct, the tracks being about 40 feet above the level of the street. The escalator will carry passengers both up and down, the two tracks being arranged in the same vertical plane. The guaranteed carrying capacity of the device is 20,000 people per hour, 10,000 in each direction. A motor of 35 horsepower will be sufficient to operate the mechanism when working at its maximum capacity.

The eastern branch of the Electrical Supply Dealers' Association, which meets at 39 Cortlandt Street, has, according to report, ceased to make any effort to control the prices of electrical supplies. Victor C. Gilpin, the secretary of the Electrical Supply Dealers' Association, was interviewed by the New York Times and said that the men who compose the organization had organized for social purposes at first. Afterward it had been ascertained that it would be advantageous to many dealers in the electrical supply business if something were done to make the prices of the various patented articles uni-

form. An understanding was arrived at, and it was operative for some time past. Recently, he said, some dissatisfaction had arisen by jobbers, principally in the West. Therefore the organization decided not to attempt to control the prices of the patented manufactured articles. "The subject of ceasing to control prices had been under consideration for a considerable time," Mr. Gilpin said, "and we only did at the meeting what we had previously decided individually we would do. We still exist as a social organization."

The following-named concerns have been incorporated at Albany during the week: The Rooney-Westbury Electric Lamp Company, New York city; capital, $50,000; directors, J. J. Rooney, Scarsdale; Harry Westbury, Harrison, N. J.; F. J. Rooney, Brooklyn.

American Electro-therapy Company, Brooklyn; capital, $50,000; directors, E. A. Calahan, J. H. Wickert and E. H. Bartley, Brooklyn.

Electric Arts Company, New York city (electrical contracting); capital, $10,000; directors, H. G. Carleton and C. E. Danforth, Jr., New York city, and H. H. Pratt, Westfield, N. J.

Camp Electric Construction, New York city; capital, $10,000; directors, C. F. Camp and F. E. Southard, New York city, and Alexander Gregory, Brooklyn.

Suburban Railway Company, New York city; capital, $100,000; directors, J. C. Simon, William Ballin and Max Cohen, New York city. O.

Canadian Intelligence.

Toronto, September 27.—Nova Scotia is to have more electric railways. C. A. Flaherty, the chief engineer of the Egerton Tramway Company of Boston, states that his company proposes to build and operate an electric railway between the towns of New Glasgow, Westville, Stellarton and Trenton, with a branch to Abercombie Point, opposite Picton, and to control the electric-lighting systems of the county from Picton.

The Montreal Street Railway Company has offered to accept a contract for the removal of snow during the night from the streets of that city. It will be a costly job, but has to be done.

The Montreal Street Railway Company is arranging with the City Council for the conveyance of freight over its lines between the hours of 1 a. m. and 4 a. m. The service as proposed will be a slow and noiseless one.

The Lake Temiskaming and Northern Railway, the government road for which the Province of Ontario has just let the contracts for building 110 miles, from North Bay to Lake Temiskaming, will in all probability be an electric road. The settlers along the proposed line are anxious that the motive power should be electric instead of steam, as they dread the danger of fire through the densely wooded districts en route. There are plenty of waterpowers along the line, which can be utilized, thus making the road a cheap one to operate. H.

From the Buckeye State.

Cleveland, Ohio, September 27.—The legislative committees at Columbus have recommended that the franchise question be allowed to remain on the statute books as it is; that is, the old law will be re-enacted in the new code bill that is now up. It now remains to be seen what will be done with it when the code comes up for vote.

Regular service has been established on the Columbus, Delaware and Marion road between Columbus and Delaware. It is intimated that the general offices of this road will be located at Delaware. One of the new 66-foot cars has been received and is now in operation. It is perhaps the largest car operating on any road in the state.

The messenger boys of the Western Union Telegraph Company went out on a strike Monday because the manager refused to increase their pay.

The Cincinnati, Milford and Loveland Traction Company has been incorporated with a capital stock of $700,000 to connect the two towns named with Cincinnati. J. M. Wilson, Claude Ashbrook, Harry L. Gordon and others are interested in the new line, which will be a competitor of both the Roudebush and the Compton lines.

The council of Reading, near Cincinnati, has granted the Cincinnati and Northeastern Traction Company a 25-year franchise to operate lines over its streets. Judge Dennis Dwyer of Dayton and other prominent men are interested in the new road.

The Toledo, Angola and Western Construction Company of Toledo has been incorporated with a capital stock of $10,000 by Thomas H. Tracey and others. It is supposed to be for the purpose of constructing an electric railroad of the same name.

The River Road Company has been incorporated in Kentucky with a capital stock of $350,000 for the purpose of connecting Louisville and Cincinnati with a trolley line. It is stated that the company will take over the Louisville and Nashville steam road, which runs from Louisville to Prospect, and will convert it into an electric road. From there the line will follow the course of the Kentucky River to Carrollton. Colonel A. S. Berry of Newport is promoting a line from Covington to Carrollton, and it may be extended to Louisville over the proposed new line. The officers of the River Road Company are as follows: President, Lafon Allen; first vice-president, Owen Tyler; second vice-president, Bethel Veech; secretary, W. N. Cox. This is an important enterprise and the first extensive one undertaken in Kentucky for some time. O. M. C.

Information from Indiana.

Indianapolis, September 29.—The last spike in the Evansville-Princeton electric line was driven at the corner of Read and Pennsylvania Streets last Friday. The spike was driven by A. G. McKasson and afterward withdrawn by William Sonntag, officers of the company, who will have it plated with silver and preserved. This company has contracted with the Westinghouse company for $72,000 worth of electrical equipment to be shipped immediately.

L. C. Henderson of Ohio, in addressing the Central States Water Works Association convention in Indianapolis, on the 26th, on the dangers of electrolysis, took the ground that cities should provide in franchises that electric-railway companies should not operate with a single-trolley system, such as is used in most cities. He asserted that such systems not only destroyed water and gas pipes, but that they were a menace to tall buildings, whose frames are of steel.

The local and the long-distance telephone companies at Richmond have brought suit against the Richmond Street and Interurban Railway Company to enjoin the construction of high-tension feed wires west to Centerville and Dublin. The wires, three in number, are to connect the Richmond power house with apparatus at Dublin. The complaint alleges that 1,300 volts of electricity passes through the wires in such close proximity to the telephone wires that damage has already resulted, and that great future damage will be caused by the burning out of instruments and apparatus. Judge Fox granted a temporary restraining order and thus put a stop to the work of completion until October 7th, when the case will be tried.

A corps of civil engineers, under R. W. Hunt & Co. of Chicago, has completed a survey for an electric line from Jasper to Mitchell by way of French Lick and West Baden.

A number of capitalists are organizing a company at Frankfort with a view to building a circle of interurban lines, Frankfort to be the center. Those interested in the company are R. F. Divan and W. F. Ball of Chicago, William George, Charles Karoley and Vine A. Watkins of Aurora, Ill., C. C. Callen and G. A. Janeson of Lafayette and D. A. Coulter of Frankfort. The company will be incorporated this week with a capital of $2,000,000. The plan is to connect Lafayette, Logansport and Kokomo with Frankfort, with an ultimate outlet to Chicago.

Ground has been broken at Indianapolis for what President McGowan of the Indianapolis Street Railway Company says will be the largest street-car barn in the country. It is calculated to house 300 cars.

The Chicago and South Shore Electric Railway Company has opened its line from Laporte to the Baptist Assembly Chautauqua grounds on the north shore of Pine Lake.

A petition for a franchise for an electric-light plant is held up at Bluffton because a majority of the council are wedded to the municipal-ownership idea. The city is in debt beyond the lawful limit, but the councilmen hope to evolve some plan to evade this limitation. The citizens generally oppose the municipal-ownership idea and are insisting on the franchise being granted. F.

Northwestern Notations.

Minneapolis, September 27.—A co-operative electric-lighting plant is urged by the Merchants' Protective Association of Mankato, Minn. A committee of the association has reported that Mankato has been paying too much for street and commercial lighting.

The Western Union Telegraph Company has ordered the establishment of a $25,000 storage battery at Sioux City, Iowa, the first one in the West. Work on the new battery is to be started at once.

The survey has been completed between Winona, Minn., and Rushford for the proposed electric railway. Another survey will be made for a line to Houston, and the company will determine which line will be the more profitable. A line from Witoka to Houston is also to be surveyed.

The Electric Light and Power Company of Wapello, Iowa, has sold its plant to O. Vaught of Centerville, Iowa, who has taken possession. Mr. Vaught is a practical electrician.

The plant of the Belt Electric Light and Power Company at Pluma, S. D., is being replaced gradually by new material. A new building is being erected over the old, which will be torn down as soon as the new one is completed. The plant is being kept in operation all the time.

An electric railway is projected from Burlington to Keosauqua via Bonaparte and West Point, Iowa. Another line is projected from Burlington to Birmingham via Lowell and Salem.

The Western Union Telegraph Company has found the use of girls in St. Paul a great success, as messengers. A number of girls have been added to the force and they are found to be quite satisfactory.

The St. Paul Gas Light Company will follow the example of the city water board and will sue the Twin City Rapid Transit Company for damages to its gas pipes by electrolysis, caused by vagrant currents from the rails of the Rapid Transit company.

The municipal electric-light plant at New Ulm, Minn., has been completed and put in operation. The old company has agreed to accept payment in full from the city to October 1st for street lighting and waive the month of October, which its contract covers. The old company's lamps were at once removed from the streets in order that the new ones might be put in place. R.

Southern Developments.

Charlotte, N. C., September 27.—The United States Railways and Electric Company contemplates issuing $600,000 car-trust certificates to pay for new equipment. The company has also agreed to sell the stock of the United Electric Light and Power Company to the Continental Trust Company of Baltimore. It is considered certain that the car trust will exercise its option.

It is probable that the Bay Shore Terminal Company of Norfolk, Va., will suspend operations for the winter, with the purpose of resuming next spring.

The committees at Richmond, Va., have in sight about $16,000, to be used in entertaining the visitors to the International Association of Municipal Electricians, to assemble in that city on October 7th.

The Columbia (S. C.) Water Power Company will install about January 1st a 1,300-horsepower generator, in addition to those now in operation.

It is announced that the merger of the three companies at Macon, Ga., representing $1,000,000, has been consummated. The properties are electric railways.

It is said that the merger of the Augusta (Ga.) Railway and Electric Company and the Augusta-Aiken electric line has been consummated.

The Shaffer Boiler and Engine Manufacturing Company of Westminster, Md., has been chartered with $200,000 capital stock. The company will also manufacture automobiles. Head offices will be in Baltimore. L.

Old Mexico.

Austin, Texas, September 25.—Mackin & Dillon, an American contracting firm of Monterey, Mexico, have taken the necessary preliminary steps toward building an extensive system of electric street railway in that city. It is reported that the deal involves the purchase and consolidation of the two horse-car systems already in operation there. Monterey has a population of about 80,000 people and is a great manufacturing and business center.

The work of constructing a street railway between the city of Queretaro, Mexico, and the town of El Pueblito, is in progress. The promoters of the enterprise contemplate equipping the line with electric power later on. The distance between the two places is five miles.

The new electric-light plant in the city of Taxco, state of Guerrero, Mexico, was formally inaugurated on September 14th. Governor Moro and other distinguished state officials participated in the ceremonies.

Arrangements have been made for the early construction of an electric-railway line between the cities of Linares, Mexico, and Teran, in the state of Nuevo Leon. W. D. H.

PERSONAL.

Fred Wilson has resigned his position as manager of the Brantford (Ont.) Street Railway Company.

W. W. Southgate of Nashville, Tenn., has been appointed engineer of the Tennessee Interurban railway, which will build extensively in Tennessee. Surveys are now in progress.

Charles E. Lee, well known to Chicago electrical men, is again connected with the Electric Gas Lighting Company of Boston. Mr. Lee is now the western traveling representative of the company and is stopping at present at the Great Northern Hotel in Chicago.

Col. Henry A. Pierce, treasurer and general manager of the Pawtucket Electric Company, died on September 25th, at Pawtucket, of appendicits. He was a prominent figure in the political and military life of Rhode Island, and from 1884 to 1894 an assistant secretary of the United States Senate. He was sixty-six years of age.

Lieutenant-colonel H. A. Yorke of the Royal Engineer Army Corps of England has recently come to this country for the purpose of inspecting electric-railway systems. It is stated that he is desirous of finding a way to prevent the leakage of power from electric wires and rails which has proved very troublesome in England.

The latest story about the redoubtable Charles T. Yerkes, street-railway magnate, formerly of Chicago but now of London, is that he may write a book based on his London experiences in dealing with the extreme conservatism of British business methods. Mr. Yerkes is thus reported: "Precedents from abroad are not tolerated at all; those made at home are viewed with suspicion and adopted with reluctance. Such American ideas as we have brought over

are bound to be unpopular until we have given an ocular demonstration of their worth. Great Britain has awakened, but the process has not proceeded beyond the eye-rubbing stage."

Killingworth Hedges, a member of a lightning-research committee in England, recently arrived in New York. He has come to this country to see if a more suitable means than a lightning rod for preventing lightning striking buildings can be found. The rod, he says, is practically useless, and this branch of scientific research has been greatly neglected.

ELECTRIC LIGHTING.

W. T. Avera and associates propose organizing a company to establish electric-light plant, waterworks and ice factory in Pocahontas, Ark.

The Consumers' Light, Heat and Water Company at Belzona, Miss., has been incorporated with $15,000 capital stock by F. Castleman, J. H. Levy and S. Byman.

The city of Winnsboro, S. C., has $10,000 available for the construction of an electric-light plant. Whaley & Co. of Columbia, S. C., are the engineers in charge.

Fred Mayer, Henry C. Mayer and John M. Gray have incorporated the Del Rio (Texas) Electric Light and Power Company, to establish an electric plant. The capital stock is $8,000.

General Irving Hale of Denver is said to be seeking a franchise from Douglas, Wyo., for the erection of an electric-light plant in that city. The proposition is now being considered.

The Marseilles (Ill.) Water and Light Company has been incorporated with $10,000 capital stock to furnish water, light, heat and power to the residents of Marseilles. The incorporators are W. Hammond and M. A. Earl.

The Zanesville Railway Light and Power Company of Zanesville, Ohio, has been incorporated with $1,000,000 capital stock, by George H. Warrington, John Ross, George M. Finch, E. F. Gunther and Thomas D. Braxton, Jr. The incorporators are Cincinnati capitalists.

At last week's meeting of the Chicago City Council 35 orders for electric-light signs in the First Ward were passed. There has been some objection to the large number of electric signs in the downtown streets of Chicago, but Alderman Jackson states the other side of the case: "The signs are usually beautiful and give the downtown streets an air of liveliness. They help to light up the street and illuminate the dark corners."

City Electrician Ellicott of Chicago has devised a plan to prevent traffic in electric-light-company franchises and to put a stop to the use of the city in such transactions. He proposes that when a franchise is given by the council it shall be required that at least 51 per cent. of the stock of the corporation be deposited with the city in escrow. While in such a state the stock can be negotiated and voted, but will remain in the hands of the municipality as a means of enforcing good faith. Mr. Ellicott finds that more than 50 electric-light companies have sprung up like mushrooms, only to be bought out by larger ones. Many of them never existed, save on paper. In some cases no plants were ever installed.

The legal department of Kansas City, Mo., is preparing to enforce that clause of the Metropolitan street-railway ordinance which requires that company to place and maintain an arc light of 2,000 candlepower at every street intersection where the tracks of the street railway cross each other, and at every corner where the tracks curve from one street into another and at every place where the street-railway tracks cross a steam railroad. The city has agreed to pass ordinances requiring the steam-railroad companies to pay their proportionate share of the cost of the lights at their crossings. The strict enforcement of this clause of the Metropolitan ordinance will give Kansas City 170 additional electric street lights without cost to the city.

ELECTRIC RAILWAYS.

It is reported that the Augusta and Aiken electric railway may be extended to Edgefield, S. C., a distance of about 22 miles. James U. Jackson of Augusta, Ga., is president of the company operating this road.

Fifteen hundred employes of the New Orleans City Railroad Company struck on September 28th on account of the refusal of the company to grant them higher wages and shorter hours. A complete tie-up of traffic is reported.

Dr. F. W. Smith and others are interested in a plan to build an electric railway from Bluefield, W. Va., to Princeton, and thence to Camp Creek. The distance from Bluefield to Princeton is eight miles, while Camp Creek is about nine miles farther on.

Application has been made to have a receiver appointed for the West Michigan Traction Company. This company was incorporated two years ago in Jackson with the purpose of building roads in different places in and near Jackson. Sixty carloads of steel rails were shipped to Benton Harbor for the road, but not one rail was ever laid. The franchise obtained from the city of Jackson expired on September 18th, and a forfeit of $1,000 goes into the city treasury. This will be the third certified check of $1,000 forfeited to the city within a year.

The Opelika and Auburn Electric and Street Railway Company proposes to build electric railways in Opelika, Ala., and to connect that place with Auburn, seven miles away. It is also designed to build an extension south of Auburn. H. D. Capers is secretary of the company.

The Texarkana (Ark.) Traction Company has been incorporated to build an electric railway. The incorporators are Colonel E. J. Spencer of St. Louis, president; Thomas W. Crouch of St. Louis, vice-president; W. H. Arnold of Texarkana, secretary; E. K. Smith of Texarkana, treasurer.

The Union Traction Company of Medina, N. Y., has been incorporated with a capital of $600,000 to build and operate a 50-mile railroad along the shore of Lake Ontario, from Batavia, Genesee County, to Olcott, Niagara County. The directors of the company are Isadore H. Gebille and Frederick L. Downs of Medina and Joseph W. Holmes of Batavia.

Colonel Samuel F. Scott of Kansas City, Mo., and associates propose to build the elevated railroad in St. Louis for which a franchise was granted the Rapid Transit Railway Company in 1889. Though it has generally been supposed that the franchise was forfeited, Colonel Scott, who is president of the company, says that work was delayed by court proceedings, which in the opinion of his attorneys, made the franchise still valid. The company was originally incorporated with a capital stock of $3,600,000. One of the three lines provided for in the 1889 franchise runs to the World's Fair grounds.

According to last year's census, Paris had 96,698 horses which could be utilized in case of war, this having been the average figure for many years; but this year the number has fallen to 90,796. This considerable diminution is said to be due to electric traction and automobiles. The Paris Omnibus Company had last year 16,579 horses in its service; now it employs nearly 2,000 less. In all the companies which compete with the tramways and the Metropolitan railway, the diminution of horses has been 2,727. The remaining 3,175 horses, which since last year's census, have passed out of service, have, therefore, it is said, been replaced by automobiles.

AUTOMOBILES.

At the Philadelphia convention of the American Carriage Builders' Association, held from September 13th to 18th, and at the convention of the National Carriage Builders' Association, held in Detroit this week, the Westinghouse Electric and Manufacturing Company made a full exhibit of its standard line of automobile equipments. The exhibits included the skeleton frame of a standard surrey, with a single motor, a double-motor equipment on an express-wagon frame, an Adams Express wagon with double equipment, a half-dozen Westinghouse electric-vehicle motors of various sizes and capacities, several controllers, also battery indicating meters, battery connectors, charging receptacles, switches, etc.

POWER TRANSMISSION.

The government geological survey is investigating the waterpower resources of the country, particular attention being given to the central and western states. Great interest is manifested in the power development of the streams in these states.

Another Potomac River power-transmission scheme is reported. Dispatches state that an English syndicate, represented by J. F. McLaughlin of Toronto, Can., contemplates investing about $5,000,000 to develop the power of Potomac Falls, near Washington, D. C., and transmit it by electricity. It is said that J. Carlin Kelly of Bradfordshire, England, and Russell Thayer of Fairmount Park, Philadelphia, Pa., are interested.

SOCIETIES AND SCHOOLS.

A meeting of the board of directors of the Michigan Engineering Society was held recently in Lansing, Mich., to canvass the votes cast by mail for officers. The following were declared elected: President, M. E. Cooley, Ann Arbor; secretary-treasurer, Francis Hodgman, Climax; vice-president, A. J. Holmes, Grand Rapids; directors, Dorr Skeels, Grand Rapids; A. C. Lane, Lansing; Professor J. B. Davis, Ann Arbor. The next annual meeting will be held January 20th.

Lewis Institute, corner Madison and Robey Streets, Chicago, will give, in addition to the night courses already announced, one in street-railway practice on Tuesdays and Fridays, commencing October 7th. The work will cover track construction, electrical overhead construction, general equipment of motors, brakes, etc., electrolysis, power-house machinery, other systems of electric traction, etc. The instructor of the course is H. M. Wheeler of the engineering department of the Chicago Union Traction Company.

PUBLICATIONS.

The Street Railway Review announces that, beginning with its number for next January, its title will be changed to Electric Railway Review.

The Link Belt Machinery Company of Chicago issues an interesting bulletin descriptive of the Renold silent chain gear, which is particularly well adapted for use with electric motors. Illustrations showing diversified methods of drive are given.

SPACE TELEGRAPHY.

It is reported that Germany's proposition to call an international wireless-telegraph conference has met with the general support of the powers, and that the meeting will be called at an early date. The Imperial Postoffice Department is now working out a programme for discussion, which will be submitted for the approval of the cabinets before the conference meets. The United States, in accepting an invitation, reserved taking further action until the programme is submitted.

TRADE NEWS.

The Charleston (S. C.) Electrical Construction Company has increased its capital stock from $7,500 to $25,000.

Among recent South Dakota incorporations was that of the National Electrical Generating Windmill Company, with authorized capital of $200,000. Joseph P. F. Flaigs is mentioned as an incorporator.

The Heine Safety Boiler Company of St. Louis has filed articles with the secretary of state of Missouri showing that it has made an increase in its capital stock from $100,000 to $430,000.

The Western Electrical Supply Company of St. Louis has recently taken the agency for the new Nernst lamp. The company states that it is carrying a complete line of these lamps, and is prepared to ship promptly any size or voltage from St. Louis stock.

In an issue of last week the Pittsburg Dispatch says: "J. W. Leech, an electrical engineer for the Keystone Electrical Company of Erie, is at the Griswold. His mission here is to establish a branch sales office. The firm is about to double the capacity of its plant."

A fire occurred in the Chase-Shawmut Company's factory for electrical supplies at 392 to 398 Atlantic Avenue, Boston, on September 22d. The company estimates its loss at $30,000; insurance, $50,000. During the fire a fireman fell from the roof of the building and was killed.

Users of conduits, and especially those in the West, will be interested to learn that the H. B. Camp Company of Akron, Ohio, whose general sales offices have been moved to New York city, has opened a western office, with headquarters at Chicago, in charge of E. V. Johnson, who is well known in fireproofing circles, as western manager. The Camp Company's products are favorably known all over the country, its conduit being extensively used by telephone and electric-light companies. The Chicago office will contain, for the inspection of prospective users, a full sample line of the company's conduits. The Camp Company has recently issued a very attractive catalogue, handsomely illustrated, which contains the names of over 150 users of its products.

The Berry Electric and Manufacturing Company of St. Joseph, Mo., has been recently organized with a capital stock of $10,000, which will be increased as the business of the company may warrant. The company plans to do a general jobbing business and construct private light and telephone lines and also push the dynamo and motor trade. It maintains a retail department for the city trade. The management of the business is intrusted to G. D. Berry, who was for 15 years purchasing agent for the St. Joseph and Grand Island railway, and whose ability and integrity will do much to set the company's business on a good footing. D. D. Berry is the chief electrician. He was a student in the works of the Westinghouse Electric and Manufacturing Company for three years, and worked about a year for the George A. Fuller Construction Company on the Frick Building, Pittsburg. F. W. Mackey, formerly local manager for the Bell Telephone Company in St. Joseph, has charge of the company's telephone department. The company will make a special effort to put in a lot of inter-communicating and rural lines, a line of business which has never been pushed in that locality.

The Crocker-Wheeler Company held at its works at Ampere, N. J., on September 25th and 26th, its annual managers' convention. On the evening of the 25th the annual banquet was held at the Engineers' Club in New York. Those present were the officers of the company, Schuyler S. Wheeler, Gano S. Dunn, W. L. Brownell, Putnam A. Bates, C. N. Wheeler and F. V. Henshaw, and the branch managers, Samuel Russell, Jr., Julian Roe, J. Hally Craig, Louis P. Hall, W. H. Wissing, Francis B. DeGress, Henry J. Sage, William A. Doble and Harold Lomas. At this dinner there were many interesting speeches made by the branch-office managers, who came from the various districts throughout the entire United States. During the evening Francis B. DeGress of the company's New York office, who has been in the service of the company longer than any of the other branch-office managers, presented to their general sales manager, Putnam A. Bates, in the name of the managers, a token of their esteem and an acknowledgment of his efforts in their behalf, which Mr. Bates responded to in his usual happy manner. The purpose of the convention was to bring all of the men closer together and give them an

opportunity of comparing notes and planning methods for handling the largely increased business of the company.

BUSINESS.

The Electric Appliance Company of Chicago is selling large numbers of Packard Mogul lamps. This lamp is said to have many advantages over the 16-candlepower incandescent lamps or the so-called incandescent arc lamp.

The Goltz Engineering Company, 1502 Monadnock Building, Chicago, manufacturer of metal block letters for electric signs, has just issued a new bulletin (No. 3). This bulletin contains much information of interest to users of electric signs and will be mailed to anyone on request. The Goltz company is doing a large business in metal letters and is placing them all over the country. These letters are said to be giving the best of satisfaction and to reduce the cost of electric signs to the minimum.

The Illinois Electrical Manufacturing Company of Peoria has been most successful in building up a street-railway and electrical-repair business. A. C. Ault, manager of this company, in conjunction with A. H. Crawley, about seven months ago organized the institution with F. S. Kline as superintendent of construction. Mr. Ault was already well known in the electrical field through his excellent work for the Jenney company and also the Kester company of Terre Haute, Ind. Mr. Ault has felt from the first that the best guarantee of good and quick work was the employment of a thoroughly competent staff. In addition to the repair branch of the business, the Illinois company has lately added a department for the purchase and sale of second-hand dynamos, motors and other electrical machinery. The company's motto in its repair business is "the very best and most accurate work and the quickest return shipments."

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, September 23, 1902.

709,465. Means for Controlling the Charging of Secondary Batteries. John Burry, Fort Lee, N. J. Application filed January 10, 1900.

A system for supplying electric energy from a central station is described in which are combined with a main line or feeder circuit, a storage battery for supplying energy to a local or consumption circuit, the circuits being always isolated from each other, an energy conveyor, and means for connecting the conveyor with and disconnecting it from the main and consumption circuits in alternation, whereby the conveyer while disconnected from the feeder-circuit charges the storage battery and while disconnected from the consumption circuit receives energy from the feeder circuit. (See cut.)

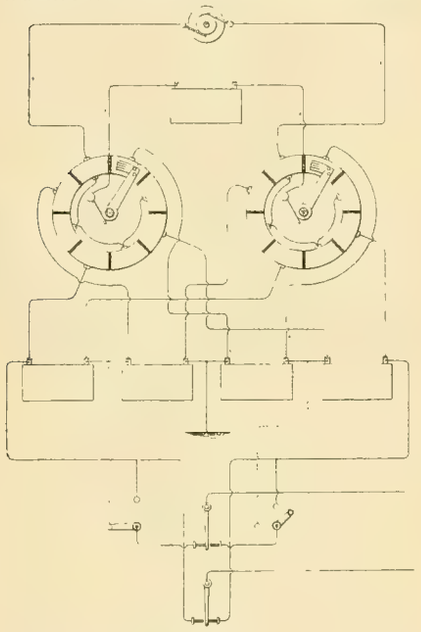
709,484. Magnetic Wheel. John O. Heinze, Jr., Revere, Mass. Application filed February 24, 1902.

For this and succeeding patent see a future issue.

709,485. Induction Coil. John O. Heinze, Jr., Revere, Mass. Application filed July 11, 1902.

709,533. Adjustable Electric-lamp Hanger. Herman G. Breitwieser, Brooklyn, N. Y. Application filed November 20, 1901.

The hanger has two lazy-tong arms, each pivoted and supported at one end on pivot blocks attached pivotally to a vertical rod.



NO. 709,465.—CONTROLLER FOR CHARGING STORAGE BATTERIES.

709,554. Electric-wire Pole. Bert McFarren, Navarre, Ohio. Application filed June 9, 1902.

The pole is formed of metal and is provided with integral flanges and open upon one of its sides. Rungs or bars are secured to the flanges of the pole and a cover plate is removably attached to the pole and located over all or part of the rungs or bars. Means are provided for securely holding the cover plate in fixed relative position with the pole.

709,598. Electric Igniter for Explosive Engines. Howard A. Gray, Plainfield, Ill. Application filed October 1, 1901.

The device consists of a pair of intermittently contacting igniting electrodes one of which is rotatable, means for rotating the electrode, a charge-controlling valve, means for actuating the valve, a governor for interrupting the action of the valve, and an adjunct of the valve-actuating means engaging the electrode-rotating means to hold the rotatable electrode against movement.

709,602. Electric Brander. Harry L. Jenkins and Oscar F. F. Kohlmann, Indianapolis, Ind., assignors of one-third to Max Davids, Indianapolis, Ind. Application filed May 31, 1902.

The brander comprises a heating box containing a number of electrically connected heating coils, a subbox or depression from the bottom of the heating box having outside branding characters, the subbox having communication with the outside air, and a cover for the heating box having a dead-air space.

709,607. Electrical Releaser for Fire Doors, etc. Henry J. Podlesák, Lincoln, Neb. Application filed March 16, 1897.

Parts of the device are a toggle-lever pivoted to a frame or base, a locking-lever pivoted to the base and having one arm jointed to the toggle-lever, the other arm adapted to engage and hold a hook when the toggle-lever is in the rigid position, the hook being attached to the door or other device to be released, an electromagnet mounted upon the frame and provided with a movable, pivoted armature having a rod or a bar connected therewith and adapted upon movement of the armature to shift or bend the toggle-lever to allow the locking link to be withdrawn from locking engagement and an electric battery and an electric circuit for energizing the electromagnet to effect the movement of the armature.

709,611. Secondary Battery. William L. Silvey, Dayton, Ohio. Application filed February 8, 1902.

In the battery are combined a battery plate having supporting ears with a lug on one of the ears, a bolt passing through the lug and provided with a screw-thread, a nut for clamping the bolt to the lug, an equalizing bar, the bolt extending into the equalizing bar, and nuts for clamping the equalizing bar and the bolt together independent of the lug.

709,676. Electrically Operated Railway Switch. James Loney, Detroit, Mich. Application filed June 21, 1902.

Combined with the movable contact on the car adapted to be connected with the source of electricity on the car and fixed contacts in the road-bed are a switch-point structure comprising a vertically movable switch-point in line with the inner rail of the side track at the junction therewith with the corresponding main rail and formed with an incline or inclines upon the lower face, a box in the road bed into which the lower portion of the switch-point projects, vertical guide bearing for the switch-point and operating mechanism inclosed in the box and comprising two electromagnets in line with the switch-point and adapted to be connected in circuit with the source of electricity on the car. A bar or carriage is slidingly supported in the box beneath the switch-point in line therewith and forms with its opposite ends cores for the electromagnets. Means carried by the bar or carriage intermediate the cores are adapted to co-operate with the incline or inclines on the switch-point to raise or lower the same.

709,714. Method of Controlling the Energy Delivered to Electrical Translating Devices. Harry W. Leonard, East Orange, N. J. Application filed January 31, 1896.

A method of reversing the direction of current through a translating device is described. It consists in connecting the terminals of the translating device with two conductors of constant but different potential, developing an electromotive force between the translating device and one of the conductors and varying the electromotive force so that the potential at one terminal of the translating device can be made higher or lower than the potential at the other terminal, whereby the current through the translating device will be reversed. (See cut.)

709,739. Automatic Telephone Exchange. Albert M. Bullard, Somerville, Mass., assignor to the American Bell Telephone Company. Application filed November 16, 1900.

For this and succeeding patent see page 236.

709,740. Automatic Telephone-exchange System and Apparatus. Albert M. Bullard, Somerville, and Malcolm C. Rorty, Dedham, Mass., assignors to the American Bell Telephone Company, Boston, Mass. Application filed August 29, 1901.

709,752. Means for Handling Telegraphic Receiving Tapes for Translation. Patrick B. Delany, South Orange, N. J. Original application filed December 15, 1896. Divided and this application filed August 20, 1901.

A telegraphic receiving tape-translating mechanism is described. It comprises the combination of a reel upon which the receiving tape is wound, a drawing device adapted to be intermittently actuated at the will of the operator to draw from the reel a definite length of tape, means by which the operator may manually control the operation of the drawing device, and a board or support between the reel and drawing device upon which the lengths of tape successively lie in view of the operator.

709,764. Illusion Apparatus. Willard L. Hall, Philadelphia, Pa. Application filed March 24, 1902.

In the apparatus are combined a scenic tunnel and an illuminated car arranged to be moved through the tunnel, the car carrying a series of exterior electric lights having independent circuits, the lights serving to illuminate only that portion of the tunnel directly adjacent to the car, and means for controlling the light circuits.

709,798. Railway Signaling Apparatus. Edward Rowe, Indiana, Pa. Application filed June 1, 1901.

Combined with a railway track are registers in a station or tower, contacts arranged adjacent the track and in circuit with the registers, a locomotive having a contact adapted to engage with the first-named contact, and an alarm in the locomotive to operate the operation being controlled by the operator in the station.

709,806. Electrical Indicator. Horatio S. Tittle, Los Angeles, Cal., assignor of five-sixths to Frank F. Wear, Adolph Gunzendorfer and William Barker, Los Angeles, Cal. Application filed November 29, 1901.

The indicator has a driven shaft, an indicator shaft, a dial thereon, segments having connections, circuit-closers having connections, an arm on the indicator shaft in contact with the segments and having connections and means for forcing the indicator shaft normally into contact with the driven shaft.

709,814. Refrigerating Apparatus. Clyde J. Coleman, Chicago, Ill., assignor to Clarence W. Coleman. Application filed October 14, 1899.

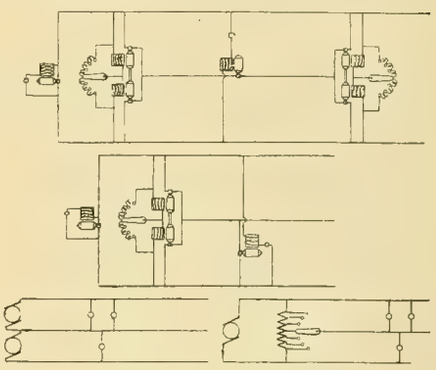
In the apparatus combined with a condenser and a cooling chamber, are a static-column conduit containing a liquid column constituting a piston at its upper end, valved conduits connecting the top of the static-column conduit with the condenser and cooling chamber, and an electrically operated pumping apparatus containing a piston or diaphragm arranged to press directly upon the liquid column at the lower portion thereof.

709,817. Electrolytically Treating Ores. Clinton E. Dolbear, Boston, Mass., assignor to the American Mining and Metal Extraction Company, Boston, Mass. Application filed June 3, 1901.

The method of reducing metals from their ores described consists in dissolving the crushed oresin a nitrate of the suitable metal, adding to the mixture thus formed sulphuric acid, and subjecting the solution to the action of an electric current, whereby the metal is plated out of the solution.

709,818. Electric Clock. Newton Harrison, New York, N. Y., assignor of one-half to William Henry Laird, New York, N. Y. Application filed May 11, 1901. Renewed January 18, 1902.

In the clock are combined the clock train and two magnets, one of which is a permanent magnet and the other an electromagnet the permanent magnet being adapted to act first upon the train through a limited movement, and the electromagnet adapted to act at the end of such movement to restore the permanent magnet to the beginning of its working position.



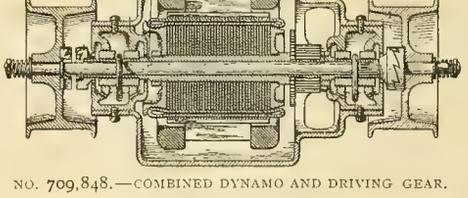
NO. 709,714.—ELECTRIC CONTROLLER.

709,820. Power Hammer. James H. Jackson, Denver, Colo., assignor of one-fourth to Frederic Schoff, Philadelphia, Pa. Application filed February 9, 1901.

The hammer consists of a casing, a tool carried by the casing, means in the casing for striking the tool, a shaft for operating the means, an electric motor, a flexible shaft connecting the motor with the operating shaft, means on the tool for making and breaking an electric circuit, and wires extending from the means on the tool to the electric motor.

709,837. Electrically Controlled Optical Appliance. Webster B. Wheeler, Fullerton, Neb. Application filed May 9, 1902.

The appliance is provided with a barrel having a shutter carrying a core and a solenoid, the core being attracted by the solenoid when the latter is energized thereby to operate the shutter.



NO. 709,848.—COMBINED DYNAMO AND DRIVING GEAR.

709,847. Means for Driving Generators by Power Taken from Car Axles. John L. Creveling, New York, N. Y. Application filed September 11, 1901.

A movable vehicle is combined with a generator and a driving gear, embodying a pulley intermediate the generator and the support for the driving gear, means for securing the generator and driving gear to the bed plate in operative positions fixed with respect to each other, and an endless belt whereby either the generator or the driving gear may be removed from the structure and replaced by a duplicate without the necessity of readjustment of the parts.

709,848. Combined Dynamo and Driving Gear. John L. Creveling, New York, N. Y. Application filed November 18, 1901.

One claim reads: The combination of a generator, a source of power whose motion is liable to reversals, a driving gear intervening between the source of power and the generator and embodying in its structure clutch mechanism and co-operating pulleys placed on opposite sides of the armature adapted to communicate motion in one direction only to the generator, irrespective of the reversals of the direction of movement of the source of power. (See cut.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, OCTOBER 11, 1902. No. 15

Jere C. Hutchins, President American Street Railway Association.

Like his immediate predecessor, H. H. Vreeland of New York, J. C. Hutchins, who was yesterday elected president of the American Street Railway Association, is a former steam-railroad man who has transferred his activities, and with entire success, to the electric-railway field. Mr. Hutchins' street-railway experience has been gained entirely in Detroit, where he is president and general manager of the Detroit United Railway and of the Rapid Railway System.

Jere C. Hutchins was born in Carrol Parish, Louisiana, October 13, 1853. His early manhood was devoted to civil engineering and construction work in the building of steam railroads in the South and Southwest. For a considerable period he was in charge of the construction department of the lines now forming the southern end of the Illinois Central system.

It was in 1894 that Mr. Hutchins came to Detroit to engage in street-railway work. At that time there was a change of management in the old Detroit Citizens' Street Railway Company, and the subject of this brief sketch was made treasurer of that company. Soon afterward Mr. Hutchins was also made vice-president of the company. When the Detroit United Railway was organized in 1900 he became vice-president and treasurer of the new company, and at the annual meeting in January, 1902, he was advanced to the position of president and general manager which he now holds. Mr. Hutchins is also president of the Rapid Railway System, which is a branch of the Detroit United Railway, with a separate organization.

As will be seen, Mr. Hutchins' advancement has been rapid. This is due to the fact that the new president of the American Street Railway Association possesses many qualities that fit him for executive positions. During the turbulent street-railway agitation in Detroit President Hutchins has invariably risen to the duty of the hour and never once lost his self-reliant and reassuring smile, which is calculated to impress the most skeptical with the belief that in the end all would be right and everybody made happy. He comes in daily contact with many perplexing subjects, but his quiet and affable manner of dealing with men and measures takes the bitter edge from all questions in dispute and has won for him high regard and the reputation for honest dealing. Mr. Hutchins is popular in Detroit, both inside his company and out of it. He is a member of the Detroit, Yondataga, Country and Fellowcraft Clubs and is affiliated with the most prominent business and social interests of the city. Besides holding the presidency, he is a director and large stockholder in the Detroit United Railway. He is also a member of the American Society of Civil Engineers. Mr. Hutchins is a widower and has no children. His administration of the American Street Railway Association promises nothing but success.

JERE C. HUTCHINS, PRESIDENT AMERICAN STREET RAILWAY ASSOCIATION.

Marconi and His Affairs.

Major Flood Page, the managing director of the Marconi Maritime Communication Company, arrived in New York city on October 4th, on the Cunarder Campania. He announced that Mr. Marconi would sail for Cape Breton in a few days on the Italian warship Carlo Alberto, which the king of Italy has loaned. Major Page denied that a wireless message had been sent from Cornwall to Cape Breton, as had been announced in the daily press, stating further that no attempt had been made to send transatlantic messages recently.

A recent dispatch from Rome, Italy, states that Mr. Marconi has perfected an electric motor car having a speed of 38 miles an hour, the accumulators, weighing 250 pounds, being sufficient for a journey of 560 miles. The account says that there are four batteries arranged in a circle, divided into four sections, and that tests will be made soon in Paris.

Largest Railway Power House South of the Equator.

The Sydney City Electric Tramway System of Sydney, Australia, has made quite extensive improvements to its power house, located at Ultimo. The additions to the power house are said to make it the largest and most efficient station south of the equator. The boiler-room extension is 85 by 160 feet in ground dimensions and has a height in the clear of 77 feet. Two new brick chimneys have been erected, one on each side of the boiler room, each 227 feet high and having an internal diameter of 12 feet at the top. The boiler room provides space for the installation of 60 boilers, each working on a pressure of 160 pounds, and supplied with Babcock & Wilcox automatic chain-grate stokers. With the total number of boilers installed the capacity of the plant will be in round numbers 24,000 horsepower.

These 60 boilers will supply steam for 10 direct-connected units, six of which will generate alternating current and the other four direct current. At present boilers are installed only for seven of the above units, four direct-current and three alternating-current, the remainder to be set up as needed. Besides the boilers, there are the following Worthington pumps in the room: Three compound, duplex-plunger feed pumps, three vertical compound-beam air pumps for the main engines, three compound horizontal circulating pumps and two combined air and circulating pumps for the exciter and stoker engines.

Coal bunkers are placed above the boilers. The coal is dumped from the railway tracks into these bunkers through a crusher, which reduces it to a three-inch gauge, and passes it on to a bucket-elevator, 576 feet long, with 288 buckets. This elevator raises the coal at the rate of 40 tons per hour, its capacity being capable of a 50 per cent. increase. The coal is carried by chutes to the automatic chain-grate stokers, which feed into the furnaces. The elevator is also employed for removing ashes from the boilers.

The engine-room extension consists of an addition, 170 feet long, making the room 98 by 270 feet. The height from the tie-rods to the floor is 55 feet. This extension provides for six main generating sets, of 500 kilowatts each, three of which are now in operation. They are Allis-Reynolds, vertical, cross-compound, condensing engines, with 32 and 64-inch cylinders and 60-inch stroke, and running at a speed of 75 revolutions a minute. Each engine drives a 500-kilowatt General Electric three-phase, 25-cycle alternator, capable of supplying 131 amperes per phase, at 6,600 volts continuously, and designed to stand an overload of 25 per cent. for two hours. All parts of the engine room can be reached by means of a triple-movement traveling crane.

The switchboard has been built for controlling the output of the completed station, and is of handsome design. All of the extension switches (enclosed oil-type) are situated in brickwork cells at the back of the board and operated by means of wooden rods and levers from in front. The switchboard instruments are supplied by means of current and potential transformers, making it impossible for an attendant to receive an accidental high-tension shock.

From the power house the high-tension current is distributed to the five sub-stations—City, Newtown, North Sydney, Waverley and Randwick—by means of three-core, paper-insulated, lead-sheathed cables. These cables are laid in duplicate to each sub-station, as a precaution in case of accident. The plant is designed to operate the street-railway system of the city, which includes 104 miles of track and 338 cars.

Electrical Exports in August.

The electrical exports of the United States during the month of August, 1902, amounted in value to $821,057, as compared with $908,395 in the corresponding month of 1901, showing a decrease of $87,338.

Under the head of "electrical appliances, including telegraph and telephone instruments," the figures are: August, 1901, $451,120; August, 1902, $262,231. A decrease of $188,889 is shown. Under "electrical machinery," these figures are given: August, 1901, $457,275; August, 1902, $558,826. Here an increase of $101,551 is seen.

Classified according to destination, the exports of electrical machinery in August to some of the most important buyers were as follows: United Kingdom, $235,904; Japan, $72,471; British North America, $68,925; Brazil, $41,207; Africa, $26,198; Mexico, $24,073; South America, $17,260; West Indies and Bermuda, $13,821; Hongkong, $10,550; Germany $8,094; British Australasia, $7,717; Chinese Empire, $4,144; Argentina, $3,456. All the above show an increase for August, 1902, with the exceptions of British North America and Argentina.

First Commercial Nernst Lamp Installation in Chicago.

The first commercial installation of Nernst lamps in Chicago was put in operation on the night of October 4th. The lamps are installed in the Armitage Clothing Company's store, 1618-1622 Milwaukee Avenue. The store is 75 by 105 feet in size and fronts on Milwaukee and Armitage Avenues. The power for the lights—220-volt alternating current—is furnished by the Commonwealth Electric Company. The installation consists of the following: Twenty-two three-glower lamps, lighting the main body of the store; one six-glower lamp in each of two entrances; 19 single-glower lamps in the show windows. The three-glower lamps are equipped with sand-blasted globes and opal reflectors. Charles Whitney Carman & Co. of Chicago were the installing engineers. It is reported that the Nernst Lamp Company has discovered a glower that works efficiently on a direct-current circuit, and that it will soon be placed on the market.

AMERICAN STREET RAILWAY ASSOCIATION.

The twenty-first annual meeting of the American Street Railway Association was held in the Light Guard Armory, Detroit, on Wednesday, Thursday and Friday of this week (October 8th, 9th and 10th). It was an entirely successful convention, with large attendance, earnest discussions of practical papers and good exhibits. The room available for the exhibition, even utilizing liberal portions of the adjoining streets, temporarily roofed over, was too small for the great aggregation of street-railway apparatus pressing for attention, and in consequence the exhibition as a whole did not make such an imposing display as at the New York, Kansas City and Chicago conventions. Nevertheless, it was a fine show and suffered only in comparison with conventions where larger space was at the disposal of exhibitors. The Detroit street-railway men were most hospitable; they were indefatigable in caring for the comfort and entertainment of the visitors. The meeting hall of the association was in a large room under the exhibit hall. The attendance was good, especially at the opening session.

The Chicago Special Train.

The largest party of western visitors to the convention was carried on the Wabash special train, leaving Chicago at 1:17 p. m. on Tuesday, October 7th, and arriving in Detroit at 8:20 p. m. on the same day. The train was made up of five parlor and sleeping cars, besides a diner and baggage car. It carried 81 passengers under the personal direction of N. C. Keeran, city passenger agent of the Wabash Railroad in Chicago. The short journey was a pleasant one in every way. Following are the names of the members of the party, arranged in alphabetical order:

R. G. Arnold, Arnold Electric Power Station Company, Chicago; G. H. Atkin, Electric Storage Battery Company, Chicago; J. M. Atkinson, Chicago; H. B. Abbott, Street Railway Journal, Chicago; Dennis Aper, Coal Belt Electric Railway Company, Marion, Ill.; Theodore P. Bailey and wife, General Electric Company, Chicago; James A. Britt, Electric Installation Company, Chicago; Frank L. Brown and wife, Omaha and Council Bluffs Railway Company, Council Bluffs, Iowa; Max A. Berg, Porter & Berg, Chicago; F. N. Baylies, Rockford and Interurban Railway Company, Rockford, Ill.; A. W. Ballard, General Electric Company, Los Angeles, Cal.; R. N. Baylies, Rockford and Interurban Railway Company, Rockford; B. C. Beckman, Standard Paint Company, Chicago; George Cutter and wife, Chicago; George W. Conover, Chicago; B. Conover, Jr., John A. Roeblings' Sons Company, Chicago; Charles L. Case, A. Booth & Co., Chicago; Robert F. Carr, Dearborn Drug and Chemical Works, Chicago; E. L. Draffen, Gould Storage Battery Company, Chicago; C. N. Duffy, Chicago City Railway Company, Chicago; A. H. Charles Dalley, Underfeed Stoker Company, Chicago; John E. Eldred, Jr., Christensen Engineering Company, Milwaukee; H. T. Edgar, El Paso Electric Railway Company, El Paso, Texas; E. J. Evans, Lorain Steel Company, Chicago; J. E. Gavitt, Federal Supply Company, Chicago; Thomas G. Grier, American Circular Loom Company, Chicago; Edward S. Grace, Wheeler Condenser and Engineering Company, Chicago; C. G. Goodrich, Twin City Rapid Transit Company, Minneapolis; R. M. Heskett, Knox Engineering Company, Chicago; Edgar H. Hammond, American Electrical Works, Chicago; Charles L. Hull, Chicago General Railway Company, Chicago; E. J. Hunt, Aurora, Elgin and Chicago Railway Company, Wheaton, Ill.; J. C. James, Christensen Engineering Company, Milwaukee; Anthony T. Kalas, Q. & C. Company, Chicago; Charles D. Knight, Christensen Engineering Company, Milwaukee; E. L. Kirk, Sioux City Traction Company, Sioux City, Iowa; George W. Knox and wife, Chicago; William E. Keily, Western Electrician, Chicago; R. B. Kent, Atlas Railway Supply Company, Chicago; N. C. Keeran, Wabash Railroad, Chicago; F. S. Kenfield, Street Railway Review, Chicago; James W. Lyons, Allis-Chalmers Company, Chicago; A. S. Littlefield, North American Railway Construction Company, Chicago; C. E. Lund, Chicago City Railway Company, Chicago; J. G. McMichael and wife, Atlas Railway Supply Company, Chicago; Richard McCulloch, Chicago City Railway Company, Chicago; W. R. Mason, Coe, Smith & Co., Chicago; E. R. Mason, Porter & Berg, Chicago; L. E. Myers, Chicago; Edgar S. Nethercut and wife, Paige Iron Works, Chicago; Michael O'Brien, Chicago City Railway Company, Chicago; H. K. Parsons, Pennsylvania Steel Company, Chicago; Alfred M. Patten, Topeka Railway Company, Topeka, Kan.; C. D. Porterfield, Atlas Railway Supply Company, Chicago; Frank L. Perry, Western Electrician, Chicago; Fred A. Poor, Webe- Railway Joint Manufacturing Company, Chicago; W. S. Patterson, Consolidated Railway and Power Company, Salt Lake City; J. W. Porter and wife, Porter & Berg, Chicago; W. P. Read, Consolidated Railway and Power Company, Salt Lake City; George F. Rooke, Peoria, Ill.; Donald Rawstrom, Allen & Morrison Brake Shoe and Manufacturing Company, Chicago; J. C. Shainwald, Standard Paint Company, Chicago; Grant W. Spear and wife, Dearborn Drug and Chemical Works, Chicago; W. B. Tarkington and wife, Omaha and Council Bluffs Railway Company, Council Bluffs, Iowa; C. K. Thomas, American Electrician, Chicago; William Walmsley and wife, South Chicago City Railway Company, Chicago; Herbert Warren, Duluth-Superior Traction Company, Duluth; A. C. Willis, Street Railway Review, Chicago; R. A. Whelan, A. Booth & Co., Chicago; F. M. Zimmerman and wife, Aurora, Ill.

STREET-RAILWAY EXHIBITION IN LIGHT GUARD ARMORY, DETROIT.

Wednesday, Opening Day.

President H. H. Vreeland of New York called the association to order at 11:25 a. m. on Tuesday morning, October 8th. He introduced Mayor William C. Maybury of Detroit, who delivered a speech of welcome with an ease and fluency that showed that he was no stranger to this style of oratory. The mayor extended a warm welcome to the street-railway men. He reminded them that Detroit is so laid out as to be peculiarly adapted to street-railway service. The center of the city is a reproduction of the plan of the city of Washington, the City Hall and the Capitol being the centers in each case. The avenues are wide; the people ride in the cars and demand the best service, and there are no hills to contend with. "I desire to say," said the speaker, "in spite of the modesty of our railroad management in Detroit—for you know anything managed by Jere Hutchins would be managed modestly—that we point with pride to the splendid operation of our street railway. We are proud of the cleanliness of our cars, the gentlemanly conduct of those in charge, and everything that goes to make the operation of a street railroad substantially successful and complete."

Speaking of the benefits of invention, Mayor Maybury made the curious statement that Tesla had "discovered the power of looking through space." He made a passing reference to the coal strike and to the mayors' and governors' conference in reference to it called by himself. Laughter was excited by the following humorous conclusion of the mayor's speech: "You will notice on the street corners here and there gentlemen who in other cities would be denominated policemen. They are not known as such here. They are guardians for the stranger. Do not pay any attention to the belts around the waists of these gentlemen. They never draw the little clubs which they have in these belts. The clubs are used to frighten the children. If confusion as to your whereabouts should overtake you at any time, step up to one of these gentlemen and tell him that you are attending the street-railway men's convention, and you will be wafted to the haven you desire."

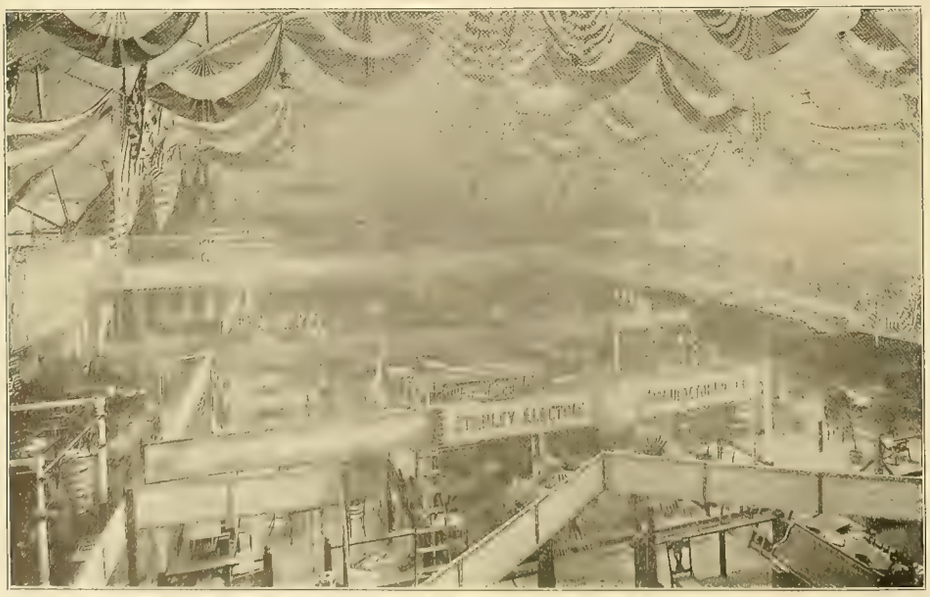
President Vreeland thanked the mayor for his welcome and then delivered his annual address, which is as follows:

President Vreeland's Address.

It is exceedingly appropriate that the twenty-first annual meeting of the American Street Railway Association should be held in the beautiful city of Detroit, for while the city street railways of the country have not been idle during the last year, the greatest development in electric-railway work since our last convention, and, in fact, for several years has been in the direction of interurban electric railways, and in this class of road Detroit railway enterprise has always been prominently identified. Radiating from this city can be found some of the largest and most modern of interurban railways, and Detroit ranks with Cleveland, Indianapolis, Cincinnati and Dayton as the most important centers in this country of the interurban railway industry. It is connected by high-speed electric railways with Port Huron on the north and Toledo and Cleveland on the south and east, while the lines to the west extend with only a slight break as far as the eastern shore of Lake Michigan, and will probably before long find entrance into Chicago.

The interurban railways have long since passed the stage when they could be considered simply as suburban extensions of city lines. They are doing a thorough business, which is constantly growing, and the later and more ambitious examples of roads of this class are built with a track construction inferior in no respect to the best practice of the steam-railroad companies. They operate usually for the greatest part of their distance over private rights-of-way, and attain speeds whch enable them to compete successfully with their steam-railroad rivals for nearly every class of traffic except long-distance passenger and freight business. This extension of the electric railway has introduced new problems of discussion, such as fares, transportation of freight, etc., into the operating department, as well as the exercise of the most advanced electrical engineering methods, not only in the transmission of the power at high voltage necessary to operate the cars, but in the car equipment as well. Up to the present, direct current has been used on the trolley wire or third rail, but if the experiments with single-phase motors, which it is announced are soon to be tried, prove successful, the possibility of the direct application of alternating current to railway work will remove some of the inconveniences which now exist in the present system.

I will not take the time of the convention to give the statistics showing the advances made in street



STREET-RAILWAY EXHIBITION IN LIGHT GUARD ARMORY, DETROIT.

railroading during the last year. Some of them will be brought out in the papers to be read, and statistics on the subject are published in the technical press from time to time. It is interesting in passing to note, however, that 11 years ago there were about 1,800 miles of electric railways in the country, while to-day there are between 24,000 miles and 25,000 miles, and that against an investment 11 years ago in street railways of about $75,000,000, the total capital invested to-day is in the neighborhood of two billion dollars. These figures show that the time has come when we should no longer apologize for our existence, but should take a stand individually and as an association for the protection of our rights as a corporation.

It is a venerable saying that corporations have no souls, and, perhaps, the credit that has attached to this aphorism accounts for the evident belief of the public that they have no feelings. We are here as members and managers of a class of corporations which is more intimately related than any other to the comfort, convenience and success of the people who live in cities and towns. Upon the orderly operation of a street railroad depends substantially everything else that goes on in a thickly settled community. It is true that what we are operating is a valuable privilege granted by the public, but its value depends chiefly upon the efficiency with which the public is served, and the public was moved to grant it solely from considerations of its own comfort and interest. The contract between the public and the street railroads, therefore, is a contract of partnership and the interest of the partners is identical. What the public wants is the best possible service, and only by giving the best possible service can we obtain the largest possible returns for our money.

And yet, despite this close association of interest, it is the experience of all of us that there is scarcely any limit to the impositions which the public will permit, and rather cheerfully permit, to be laid upon street-railway corporations. Legislatures and boards of aldermen seem to regard street railroads as fair game to be hit at as often and as viciously as anybody chooses, and the public newspapers, so far from taking into account the service we are rendering and protecting us against the schemes of demagogues, are rather inclined to regard injuries so inflicted with amused indifference, if not with positive favor.

In every other form in which property manifests itself, except in shares of corporate stock, it has well-defined rights and valuable privileges. One thousand dollars invested in banknotes or government bonds, or even in real-estate mortgages, are surrounded with legal safeguards to maintain their value, and if the hand of the despoiler for one moment seems to menace them, everybody begins to talk about the sacred rights of property. That is just as it should be. But money lent to the government at a comfortable rate of interest is no more directly employed upon the public business than that which is represented by the stock of a street railroad, and it is no answer to the claim that it ought to have fair treatment, that it ought not to be the object of special prejudice and attack to say that it is particularly valuable. Its value is strictly measured by the public service it renders. The contract, of which our charters and certificates of incorporation are the witnesses authorizes us, as the universal law of business authorizes everyone, so to employ our abilities and resources as to obtain from them the greatest possible result to ourselves, and if, in recent years, street-railroad shares have been especially good income earners, it is because the street-railroad companies are meeting the public ends for which they were organized, because they have studied and facilitated the public interests and needs, because they have put themselves in advance of the development of the cities and towns they run through, because at vast expense they have introduced new methods, new machinery, swifter, more frequent and improved accommodations, and it has never been laid down by the courts that a contract could be broken and new conditions imposed because either of the parties to it had done better than was anticipated, and certainly not because both had. And yet the contracts between the public and the street-railroad companies are being continually infringed upon by the imposition of new taxes and new requirements, and it has come to be considered almost an impertinence for a corporation so injured to offer ever so mild a protest.

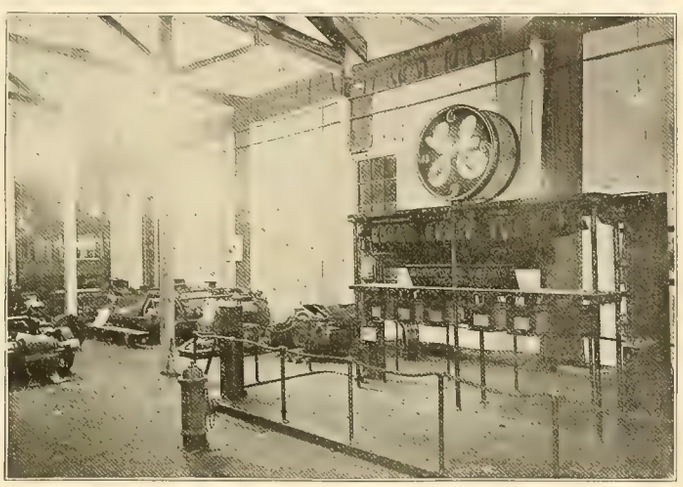
In the theory of the law a corporation is an individual, but apparently only for the purpose of enabling it to be got at. It has all the obligations of individuals, but of their rights few. The politicians of all parties talk themselves hoarse with eloquent protestations of their love of individual liberty and individual rights, and so well have their laws justified these pretensions that no man in this country is so idle, so worthless, so bereft by his own acts of character, property or position but that if he contrives to keep out of prison he has a vote and the opportunity of making his equal influence felt in the determination of public questions. But a corporation, even such a corporation as is organized to serve the public convenience, may neither vote nor in any other way participate in making the laws by which is must be bound. The proposition before the public on which an election is to be held and a policy defined for future legislation, may be one which vitally concerns the interests, even the life of a corporation, but if it were to undertake to express its views from a public platform or to influence the votes even of those persons who derive their means of livelihood from its operations, the very foundations of social order would seem to be attacked. It must stand by on such occasions in submissive silence. It must affect an attitude of indifference, and if it does not actually proclaim to its employes their title to vote as they please it becomes at once the object of suspicion and prejudice.

Wars have been fought and governments formed to vindicate the principle that there shall be no taxation without representation, but if a corporation should ask to be represented in a public body that had the power of taxation and was proposing to exercise it upon corporations, its action would be observed with indignation and amazement. Even in the courts its standing is prejudiced, and before a jury sworn to render an impartial verdict upon the facts, its first and constant care is to remove from the minds of the jurymen a frankly admitted antagonism.

It is not remarkable that in this situation the law should discriminate against corporations. The failure to assert rights when they are threatened is always taken as a confession that they do not exist, and encroachment follows encroachment, with ruthless certainty. Timid counsels have so far prevailed among the street-railroad companies in the adjustment of their affairs with the public that in many states there is a gross discrimination in the taxing laws against such corporations. When, by Federal legislation, it was proposed to tax the incomes of individuals, although a limit was placed which protected the poorer classes, public protest made itself felt so powerfully that the Supreme Court of the United States, after holding that an income tax was lawful, proceeded to reverse itself and to find constitutional objections that absolutely killed the income-tax law. And yet an income tax upon the earnings of corporations is found upon the statute books of many of our American commonwealths, and corporations with which a state has made definite contracts fixing and limiting the obligations on either side are required, notwithstanding these contracts, to pay other and additional taxes upon their gross earnings.

When money is invested in a public franchise upon terms and conditions expressed in a charter or a certificate of incorporation under a general act, the shareholders have a moral, and it ought to be a legal,

[*Continued on page 258.*]



GENERAL ELECTRIC COMPANY'S EXHIBIT AT THE DETROIT STREET RAILWAY CONVENTION.

WESTINGHOUSE EXHIBIT AT THE DETROIT STREET-RAILWAY CONVENTION.

The Steam Turbine—Its Commercial Aspect.[1]

By Edward H. Sniffin.

It is of little moment what the direct or contingent advantages of the steam turbine may be, if its reliability remain in doubt. Offered, as it is, in large units, and being apparently more related to the classes of service which impose the most exacting requirements, the demand is imperative that in this one vital respect there be little left to chance.

Before recurring to actual experience, it may be instructive to consider for a moment the general character of the turbine as a type of motor, contrasted with the piston engine. Fig. 1 shows the longitudinal section of the Westinghouse turbine. The steam entering the governor valve arrives at the chamber (A), then turns to the right, passing first a set of stationary blades, then impinging on the moving blades, driving them around, and so on, until it arrives at exhaust chamber (B). And here is an interesting lesson in physics—a demonstration of the

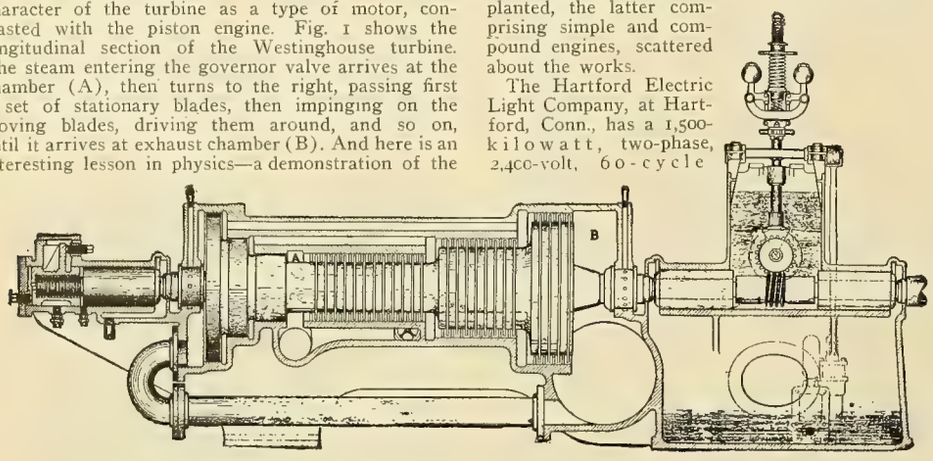


FIG. 1. THE STEAM TURBINE—ITS COMMERCIAL ASPECT.—WESTINGHOUSE TURBINE.

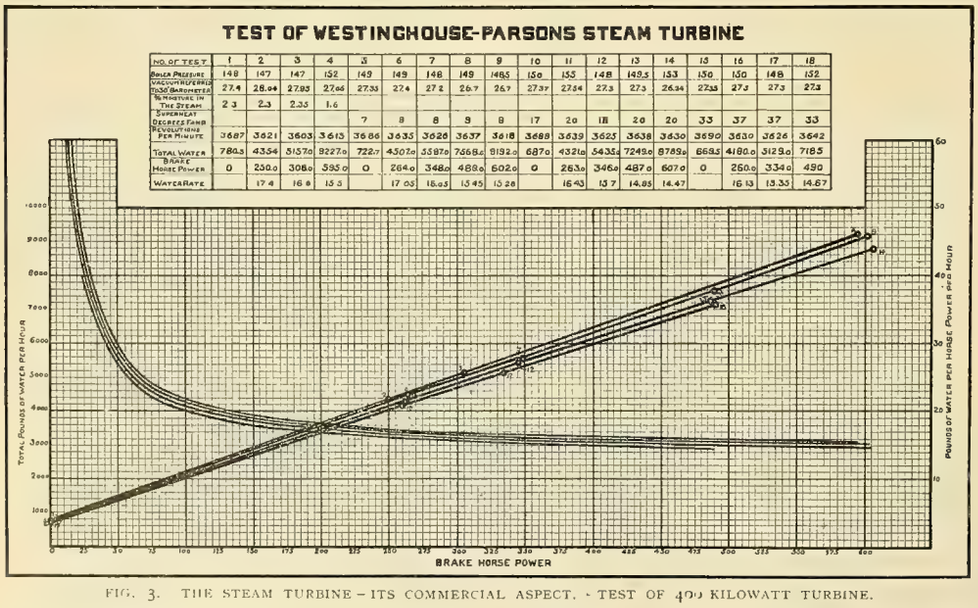
conversion of heat into energy; for while the temperature of the inlet end is that of the entering live steam, the exhaust end, but three or four feet distant, is not so hot (about 126 degrees F.) but that one may bear the hand. The cut will show that the only real moving part is the spindle, revolving in its bearings, the governor mechanism and oiling arrangement being comparatively insignificant. The blades do not wear, as the steam velocity—some 500 or 600 feet per second—is not sufficient to affect them. The blades are made of a special material, and are calked in such manner that the force required to pull them out would exceed the elastic limit of the material in the blades. They are subjected in regular practice to a strain of about one-fortieth of this amount. The actual pressure exerted on each blade is about one ounce. A complete description of the mechanism is not needed here. It is sufficient to note its general character and to contrast its obvious simplicity and freedom from complication, with the recognized complexity of the piston engine. The inference is clear that in contructive opportunity, at least, the turbine should be the more reliable.

The steam turbine, before it had obtained any considerable recognition here, was not entirely without success abroad. Parsons and others had done much to prove its reliability. For instance, in 1897 the Newcastle and District Electric Lighting Company, operating 11 turbines of 75 to 150 kilowatts each, showed their cost of repairs and renewals on their entire plant, including turbines, generators, boilers, condensers, pumps, fittings, cables, etc., to be twenty-six one-hundredth of a cent per kilowatt per annum.

In this country the steam turbine is now operating in several plants. The first prominent installation was at the Westinghouse Air Brake Company's works, at Wilmerding, Pa., where the first unit was started in August, 1899, two more shortly after, and the fourth unit in April, 1901. Thus, the plant has been in service, for the most part, more than three years, and the fourth unit about 18 months. The plant operates regularly 11 hours per day, the service being electric power and lighting. With the iron foundry running at night, one turbine is run 22 to 23 hours per day. In general, the units have run quite to their rated capacity—perhaps within 20 per cent. of it, as a minimum. An interesting comparison has been made elsewhere of the efficiency of this turbine plant with the installation it supplanted, the latter comprising simple and compound engines, scattered about the works.

The Hartford Electric Light Company, at Hartford, Conn., has a 1,500-kilowatt, two-phase, 2,400-volt, 60-cycle turbo-generator outfit, which was started in April, 1901. This, at present, is the largest turbine yet installed in this country. Put in, as it was, to relay the company's waterpower, it has not been in constant service, but has usually been required but one or two days a week. At such times, however, it has carried the full station load of some 1,800 or 1,900 kilowatts. Reference will hereafter be made to its striking economy.

A great deal of interest has centered in this early installation of a good-sized outfit in a prominent location, and its excellent performance is now generally well known. Some difficulties were at first experienced; nor were they entirely unexpected, for there had been no facilities, as there now are, for testing the outfit before shipment, and it was merely run at the shop without load. Having in due time overcome these local defects, which partook in no sense of functional fault, the turbine was then in serviceable condition, and its operation has since been most satisfactory. And the Hartford company, notably alert to adopt the newer thing if there seemed



No. of Test.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Boiler Pressure	148	147	147	152	149	149	148	149	1485	150	155	148	1495	153	150	150	148	152
Vacuum Referred to 30 Barometer	27.4	28.04	27.85	27.66	27.33	27.4	27.2	26.7	26.7	27.37	27.54	27.3	27.3	26.34	27.25	27.3	27.3	27.3
Temperature in the Steam	2.3	2.3	2.35	1.6														
Superheat Degrees F. and Revolutions per Minute					7	8	8	9	8	17	20	18	20	20	33	37	37	33
	3687	3621	3603	3613	3686	3635	3626	3637	3618	3688	3639	3625	3638	3630	3690	3630	3626	3642
Total Water Brake	7803	4354	5157o	9227o	7227	4507o	5387o	7568o	9132o	6870	4321o	5435o	7249o	8789o	6693	4180o	3129o	7185
Horse Power	0	230o	308o	395o	0	264o	348o	488o	602o	0	263o	346o	487o	607o	0	260o	334o	490
Water Rate		17.4	16.8	15.5		17.05	16.05	15.45	15.28		16.43	15.7	14.85	14.47		16.13	15.35	14.67

FIG. 3. THE STEAM TURBINE—ITS COMMERCIAL ASPECT.—TEST OF 400 KILOWATT TURBINE.

advantage in it, has found when its water supply ran short that it paid to run the turbine and allow its Corliss engines to remain idle. This turbine is seen in Fig. 2.

Is the steam turbine efficient? And what, if it may be so termed, is the character of its efficiency? Is it, like the various types of piston engines, peculiarly fitted to certain conditions which permit of little change if economical performance be retained, or is there evidence that the turbine has a greater inherent efficiency that is less affected by attending circumstances?

The interest of engineers in the turbine has, perhaps, been drawn chiefly to the evident possibilities of its steam economy, and to the data already acquired, with the discussion it has provoked, much more of value will be added. We may, in a general way, however, without referring to its thermodynamics, obtain from the evidence of actual results some knowledge of its efficiency and determine if the standards of present practice may not be improved.

It is well that the makers of the turbo-generator have been compelled to adopt the practice of basing the steam consumption on the unit of output, so that their guarantees are given on the electrical horsepower or kilowatts delivered on the switchboard, and not on the indicated horsepower developed. This at once eliminates the factors of engine friction and generator loss, and thus more definitely establishes a measure of performance.

One is impressed with two distinguishing features of the turbine's steam efficiency, namely, that it seems to vary but little over wide ranges of load, and, further, that the size of the unit has comparatively little bearing. It follows, then, that if good results are possible at all, they are neither restricted to the larger plants nor to the requirement of steady load.

Fig. 3 illustrates this. Herein are given the results of tests on a 400-kilowatt turbine, made at the builders' works before shipment, the machine having since been in daily operation some eight months. These tests were conducted under brake load, so that the figures are based on the brake horsepower developed. The rated load would be about 600 brake horsepower. The steam-consumption curve is seen to be very flat, graduating from 14.47 pounds at full load, to 16 pounds at half rating, and to less than 19 pounds at one-quarter capacity. The relation of the consumption of steam in pounds per hour to the brake horsepower developed is also shown, this line being almost straight. In the tabulation may be observed the interesting comparative effect of vacuum and superheat.

If it is thus shown that with a unit as small as 400 kilowatts, we may obtain a result of 14.47 pounds of steam per brake horsepower per hour, corresponding to less than 13¾ pounds per indicated horse-

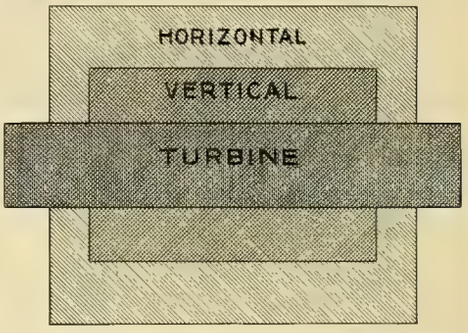


FIG. 4. THE STEAM TURBINE.—COMPARISON OF FLOOR SPACE OCCUPIED BY TURBINE AND CORLISS ENGINES.

power, it is evident that moderate-sized plants may with the turbine be sufficiently subdivided to give the maximum flexibility of service, with insurance of relay, and yet possess an efficiency heretofore identified only with very large units. Further than this, a fluctuating load is not incompatible with high economical performance.

As the units become larger the turbine is then brought into comparison with the best steam-engine practice, where it still preserves its uniform efficiency, and where its practical advantages are no less evident. In a recent instance, a result of 11.7 pounds of steam per electrical horsepower per hour was guaranteed on a turbine of 750 kilowatts capacity, corresponding to about 10.17 pounds per indicated horsepower, which, though the size is moderate, is perhaps within the ability of but few engines, of any size or type, that have ever been built.

It may be pertinent to cite a few results obtained in regular service. The turbine at Hartford, under test conducted by Professor Robb, at an average load of 1,800 kilowatts, with 155 pounds steam pressure, 27 inches vacuum and 45 degrees superheat, gave a result of 19.1 pounds of steam per kilowatt-hour, or an equivalent of about 11.46 pounds per indicated horsepower-hour. An interesting comparison has been made at this plant of the relative efficiency, under regular operating conditions, of the turbine and their Corliss engines. They have one 18 and 34 by 48, and one 24 and 44 by 60 cross-compound horizontal Corliss engine. These engines drive direct by belt one 400-kilowatt and one 600-kilowatt generator. The turbine is, of course, direct-connected to its generator. They have made comparisons of operations based in each case on rather extended runs. It has been found that the turbine requires in delivering 1,900 kilowatts on the board about the same amount of coal that is used with the Corliss engines to deliver 925 kilowatts, the steam pressure and vacuum being identical in both cases; and this with the engines running at about their point of best efficiency, and known to be in excellent condition. Comparisons of this kind, while not scientifically exact, are perhaps of greater interest as a measure of commercial performance.

But is its efficiency maintained? A question often asked, and a very important one, too. Looking at the turbine casually, it seems as though there would be little opportunity for any change in its mechanical functions. There is no complicated valve gear to

1. Abstract of paper read before the American Street Railway Association at Detroit, Mich., on October 10, 1902.

get out of adjustment; no pistons to leak; no rubbing surfaces to set up excessive friction; little chance of misalignment; and, altogether, there seems to be no good reason why its original condition should ever be very much disturbed. The blades appear to be the vulnerable point, for they do the work, and there are a good many of them. Their number, though, is in their favor, and being loaded as they are to only about 2½ per cent. of the pressure they are built for, they possess an abnormally large factor of safety. The experience has been that the turbine is less liable to depart from its original standard of performance than any other type of prime mover, and there seems little reason to suppose that it is capable of much deterioration.

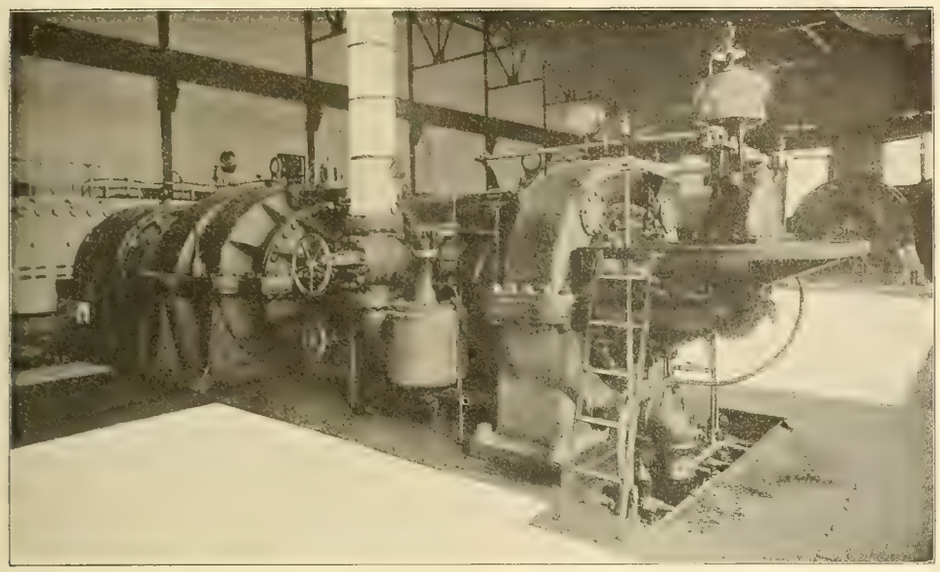


FIG. 2. THE STEAM TURBINE—ITS COMMERCIAL ASPECT.—1,500 KILOWATT TURBO-GENERATOR AT HARTFORD, CONN.

It remains to be said in this general connection that there will be found in steam-turbine practice a more satisfactory treatment of the economy question than has heretofore prevailed. There will exist not only a truer basis of measurement than the indicated horsepower, but there will be opportunity for more thorough demonstration. It is now generally recognized that efficiency guarantees on large engines have little significance. The builder is physically unable to assemble completely and test such engines before shipment, and the user is seldom able or disposed to incur the distraction and expense which a field test involves. It is in the exceptional case, therefore, that actual tests are made, and there is still much to be known concerning the economy performance of large engines. It might be said, too, that while builders and engineers generally recognize the elements of design that conduce to efficiency, there is no unanimity of opinion as to what those elements will actually produce.

It is, therefore, gratifying to know that one builder, the Westinghouse company, is now erecting a new testing room in which a complete plant of boilers, condensing and superheating apparatus will afford facilities for testing turbines up to 3,000 horsepower, at all loads up to full capacity, and larger units up to this point, with practically any steam pressure and wide ranges of vacuum and superheat. Thus, the conditions to be met in practice may be approximated in the shop, and the information acquired will be of the highest value.

Turning now to one notable feature of the turbine—its compactness—Fig. 4 is a graphic illustration of the floor space it occupies, compared with the vertical and horizontal cross-compound Corliss engines, the basis of comparison being a 1,000-kilowatt unit, including the direct-connected generator, the engine cylinders being 28 inches and 56 inches by 48 inches stroke, which, at 95 revolutions, with 25 pounds mean effective pressure, referred to low-pressure cylinder, gives about 1,400 indicated horsepower. It will be seen that the floor area of the turbine is about two-thirds that of the vertical engine and about two-fifths of the horizontal. Such comparison, of course, is limited in its application. With each set of conditions requiring special treatment, no standardization of space requirements can be established. Still, with the limitation of isolated experiences, it is possible without attempting to establish any universal laws, to make some reasonably close comparisons of the space required for the turbine as against the conventional types of engines. It has been thought desirable, then, to take a number of different-sized plants, each composed of several appropriate-sized units, the selections being as follows:

1,000 horsepower in	2— 400-kilowatt units.
3,000 horsepower in	5— 750-kilowatt units.
5,000 horsepower in	4—1,000 kilowatt units.
*10,000 horsepower in	3—2,500-kilowatt units
15,000 horsepower in	4—2,500-kilowatt units.
30,000 horsepower in	4—5,000-kilowatt units.
50,000 horsepower in	7—5,000-kilowatt units.
75,000 horsepower in	10—5,000-kilowatt units.

*In this size the horizontal engine is figured on 5—1,500-kilowatt units.

These combinations were laid out for the turbines, and for the vertical and horizontal cross-compound Corliss engines, all with their direct-connected generators. A clear space of seven feet in all directions was allowed, and is probably a fair average. The computations were confined to the units themselves, with the clearance stated; the disposition of the balance of the plant being assumed to be unaffected by the type of motive power.

Fig. 5 shows the comparison of floor space. The curves show the turbine to require about 80 per cent. of the space needed for the vertical, and not over 40 per cent. of that wanted for the horizontal. In this diagram the vertical engine compares less unfavorably with the turbine than might generally be supposed, while the horizontal-engine curve is about where one would expect to find it. The latter is not carried beyond 10,000 horsepower, this type of engine being practically limited in size to that required for the 1,500-kilowatt generator.

Fig. 6 shows how the factors of cost, foundations, building and land compare. The data will have served their purpose if they show that in a properly designed plant, employing the steam turbine, far more money may be saved in these particulars than is ever represented by the difference in cost between machinery of high grade and that of inferior quality.

A case or two may be to the point: A plant was recently laid out to contain three 1,000-kilowatt units, with vertical cross-compound Corliss engines. Subsequently, three more 1,000-kilowatt units were contracted for, steam turbines being ordered. It was found that the turbine saved 900 square feet of engine-room floor space, and about 38,000 cubic feet. Had the whole plant been originally designed for turbines, the saving of space would have been double these amounts, and the cost of land, building and foundations been reduced about $50,000.

One other case of perhaps greater interest recently came to notice, that of a plant of 8,100-kilowatt capacity, laid out on modern lines, employing vertical cross-compound condensing engines. There is no space for additional engine power, and any increase would require building extension and encroachment upon valuable land. It was shown that without going beyond the present building walls, and without disturbing the existing machinery, the plant might be doubled in capacity by installing turbines in the space available below the present engine-room level and adding another deck of boilers. And it has been figured that this arrangement would effect a reduction of over $3 per kilowatt per annum in the present interest charge.

With some measure thus obtained of the comparative indirect expenses of installation, we may turn to consider the cost of the turbo-generator outfit itself. Is it high in price, or is its cost, if not an attractive feature, still within our common idea of value? The answer is that its price is reasonable; that, indeed, where the comparison is fair, the turbine will require the lesser first investment. It is, unhappily, quite as difficult to compare the costs of the turbine and piston engine as to compare the costs of engines themselves. A thing is, of course, high or low in price by comparison, but where the steam engine is concerned, to measure values were a hopeless task so long as there are held divergent views of design and construction and of engineering adaptation, with the builders themselves wide apart in their practice.

There are engines of good workmanship and of poor, of heavy proportions and light, and generous and scant proportioning of cylinder size and ratio, and of piston speed, to the work to be done. Perhaps, too, the voice of experience may protest that the buyer's insistence on his bargain is not always in keeping with the quality he would have, or should have, and it is not surprising that commercial necessity should sometimes affect engineering ideals. While the reliable builder will adhere to his high standards, there still will be found those whose more flexible practice will suffer impairment of quality to fit the price.

Proceeding with the comparison, however, it may be assumed that the larger field for the turbine begins about where the high-speed engine leaves off. Its steam economy at once identifies it with the most efficient engine practice, and it therefore applies more appropriately to the classes of service where medium and large-size units are used. The comparison, then, lies generally between the turbine and the slow-speed engine. It remains merely to take an engine and generator of good construction, bring the engine efficiency as nearly as possible into parity with that of the turbine, also having it possess the same overload capacity, to find that the turbine is reasonable in price. And when we add the possible saving in foundations, buildings, etc., the first cost of installation is usually much in its favor.

There remain still one or two important features of electric power-plant operation wherein the use of the reciprocating engine is attended with difficulty, and with respect to which the steam turbine offers unquestioned improvement.

One of these—the running of direct-connected alternating-current generators in parallel—has come to be a frequent requirement; but frequent as it is,

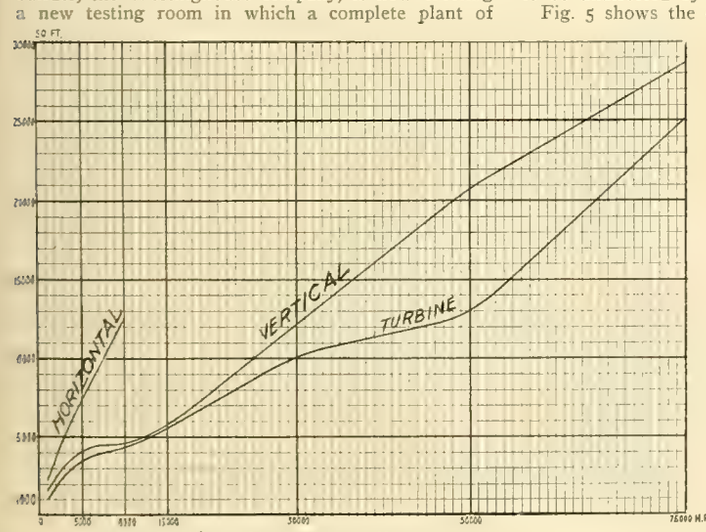


Fig. 5. Floor Space per Horsepower.

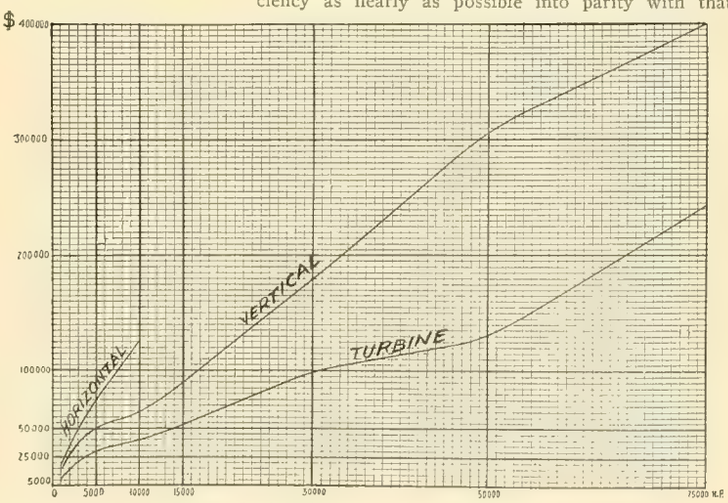


Fig. 6. Total Engine-room Cost per Horsepower.

and essential as it is, its accomplishment has been anything but an exact science. There has, in fact, been so little synchronism of method as to justify some wonder at the results that have really been obtained. There is no need here to particularize the complications of the problem. It obviously is not the work of the tyro to introduce into two or more units the identical conditions that will convert reciprocating motion into synchronous rotating motion, correlating, as he must, the features of governing functions, inertia of reciprocating parts, flywheel weight and radius, and the like. And it becomes evident that where successful parallel running is achieved, it is the triumph of skill not only in design, but in the handling of the machinery itself.

These difficulties cease with the turbine. In it there is no fluctuation of angular velocity. There is but one direction of motion, with no element to detract from even turning moment, and due to its speed there is stored up more flywheel effect than is present in the piston engine.

It is, therefore, found that not only do steam turbines easily run together in parallel, as hydraulic turbines have always done, but it may be expected that they will operate with piston engines and the performance of the latter in this respect be much improved. In electric-railroad work especially is this feature of the steam turbine of much interest, for it is well known how irregular loads accentuate the difficulties of regulation. Furthermore, the question of operating high-frequency apparatus in combination with electric-railroad and lighting service may be more satisfactorily approacned.

The feature next in importance, perhaps, is that of superheated steam. It is now quite generally recognized that superheating is of advantage, though there is still much about it to be learned. The turbine may be used unreservedly with superheat of any feasible temperature. It has no internal rubbing surfaces, and there are no glands to become injured. Also, as no cylinder oil is required, there is no opportunity for lubricating trouble. Furthermore, there seems to be with the turbine rather more proportionate benefit from superheat than with the piston engine, because of diminished skin friction.

Having said that the turbine requires no cylinder lubrication, the inference follows that the steam is therefore uncontaminated with oil, and that the exhaust, when condensed, is pure distilled water. Lubrication in the turbine is an item of very little expense. The bearings are the only points requiring oil, the lubricant being circulated around under pressure. The reservoir being once charged, very little is needed to maintain the supply.

Finally, in this commercial consideration of the turbine, one other question should perhaps not be omitted, one, in fact, which sometimes seems to outweight almost every other—namely: How long does it take to get it? While the demand has, in truth, for some time exceeded the capacity for production (there being now under construction at East Pittsburg some 44,000 kilowatts on order), so that the turbine has required about as much time to build as everything else, the extended facilities now nearing completion will better this considerably. Certainly, under normal conditions, these outfits, made of comparatively small parts, with no enormous pieces to be handled, ought to be quickly built, and what is quite evident, they can, when delivered in assembled condition, be so readily installed that the months sometimes required to erect large engines will be reduced to weeks.

If it is, then, seen that the steam turbine in all the essential aspects of its commercial utility appears to stand on solid ground, there cannot be yet attributed to it the virtue of universal application. It has its field chiefly in electric-lighting and power work, though in small sizes it has been extensively used for driving blowers, pumps and other devices. Its speed, of course, prohibits belt drive.

The last report concerning the North Jersey traction deal is to the effect that $15,000,000 has been determined upon as the price for the controlling interest of the North Jersey, Jersey City, Hoboken and Paterson, Orange and Passaic Valley and Elizabeth, Plainfield and Central Jersey traction companies. Edwin Gould and Gen. Samuel Thomas are said to be the purchasers.

Alternating-current Railway Systems.

By Frank C. Perkins.

III. Induction Methods.

Having taken up some of the systems employing single-phase and polyphase converters for operating electric railways, as installed along the lines in substations, as well as when mounted upon the train, it may now be of interest to consider a few of the designs of induction railway systems, in which there is no electrical connection by trolley, collector or brushes of any kind between the source of power at the generating station and the moving car or train.

The accompanying drawing (Fig. 1) shows one of these methods for utilizing alternating currents in this way, and it may be well to note first a few of the high-tension, high-frequency systems as well as those using condensers on the cars and along the track, before taking up those designs which employ stationary primary coils along the track and secondary coils on the train.

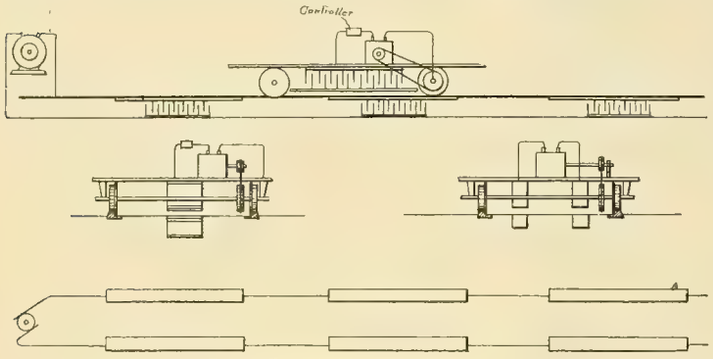


Fig. 1. Dewey's Condenser Method.

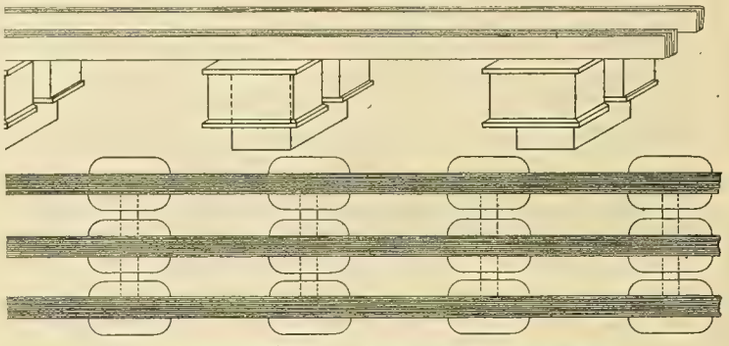


Fig. 6. Sussmann-Hellborn and Hornauer Polyphase Arrangement.

ALTERNATING-CURRENT RAILWAY SYSTEMS.—INDUCTION METHODS.

In reference to Nikola Tesla's high-tension, high-frequency electric railway, he states that his invention is "an improved system or plan of supplying electric current to the motors of cars or vehicles from a central source of supply without the use of sliding or rolling contacts between the line conductor and the car motors." He uses alternating or pulsating currents of very high potential, and high frequency for higher economy. The conductor which conveys these currents is run from the stationary source of supply along the line of travel, through a conduit constructed between or alongside of the rails. To prevent the dissipation of the electric energy he insulates the line conductor and surrounds it with a conducting coating that serves as a screen, the outer conductor being divided into insulated sections. On the car is attached a conducting plate or bar that is electrically connected with the motor coils and which by the movement of the car is carried in proximity to the line conductor, so as to take off, by condenser action, sufficient energy to run the car motor.

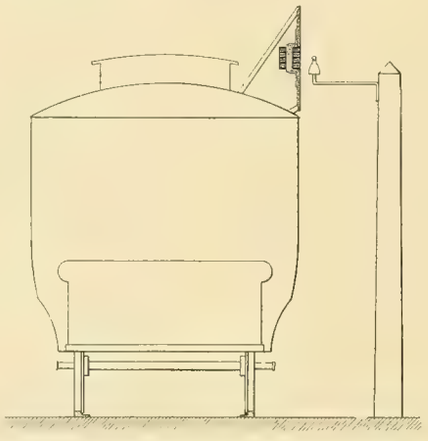


FIG. 2. ALTERNATING-CURRENT RAILWAY SYSTEMS.—HUTIN-LEBLANC TRANSFORMER ARRANGEMENT.

The electric-railway system of Mark W. Dewey (Fig. 1), which dispenses with contact and brushes, trolley wheels or sliding contacts in connection with conductors along the route of the vehicle, is said to be accomplished by electrostatic induction. The inventor utilizes any number of condensers connected to the conductor from a source of supply of alternating current, and having the condenser plates parallel with the railway. The propelling electric motor is connected with condensing plates upon the car parallel to and adapted to be moved in inductive proximity to the former plates.

Messrs. Hutin and Leblanc of Paris, France, have patented in the United States a transformer system for electric railways, a drawing of which is noted in Fig. 2, using a line wire or conductor, over which passes an alternating current, while a coil is arranged on the car, with the plane of its spirals parallel with the line wire and connected in circuit with an electric motor which propels the car. In support of this system the inventors say: "The driving of railway vehicles by electric power should offer the greatest advantages as to facility and economy, if only the energy supplied from a stationary plant could be transmitted directly to the vehicle from an electric conductor along the line. It is, however, very difficult to establish a constant communication between the vehicle and the electric conductor under proper conditions. In the case of high-speed railways, the difficulty arises principally from the great velocity with which the moving contact has to traverse the conductor; while in the case of tramways the use of an overhead wire presents serious disadvantages in public streets, and the use of a subterranean wire carried in a conduit or tunnel beneath the pavement having a slot for passage of the movable contact is unduly expensive; and, finally, the use of the rails as conductors causes much leakage, or, if the circuit is divided into a great number of sections in order to diminish this loss, excessive complication is involved. It has been proposed to overcome these difficulties by employing alternating currents for transmitting energy over the line, in connection with coils carried by the moving vehicles, the motors of which are energized by the alternating secondary currents generated in these coils; but heretofore this plan has not been practically available, because of the extreme loss resulting from the wide separation of the primary conductors and the coils, in connection with the necessity of transmitting the lines of force through the air, the magnetic conductivity of which is about 2,500 times inferior to that of iron, which is ordinarily employed in transformers for converting the energy from a primary to a secondary circuit."

The principles involved in this induction railway system are stated as follows: "First, by reason of the inductive effect of the primary alternating current, there will be generated in the coil included in the secondary circuit an electromotive force proportional to the volume of the alternating current and to its frequency. Consequently, however low may be the mutual coefficient of the line and the secondary coil, and however small may be the volume of the alternating current upon the line, any desired electromotive force may be developed in the secondary coil by sufficiently increasing the frequency of alternation of the primary current. Second, while the electromotive force developed in the secondary coil increases with the frequency, the apparent resistance of the coil will increase at the same time and will become sensibly proportional thereto. Hence, it results that under these conditions the amount of energy transmitted to the secondary does not sensibly increase with the increase in the frequency of the alternating current thrown over the line. This result would no longer follow if the coefficient of apparent self-induction of the secondary coil were suppressed by introducing into its circuit a condenser of suitable capacity, or by other suitable means for suppressing or greatly reducing the apparent self-induction of the coil. For determining the capacity of the condenser, we employ the following formula: $C = \frac{T^2}{4\pi^2 h}$, in which T represents the period of the current employed and h the coefficient of self-induction of the circuit, the effect of which is to be neutralized."

With the system of Hutin and Leblanc, the vehicle is provided with a secondary coil, the convolutions of which have their planes parallel with

the electric conductor, and with a condenser, or its equivalent, and with a motor, which is fed from the alternating currents generated in the coil, and connected to drive the wheels of the vehicle.

A method of operating electric railways by dynamic induction was patented by Elias E. Ries, and one of the designs is shown in Fig. 3, in which alternating currents are used on the line of conductors, which induce currents in circuits upon the car, which feed the propelling electric motors.

A recent system of electrodynamic propulsion (Fig. 4) was patented in the United States, April 23, 1901, by L. Rosenfeld, C. Zelenay and J. Dulait of Charleroi, Belgium. It utilizes polyphase alternating currents, in which the induced element or

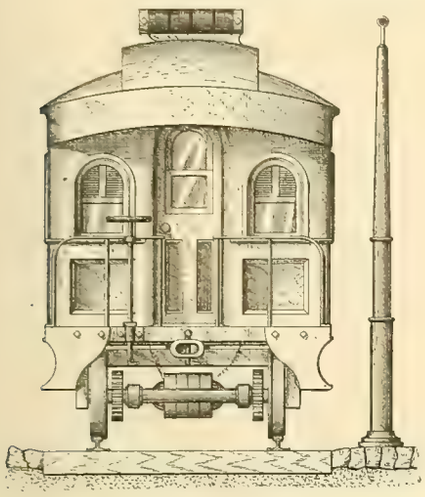


FIG. 3. ALTERNATING-CURRENT RAILWAY SYSTEMS.—RIES DYNAMIC-INDUCTION PLAN.

armature is suspended from the vehicle, and is influenced parallel to the inducing element or field magnet, without any other correlation thereto than the energy produced in the inter-air space.

This system has in reality a moving armature upon the car and a stationary field magnet along the track, and is an electric-traction system with polyphase currents, having no connection other than the sliding magnetic field between the induction element suspended on the vehicle and the inductor extending on the track. The construction of the inductor and the induced element has pole pieces in T-form extended laterally in relation to the diameter of the magnetic core.

The method of construction is said to obviate the chief disadvantage, which lies in the insufficiency of air space, by rendering it much more adequate

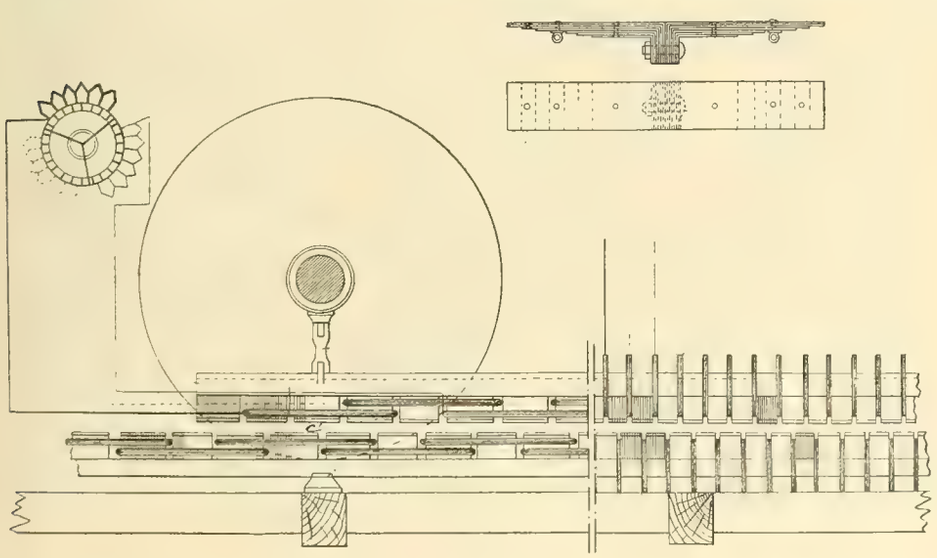


FIG. 4. ALTERNATING-CURRENT RAILWAY SYSTEMS.—ROSENFELD-ZELENAY-DULAIT ELECTRODYNAMIC PROPULSION.

without diminishing the effect of the magnetic flux to be applied to the armature by which the vehicle is propelled. The inventors assert: "Heretofore the minimum adequacy of the inter-air space has been indispensable for obtaining with a given weight of copper for the ampere-turns of the field magnet a magnetic flux applying sufficient energy to the armature for the propulsion of the vehicle, as with the existing arrangements it was not possible to increase the 'value' of the inter-air space without diminishing its energy in the same proportion, so that in order in this case to maintain the same energy of the magnetic flux a considerable increase in the weight of the copper would be suggested, as necessary. As, moreover, the very little value of the inter-air space renders this system of propulsion, if not impossible, at least very difficult in practice, as in consequence of the jolting of the vehicle it might even happen that contact would be established between the field magnet and the armature with all its possible disastrous consequences, it becomes necessary to increase the value of the inter-air space considerably. Now this increase of the actual value of the inter-air space, which is about three millimeters, to nearly four times its value, say, to 12 millimeters—without increasing the weight of copper, while preserving an energy equal to the magnetic flux, is realizable by means of a special arrangement of the pole pieces of the armature and of the field magnet."

Several interesting designs of converter systems have been invented by M. W. Dewey, in which the primaries are arranged along the track and are stationary, and the secondaries are movable and mounted upon the train and supplying current to the motors of the cars; as well as a design where the secondary is movable upon the car, and the primary of the transforming device is also movable, traveling along within an underground closed conduit. Mr. Dewey also makes use of the converter or rectifier, as well as direct-current motors upon the cars for propelling them, the direct current being supplied from the rectifier, which receives the energy from the secondary of the induction collective device.

The high-tension induction railway shown in Fig. 5, designed by Charles E. Roehl, provides the means for preventing the loss of current through the primary coils when they are not in use. He states in reference to such loss: "This is obviously a most important item, since on a road several miles in length, the loss through leakage of current through the primary coils would amount to hundreds of horsepower per day. To avoid this loss a self-inductive resistance is provided, consisting of a coil of wire made up of a few turns of large copper wire in series with the primary coil and having a movable iron core. When the core is in the coil, current cannot flow through the primary coil, owing to the self-induction caused by the presence of the iron core, which chokes the flow of the current. When the car comes along the core is automatically withdrawn from the coil and kept out as long as the car is to be supplied by that primary coil, thus allowing the current to flow through the latter and induce a current in the secondary coil."

A polyphase induction railway was patented recently in the United States by E. Sussmann-Hellborn and W. Hornauer of Munich, Germany. This arrangement, illustrated in Fig. 6, consists in the enlarged or extended employment of a divided transformer, the primary windings of which are arranged in the ground or underground, while the secondary windings are mounted on the car and move with it. The primary windings are arranged continuously, so as to enable the car elements to receive the current always by induction produced by the primary elements and to feed the same to the electric motors upon the car. The iron cores of the primary and also of the secondary elements are each magnetically connected up among themselves, parallel to the direction of the rails by means of a plurality of parallelly located compound iron binders between the rails, and also on the car. This design is said by the inventors to be equally adapted for single-phase or multiphase alternating currents.

While it may be possible in the near future to utilize an induction system for electric-railway propulsion, the great cost of the systems having so many primaries along the line, together with the heavy cost of the track and iron-core construction, and the difficulties due to the high reluctance, both of the air gap which is necessary between the car and the track, as well as the high reluctance of the magnetic circuit in passing from primary to primary along the track, are almost fatal to these systems. Again, the leakage of magnetic lines of force would be enormous, and it is a question whether the efficiency can be brought to a very high figure.

In a recent paper E. Basil Wedmore pointed out,

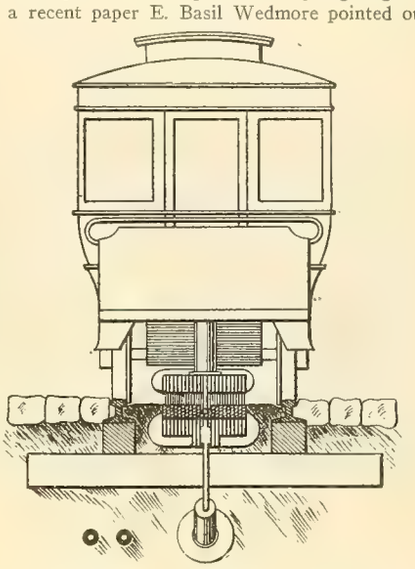


FIG. 5. ALTERNATING-CURRENT RAILWAY SYSTEMS.—ROEHL INDUCTION RAILWAY.

in speaking of the analogy between magnetic and electric flux, that it might be possible to transform up a magnetomotive force in some manner, as with the electromotive force, so that the magnetic flux, like the electric current, may be transmitted through longer and thinner conductors without appreciable loss.

A discovery of a means to transform up magnetomotive force, allowing longer and thinner magnetic conductors, would, without question, make induction electric railways thoroughly practicable, but this is not in sight, and without question very unlikely, although it is not safe to prophesy in the electrical field, as many wonders are opening up before the electrical engineer every decade.

COMMUNICATION.

Mr. Guarini on Space Telegraphy.

To the Editor of the Western Electrician:

I have read your editorial note of September 13th in relation to my attitude toward Marconi and Braun, as shown, you think, by the article on "Progress in Space Telegraphy," which I had the honor to contribute to the same issue of your journal. Allow me to make my position clear by what follows.

I am not at all incredulous as to the Marconi tests, and I have no reason to favor Braun or any other person more than Marconi. I am, on the contrary, a profound admirer of the great work of my young compatriot, which several detractors attempt basely and uselessly to belittle. I do not believe that syntony can ever solve in the Braun, Marconi, Slaby or other systems, at least in a practical manner, the problem of the absolute secrecy of dispatches and of multi-communication in wireless telegraphy. These problems, to my very modest idea, can only be solved by limiting the space where one sends and whence one receives the waves. At the present time I am carrying on exhaustive experiments along this line, and I have already arrived at some satisfying results.

I believe in the Marconi transatlantic wireless telegraphy (see my article in the London Electrical Review in an issue in January, 1902), but I contend that the present solution is not complete.

EMILE GUARINI.

Brussels, September 25, 1902.

The Treasury Department recently received an application from the Providence Engineering Works, requesting an allowance of drawback equal to 99 per cent. of the duties paid on an armature recently imported from Canada, intended to form a part of a generator used in connection with an engine the firm is making for the Halifax Electric Tramway Company of Halifax, N. S. As it appears from the statements made by the applicants that the armature has been incorporated into, and has become a permanent part of, the completed generator, the collector of customs at Providence, R. I., has been authorized to allow the drawback, as requested.

Manufacture of Nitrogen Compounds at Niagara Falls.

The new building of the Atmospheric Products Company at Niagara Falls, N. Y., is approaching completion. It is located on the lands of the Niagara Falls Power Company, on Buffalo Avenue, in front of the upper works of the Pittsburg Reduction Company. The building is of brick, substantially built. When finished it will be used as a machine shop in which the apparatus for the company's proposed new factory for the manufacture of nitric acid will be made. It is the company's intention to begin operations in its factory with 2,000 horsepower. The space required for its apparatus will be large, so it is expected that the manufacturing plant will be extensive. It is interesting to observe that to supply all of the nitric acid used in the United States alone would require the use of 150,000 horsepower in a factory that would cover many acres of floor space.

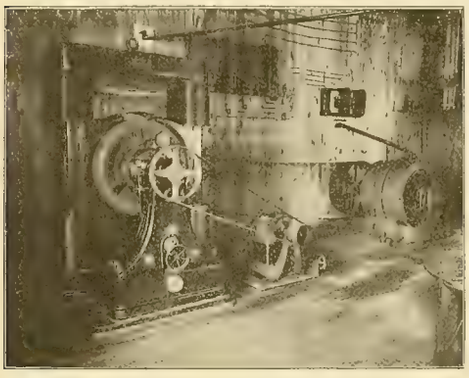


FIG. 1. MANUFACTURE OF NITROGEN COMPOUNDS AT NIAGARA FALLS.—10,000-VOLT DYNAMO, WITH EXCITER AND MOTOR.

The company's process is a success, and to meet even this extensive requirement would simply mean a vast extension of its facilities. Located, as the company is, at Niagara, it is evident that the want of power will never retard its development.

The Atmospheric Products Company was incorporated in May, 1902, with a capital of $1,000,000. The process was evolved by Charles S. Bradley, who is president of the company, and was worked out in an experimental plant at Niagara Falls by D. Ross Lovejoy, the company's electrician. The papers of incorporation mention Charles S. Bradley, William E. Knight, William F. Crawford, Harry E. Knight, David J. Newland, C. von Gruever and William P. Hammond, all of New York, as directors. The patent claims of the company are for "exposure of a mixture of nitrogen and oxygen to the action of an electric arc, and renewing the mixture with sufficient rapidity to carry away the nitrous products from the arc and substantially prevent dissociation." The patent is for a method of producing nitrogen compounds from atmospheric nitrogen.

In the experimental station a 45-kilowatt generator (Fig. 1), which ordinarily delivers 0.75 ampere direct current at 8,000 volts, but of a capacity to give several amperes at 15,000 volts, has been in use. The company has found it necessary, in order to secure efficiency, to use an arc, which is divided into small, thin, flat subdivisions, so as to present a large surface for a small amount of energy. In fact, the thinner the arc, the greater is said to be its efficiency up to the point where it is broken. There are 138 of these arc contacts, and each is made and broken 50 times per second, each arc receiving about 0.005 ampere. Despite the number of the arcs, they are all sprung successively, 6,900 in the apparatus in use, each arc lasting about one twenty-thousandth of a second. When the arcs form, there is a sudden increase in volume, and short-circuiting is prevented by inductance coils in series with the arcs. These retard the current for about one forty-thousandth of a second, and during the remainder of the period, or another one forty-thousandth of a second, as the arc is drawn out and about to break, an impulse is sent, and the arc prolonged. When 8,000 volts are used, with an average of one two-hundredth of an ampere to an arc, the arcs are drawn out four to six inches.

During the time the company has been experimenting at Niagara Falls, its apparatus has been located in the Ampere Electrochemical Company's plant, in the rear of the United Barium Company's factory. The apparatus is well shown in Fig. 2. It is of iron and round. It stands five feet high and is four feet in diameter. Attached to the sides there are six rows of inlet wires, 23 to a row. A vertical shaft runs through the center and contains a series of 23 radial arms. Each plane has six radial arms. The radial arms are tipped with platinum wires that extend to within one twenty-fifth of an inch of the similar wires on the opposite poles. When the two points get close, a spark leaps about an eighth of an inch to meet the approaching point, and as the point retreats the arc is drawn out. In series with each arc is a resistance coil, 12 inches long and five inches in diameter, immersed in oil, and containing several thousand turns of wire. To run the central shaft at 500 revolutions per minute requires, it is said, a trifle over a single horsepower, while five horsepower is required to give it a velocity of 1,000 revolutions per minute. The output is one pound of theoretical nitric acid per seven horsepower per hour current used.

While air can be used in the apparatus, after being dried, it has been ascertained that a mixture of equal parts of oxygen and nitrogen gives better results. Air, it will be recalled, contains but one part of oxygen to about four of nitrogen, the gases formed containing one part oxygen to 1½ or two of nitrogen. A renewal of the gases is made to the extent of three to four cubic feet a minute. The gases pass into an iron reservoir, that has a height of 10 feet and a diameter of two feet, where they still further combine, and then pass into a scrubbing tower. This scrubbing tower is of earthenware pipe, nine inches in diameter and 25 feet high. It is filled with coke, and if nitric acid is the product desired, water runs over it, or, if alkaline nitrate is desired, a solution of caustic alkali is used. Calcium nitrate is made by using a scrubber supplied with milk of lime.

It is interesting to review the two patents granted to Bradley and Lovejoy, which cover the process. They are numbered 709,867 and 709,868, and were issued on September 30th. In the first of the two patents mentioned the inventors set forth two methods for carrying out their process, one by alternating current and one by direct current.

The alternating apparatus is diagrammatically illustrated in Fig. 3. A number of receivers are shown at (1), these receivers being of glass or other suitable material. Inlet and outlet ducts or passages (2), (3) provide for the passage of air through the same, the passages (2) leading to the outer air or to a source of air and the passages (3) being connected to delivery pipes (4), leading to the collecting apparatus. Two terminals (5) (6) are sealed through and into each receiver, so as to be in proximity at some point (indicated at 7), and diverging from this point in any desired direction. In this case the divergence is upwardly, with the result that when an arc is struck between the two terminals it will travel upwardly under the influence of the draft caused by its oven heat or by reason of the air current delivered through the air receptacle or for any other reason, and will thereby become rapidly elongated or drawn out, thus preventing the sudden decrease of resistance and increase of current that would otherwise take place, and, finally, the arc will snap or break at the ends of the terminals before the arc deteriorates into a spark, this operation taking place repeatedly, it being understood that the voltage delivered to the terminals is just sufficient to insure its breaking across the narrowest part of the air gap between the terminals. It is important to break the arcs in such manner as to prevent formation of sparks, as the main effect of the latter is to produce ozone, while for nitrification arcs are more efficient. The several arc-supplying circuits (8) (8) are supplied from the secondary coils (9) of transformers whose primaries (10) are connected in parallel to the energizing circuit (11), which may be energized from any suitable source, such as the alternating-current generator (12).

In collecting the products by the use of sulphuric acid the apparatus represented in Fig. 3 may be used, the same comprising a tubular conduit or tower (14), through which the gases from the nitrifying apparatus are drawn in an upward direction, while sulphuric acid is supplied at the top of the tubular conduit and trickles over the obstructing material (15) placed therein, absorbing in its downward passage substantially all of the nitrous product contained in the air, and finally passing into a receptacle (16), which is kept warm by suitable heating means (17), so as to heat the sulphuric acid sufficiently to cause expulsion of the nitrous product as vapor, such vapor passing off through worm (18) in cooler (19) to the receptacle (20). A pump (21) draws the sulphuric acid through a return tube

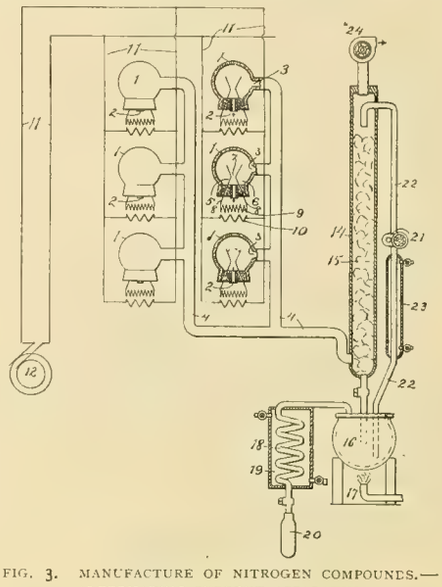


FIG. 3. MANUFACTURE OF NITROGEN COMPOUNDS.—ALTERNATING CURRENT APPARATUS.

(22), passing through a cooler (23). Blower (24) draws the air upwardly in the tubular conduit, and thus draws the nitrified air through pipes (4), from all the nitrifying devices or receivers (1), a steady current of air thus being maintained through such receivers.

The direct-current system that is illustrated in Figs. 1 and 2 is also shown diagrammatically in Fig. 4. The receiver (1) in this case is common to a large number of arc-developing devices or terminals (5) and (6). The terminals (5) are set into the cylindrical wall of receptacle (1) and project slightly into the receptacle. On a spindle (34), mounted in bearings (35), and driven by motor (36), are carried a number of movable terminals (6), preferably arranged radially on disks (37) on the spindle, each disk carrying a series of terminals adapted to co-operate with all of the fixed terminals (5) adjacent to their plane of rotation. The terminals (5) are connected, through branch circuits containing inductances or induction coils (38), to one side of a circuit (11), containing a generator (12'), in this case a high-tension, direct-current generator, whose other side is connected to the step of the spindle (34). As the spindle is rotated by the motor the arcs are struck, drawn, and interrupted in rapid succession between the fixed and moving terminals, each moving terminal coming close enough to the fixed terminals in the same series to enable the arc to strike across and then by withdrawing quickly

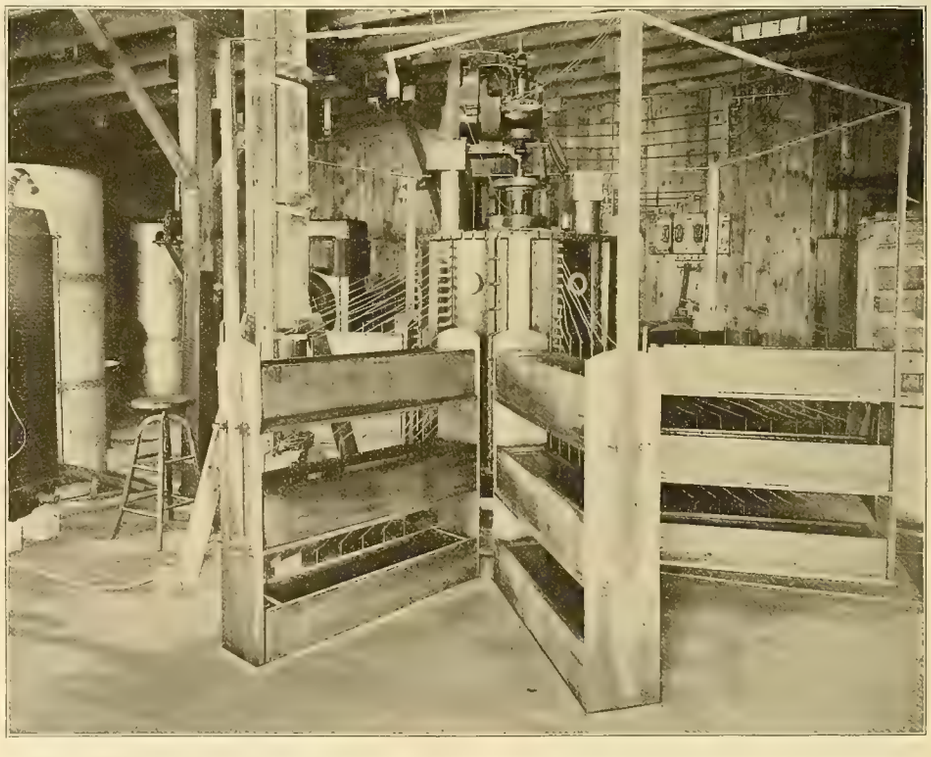


FIG. 2. MANUFACTURE OF NITROGEN COMPOUNDS AT NIAGARA FALLS.—EXPERIMENTAL APPARATUS, SHOWING NITRIFICATION CHAMBER AND COLLECTION TOWER.

drawing the arc rapidly out. By providing a sufficient number of the movable terminals (6) and rotating the shaft at a sufficient speed a periodicity of interruption of the arcs may be obtained of, say, 500 to 1,000 per second.

In Fig. 5 is shown a complete installation comprising devices of the type represented in Fig. 4, enclosed in a room or chamber (45), supplied with fresh air at the top by means of conduit or distributing chamber (46), and the air being drawn out at the bottom of the receivers (1) by conduit or main (4), which may include a trap (47) for arresting, collecting, and delivering any nitric acid that

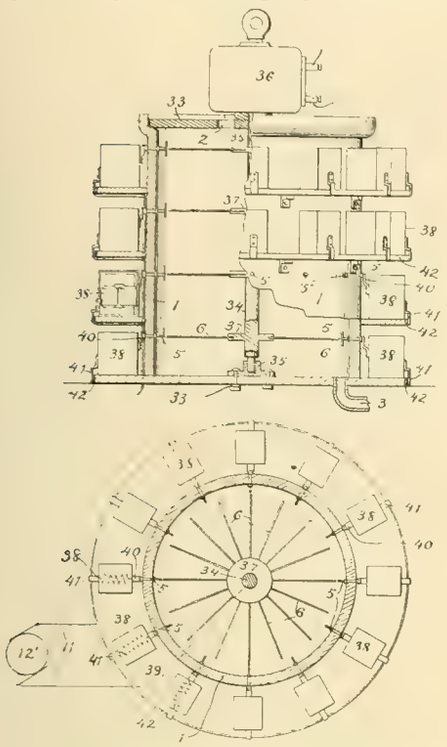


FIG. 4. MANUFACTURE OF NITROGEN COMPOUNDS.—ELEVATION AND PLAN OF DIRECT CURRENT APPARATUS.

may be formed. The collecting means for the nitrous product here shown is based on the condensing principle and comprises, preferably, two coolers (48) (49), through which the pipe (50) from the main (4) or from the trap (47) passes successively. In the first of these coolers the air is cooled sufficiently —say, to about 0° Centigrade—to condense substantially all of the nitrogen tetroxide (N_2O_4) which collects in a receiver (51), and the remaining gas then passing through the cooler (49) is further cooled sufficiently (to 30° Centigrade or below) to condense all the nitrogen trioxide (N_2O_3) which is collected in a receiver (52). From the receiver (52) the unaltered air is discharged through pipe (53).

Inasmuch as this discharged air is extremely cold, the inventors prefer to pass it through regenerating devices to utilize such cold. They also prefer to subject the air which is to undergo the nitrification process to a preliminary cooling, so as to deposit all

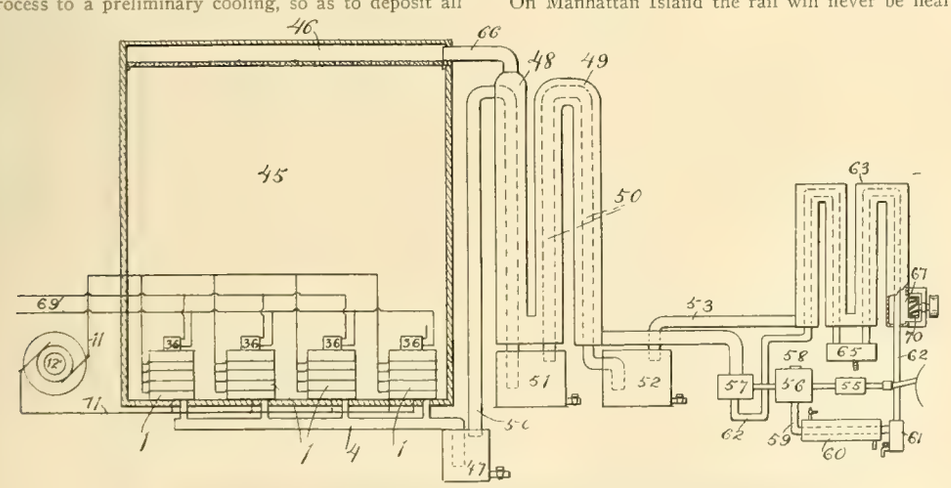


FIG. 5. MANUFACTURE OF NITROGEN COMPOUNDS.—COMPLETE DIRECT-CURRENT PLANT.

the moisture therefrom, and the apparatus shown is adapted to carry out these several functions.

The electric connections are as shown, all the arcing circuits being connected in multiple to the exciting circuit (11) and the several motors (36) being connected to an energizing circuit (69).

In the operation of the apparatus the ratio of air flow to the amount of energy supplied by the electric discharges or arcs is such as to carry away the combination products of the discharge almost as rapidly as they are formed. The amount of nitrous product only amounts to about two to three per cent. of the amount of air supplied. By this means the waste due to dissociation by the action of the arcs on the combination products already formed is substantially presented.

D. Ross Lovejoy is in charge of the company's operations at Niagara Falls, and the doings of no man in the electrical field there are more interesting. It is generally recognized that the company has a brilliant future, and all interested in the success of Niagara industries are alert to the possibilities before this process. When the site for the manufacturing plant is selected, it will be with a view of large extensions, and it is understood that the company will start by using 2,000 horsepower. It is probable that plants will be established in other countries, so that the world at large is quite sure to benefit finally by this new Niagara discovery.

The Pennsylvania Railroad in New York.[1]

The great undertaking of the Pennsylvania railroad in carrying its line across Manhattan Island and in establishing a station on the island will cost something like $40,000,000.

The new line begins at Harrison on the east side of the Passaic River, just across from Newark. It runs along the south side of the Pennsylvania main line for about 5,000 feet, at which point it has reached such an elevation that it can cross to the north side overhead. Then it trends to the northward across the meadows, to the west side of the ridge, just back of Hoboken. On the meadows the line crosses seven railroads, besides the main line of the Pennsylvania itself, and an important highway, on which is a double-track trolley road, and it also crosses the Hackensack River. All of the crossings are over grade. This necessitates continuous embankment, or viaduct, from Harrison to the tunnel portal at the west side of the ridge, about six miles.

At the Bergen ridge the line enters a rock tunnel, and emerges again in Long Island City, the total

THE PENNSYLVANIA RAILROAD IN NEW YORK.

length of tunnel being a little under six miles; the total improvement from Harrison to the junction with the Long Island railroad is 12⅛ miles. This is all costly work. Not a foot is on the natural surface; all is in tunnel, or cutting, on an embankment or viaduct.

Across the North River will be two tunnels, and across the East River will be four, these various tunnels meeting at a great central station to be established on Manhattan Island between Seventh and Ninth Avenues and between Thirty-first and Thirty-third Streets.

On Manhattan Island the rail will never be nearer the surface than 40 feet, and everywhere it will be below mean tide level. In fact, at the highest point of the tunnel the rail will be about 10 feet below mean low water. Obviously, the station platforms will also be below tide level. Under the Bergen ridge the grade of the tunnel will be 255 feet below the highest point of the hill. Under the North River it will be 35 feet below the natural bottom of the river, and 80 feet below mean low water. Under the East River the depths are about the same.

The method to be adopted for driving these tunnels has not yet been decided on, because of the magnitude of the work, and because of the peculiar conditions. Across the North River the tunnels will be driven all the way in silt. There the old Hudson River tunnel furnishes experience which will be useful to the engineers of the new tunnels. It is not believed that there will be any extraordinary difficulty in the North River. Under the East River the situation is worse. Deep pockets of silt and of quicksand are found on either side of a ridge of rock, and the method of carrying on this work will have to be studied with great exactness to avoid interruption.

The engineering studies are being developed by a commission of six expert engineers, and it is reasonable to expect that the methods in general, and in detail, will be quite up to the highest state of the art. In fact, they will necessarily establish a new state of the art, because of the novelty of the conditions.

Such, very briefly, are the elementary engineering features of the work. It will be full of details which will interest the layman as well as the engineer.

One great object in building this new connection is to establish direct communication from a station in the heart of New York city with the whole continent west of the Hudson River. Passengers to and fro will not pay more for the privilege of landing in New York city, or leaving from New York city, than they do now. The rates are largely competitive. The Pennsylvania's opportunity to make money is by getting more passengers to go by its lines, and this can be done only by making it pleasanter and more convenient for them to go that way. The great volume of the suburban-passenger business coming now to the west bank of the North River will probably continue to enter New York city by the ferries, for reasons that we need not go into now.

Another direction in which the volume of traffic will be increased is across the East River to Long Island. Here a large growth must be looked for, and it is not impossible that the revenue earned on the east side of the new central station will be greater, before many years, than the revenue earned from the traffic through the tunnels on the west side of that station. This is a speculation, but it does not seem improbable. It should be apparent, therefore, that the Pennsylvania Railroad Company has but one hope of financial success in this tunnel enterprise, namely, by giving to the people who travel to and from Greater New York, conveniences and attractions which they do not now enjoy. We need not now enter upon the terms of the franchise, but there are those who think that the Pennsylvania Railroad Company made a mistake at the outset in not asking the city to co-operate in the cost of bringing its lines to the center of the island. The city could well have afforded to do so.

1. Abstract of an article by H. G. Prout in the New York Times.

Municipal Electricians' Convention at Richmond.

The seventh annual convention of the International Association of Municipal Electricians was held at Richmond, Va., on October 7th, 8th and 9th. A large party of delegates, members and friends from New York city and vicinity bound for Richmond left New York on the steamship Princess Anne, Old Dominion Line, on Saturday, October 4th. The party consisted of the following-named persons: F. C. Mason, Brooklyn; William Brophy, Boston, Mass.; W. Y. Ellett, Elmira, N. Y.; F. P. Foster, Corning, N. Y.; F. A. Burns, Schenectady, N. Y.; S. L. Wheeler, Springfield, Mass.; Henry Smith, Buffalo, N. Y.; W. M. Petty, Rutherford, N. J.; Mrs. Petty and daughter, Rutherford, N. J.; Mrs. Curman, Rutherford, N. J.; G. W. McDonald, Ottawa, Can.; F. Burns, Schenectady, N. Y.; Mrs. Charles Newman, Passaic, N. J.; Charles Newman, Passaic, N. J.; F. W. Farrand, Atlantic City, N. J.; A. J. Bell, New Rochelle, N. Y.; Mrs. Bell, New Rochelle, N. Y.; J. W. Zeluff, Paterson, N. J.; Adam Bosch, Newark, N. J.; F. E. Pierson, Morristown, N. J.; Mrs. Pierson, Morristown, N. J.; W. A. Barns, Bridgeport, Conn.; J. W. Aydon, Wilmington, Del.; Frank Boyd, Baltimore; L. W. Miller, Rochester; W. Crane, Erie, Pa.; W. C. Banks, A. P. Eckert, W. Stanley Eckert, George Porter, F. W. Harrington, S. Brixly, P. H. Alexander, W. Watson, W. L. Candee, George Manson, T. H. Bibber, Fred Pearce, Mrs. D. Grant, Mrs. S. Davis and B. E. Green of New York city.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Jere C. Hutchins, President American Street Railway Association. Portrait 245
Marconi and His Affairs 245
Largest Railway Power House South of the Equator 245
Electrical Exports in August 245
First Commercial Nernst Lamp Installation in Chicago 245
American Street Railway Association. (Convention at Detroit, October 8-10, 1902.) Illustrated. 246, 247, 258, 259, 260, 261, 262
The Chicago Special Train 246
Wednesday, Opening Day 246, 247, 258, 259
President Vreeland's Address 246, 247, 258, 259
Official Reports and General Business 259
Registration of Transfers 259
Benefit Associations and Pensions 259
St. Louis World's Fair 259
Electric Express and Package Delivery 259
Miscellaneous Business 259, 260
Thursday, Supply Men's Day 260
Friday, Closing Day 260
Steam Turbines 260
Closing Business 260
Street Railway Accountants 260
Master Mechanics Organize 260
Convention Notes and Exhibits. Illustrated 260, 261, 262
The Steam Turbine—Its Commercial Aspect. By Edward H. Sniffen. (American Street Railway Association.) Illustrated 248, 249, 250
Alternating-current Railway Systems. By Frank C. Perkins. Part III. Illustrated 250, 251
Communication.—Mr. Guarini on Space Telegraphy 251
Manufacture of Nitrogen Compounds at Niagara Falls. Illustrated 252, 253
The Pennsylvania Railroad in New York. Illustrated 253
Municipal Electricians' Convention at Richmond 253
Editorial 254
Magnetic Wheel for Railways. Illustrated 255
Ohio Electric Light Association 255
Institute Proceedings 255
Hints to Exporters to Siam 255
Chicago Electrical Association 255
Development of the Telephone Field 256, 257
Ohio Telephone Notes 256
Indiana Telephone Items 256
Telephone News from the Northwest 256
Southern Telephone Developments 256
Kentucky Independent Telephone Association 256
A Telephone System Needed in the Madeiras 256
Independent Telephony in Colorado 256
General Telephone News 257
Telephone Men 257
Manufacturers and Dealers 257
Signals for Urban and Interurban Railways. By G. W. Palmer, Jr. (American Street Railway Association) 257
The Christensen Engineering Company Enters the Electrical Field. Illustrated 262, 263, 264
John I. Sabin's House Burns Down by a Remarkable Accident 264
Use of Juniper for Poles 264

DEPARTMENTS.

Correspondence 264, 265, 266
New York Notes 264
Southern Developments 264
New England News 264, 265
From the Buckeye State 265
Information from Indiana 265
On the Pacific Slope 265, 266
Personal 266
Electric Lighting 266
Electric Railways 266
Publications 266
Trade News 266
Business 266
Illustrated Electrical Patent Record 267, 268

CONVENTIONS AND EXPOSITIONS.

Indiana Mutual Telephone Association, Indianapolis, Ind., October 14th.
Ohio Electric Light Association, Columbus, Ohio, October 14th, 15th and 16th.
Kentucky Independent Telephone Association, Louisville, Ky., October 28th and 29th.

By the error of substituting a "£" for a "$" sign, the Electrical Review of London says that "the exports of electrical machinery from the United States of America for the 12 months ending June, 1902, were valued at £5,379,746, as compared with £5,812,715 for the same period the previous year." We wish that our contemporary was correct, but, unfortunately, the respective amounts should be stated in dollars, not pounds. In a few years, perhaps, we may measure up to the standard set for us by the English journal.

CONSIDERABLE public interest has been excited recently by the announcement that Charles S. Bradley with the cooperation of D. Ross Lovejoy has perfected a method for the production of nitrogen compounds from atmospheric nitrogen. The gentlemen are now working in the interests of the Atmospheric Products Company at Niagara Falls, and sufficient experimental work has been done to warrant the success of the enterprise. In another part of this issue of the Western Electrician is given an illustrated account of the inventors' work and of their apparatus, which will be of interest to the layman as well as the man of science. The possibilities before a successful industry of this kind are apparently vast. The world's supply of fixed nitrogen is largely in the form of Chili saltpetre and its supply is said to be limited to a few years. So in the production of nitric acid and other nitrogenous compounds, there seems to be ample room for the new atmospheric products.

PUBLIC OWNERSHIP is severely criticized in Great Britain, where it has had its greatest and freest development. The government telegraph service of the British Postoffice, for instance, affords a never-failing subject for the complaint and ridicule of press and public in the United Kingdom. But, even conceding that municipal ownership is desirable in the cities of the British Isles, it does not follow that it is wise to transplant the system to American municipalities under existing conditions. This is the opinion of a disinterested observer like Dr. Frank W. Gunsaulus, president of the Armour Institute, who has recently returned from a trip abroad. The municipal enterprises of Glasgow, for instance, are all right, says Dr. Gunsaulus, but he goes on: "You must not try to have municipal control here until you have municipal regeneration. You must not omit one of the phrases 'of the people, by the people, for the people' before you attempt anything of this kind." In other words, conditions in American cities must totally change before widespread municipalization can be permitted. This is the opinion of a majority of all thoughtful students of the problem, we think. To us it seems that there is a still deeper objection to the municipal-ownership idea. It is that it imposes on government what in self-reliant communities is best done by individuals or groups of individuals, thus sapping the independent spirit of self-help which is the dominant note of the American character and the foundation of American institutions.

THE latest novel invention announced from Germany, whence so many startling discoveries are reported from time to time in the daily press, is no less than a safety suit for electrical workmen in which, it is asserted, it is impossible to obtain a deadly shock of current. The suit, which has been invented by Professor Armetieff of Berlin, is made entirely of fine but thickly woven gauze, evidently of a metallic composition. It completely incloses the wearer, including his head, feet and hands, but its entire weight is only 3.3 pounds. That the gauze is a good conductor of electricity is shown by the fact that the resistance of the garment from hand to hand is but 0.017 ohm. while its capacity is said to range from 0.0002 to 0.00025 microfarad. No perceptible heating effect is noticed as a current of 200 amperes can be passed through it from hand to hand for a number of seconds without heating it in the least. This was demonstrated by the inventor who, dressed in the suit, allowed stronger currents than are commonly used to execute criminals to be sent through it. Other wonderful experiments are reported, such as the wearer drawing sparks from a 75,000-volt transformer and grasping the terminals of a 200-kilowatt generator with safety. The suit is said to be pliable in all the parts and capable of being worn by the electric artisan in any work he may be called upon to do in the neighborhood of dynamos and live wires. Certainly here is the long-needed safeguard for the amateur electrical worker. Its practicability for use by the lineman or the station electrician, however, is probably a thing of the distant future, as the suit is undoubtedly expensive and somewhat cumbersome to wear.

A REVIEW of the patents granted each week by the United States Patent Office brings to light at times many interesting facts. The number issued weekly varies from about 450 to 550, and of that number from 30 to 60 patents relate directly or indirectly to electrical apparatus. Taking the Official Gazette for last week as a typical issue, one finds the total number of patents to be 541. Of these, 59, or nearly 11 per cent., are of an electrical nature and cover a great variety of applications, many of the inventors being foremost in the ranks of electrical engineers. There are distribution systems invented by Steinmetz, Emmet, Lunt and Lamme, wireless-telegraphy outfits by Ehret and Shoemaker, telephone accessories by McBerty and Loveridge, controlling and circuit-breaking devices by Haskins, Leonard and Reed, an electric-railway appliance by Potter, lamp-exhausting apparatus by Doane, improvement in Nernst-lamp detail by Goddard, and manufacture of nitrogenous products by Bradley and Lovejoy. Besides these, there are letters patent which pertain to inventions of arc lamps, signal and telegraph systems, batteries, railway appliances, meters, elevators, steering gear, switches, insulators, electrolytic apparatus and various other contrivances by men only slightly less prominent in the scientific world. It is a significant fact that of the 59 patents, 13 are assigned to the two largest electrical manufacturing concerns in the country, perhaps a larger proportion than usual, but one that is frequently exceeded. Two men to whom the electrical age owes considerable appear in this issue of patents as non-electrical inventors. Thomas A. Edison is granted reissues on a kinetoscope and a kinetoscopic film, and to George Westinghouse is issued an original patent on a gas engine with special cooling-jacket arrangements. It is a well-known fact that the number of patents issued by the government is an indication of the prosperity of the country and its manufacturing industries, and it is thus seen that electrical manufactures are maintaining their already prominent position.

ANOTHER successful convention has been added to the already long list held by the American Street Railway Association. It was the twenty-first annual meeting and opened in Detroit on Wednesday of this week, closing just as this issue of the Western Electrician goes to press. In point of numbers attending and in the size of exhibits the convention, perhaps, did not equal former records made by the association, but these facts in no way detracted from the success of the meeting. There were approximately 2,500 delegates, visitors and supplymen in attendance, and the representation was good from all parts of the country. The exhibition, which is always such an important feature at American Street Railway Association meetings, was of an excellent quality, but in quantity it was of necessity limited to the capacity of the hall and the annex built in the street outside. The Detroit street-railway men and members of the local committees outdid themselves in providing entertainment and in arranging for every convenience and comfort for the city's guests.

In other portions of this issue will be found a full report of the convention proceedings, portrait and sketch of the new president, two of the papers read and a quantity of convention news and exhibit notes, illustrated by several views of the hall and individual exhibit booths. Of the two convention papers mentioned, the one by Edward H. Sniffin on "The Steam Turbine—Its Commercial Aspect" attracted the greatest attention. Mr. Sniffin handled his subject in an able and exhaustive manner and clearly set forth the many advantages of the steam turbine for central-station work. The vital points brought out in the discussion of this paper will be found in the report of Friday's proceedings. The other paper was on "Signals for Urban and Interurban Railways," and was presented by G. W. Palmer, Jr. It received careful attention, as it should, the subject being one of considerable importance from the electric-railway operator's as well as the public's standpoint.

Magnetic Wheel for Railways

An ingenious invention of a "magnetic wheel" is covered in a patent, No. 709,484, issued recently to John Otto Heinze, Jr., of Revere, Mass. Fig. 1 is a perspective view of the invention embodied in two railway wheels and rails with which they are in contact, the structure supported by the wheels and axle being omitted for the sake of clearness. Fig. 2 is an elevation of one of the wheels, two of its sector plates having been removed to show the yokes of two of its electromagnets and one electric coil mounted on one of the yokes. Fig. 3 is a cross-section on line (33) of Fig. 2, one coil having been removed.

The object of the invention is so to design a magnetic wheel that it will have the greatest magnetic efficiency by establishing therein the shortest magnetic current, the least magnetic leakage, and the greatest concentration of magnetism where the magnetic field is to be used, all of which may be accomplished with the least expenditure of electrical energy. Further, by its construction, the magnetic lag is reduced to a minimum, and the strength of the wheel and the facility with which the parts of the wheel may be assembled are greatly increased.

The inventor says: "A wheel embodying my invention may be made self-propelling, as will later appear. To accomplish these objects, I so design the wheel that it consists of two or more independent magnetic circuits or electromagnets, both poles of each and every electromagnet or magnetic circuit being at the periphery of the wheel.

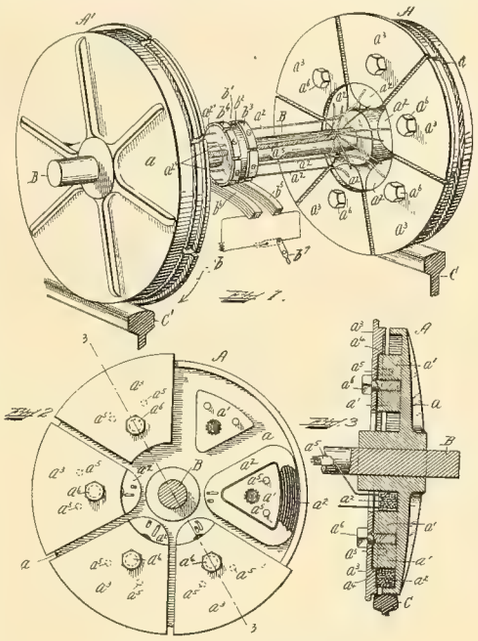
"In the drawings illustrating the principle of my invention and the best mode now known to me of applying that principle (A A′) are railway wheels fixed to an axle (B) in any well-known manner, as by shrinking, keying, or the like, and (C C′) are rails with which the wheels are in contact. The wheel (A) is of magnetic material, and is made up of a ribbed circular plate (a), from the inner face of which project two or more yokes (a′), (see Figs. 2 and 3), that are cast therewith. Copper wire (a^2), covered with suitable wrapping, is coiled about each yoke (a′), the terminals of the wire being connected with a commutator (b′), later to be described. A sector-like plate (a^3), concentric with the main plate (a) and having the same diameter as main plate (a), is mounted on each of the yokes (a′). The inner face of each plate is cut away to engage a shoulder (a^4), formed by the upper portion of yoke (a′). (See Fig. 3.) It has two holes that receive pins (a^5) in the yoke (a′), and is held in close contact with yoke (a′) by bolt (a^6) or any other suitable means. The sector plate, yoke and main plate by this construction virtually become one solid piece and a magnetic section, yet it permits any one or more of the coils (a^2) to be quickly assembled or removed whenever occasion may require. (See Figs. 2 and 3.) The sector plates (a^3) are magnetically insulated from each other, as by air spaces or by filling the spaces with any suitable non-magnetic material, the peripheries of the sector plates and the main plate forming the tread of the complete wheel. The wheel (A′) is similar to the construction of wheel (A), just described.

"The electric current required to magnetize each of the magnetic sections or electromagnets of each wheel can be supplied from any suitable source of electrical energy, as battery (b). Mounted on the axle (B) is the commutator (b′). It consists of a circular disk (b^2), of insulating material, and has fixed thereto a number of metallic segments (b^3) (b^4), each pair composing the terminals of an electric circuit, the electric circuit being composed of a wire which is wound into a coil (a^2) about one yoke (a) in each wheel (A A′). That portion of each wire leading from one coil in wheel (A) is wound into a cable (a^5) and carried through the commutator (b) to the other wheel (A′), where each wire, as (a^2), is separated from the cable (a^5) and passed about its respective yoke (a′) in the wheel (A′). These wires then return and are secured to the metallic pieces (b^4), as above described. (b^5) (b^6) are two commutator brushes, (b^5) being in contact with series (b^3), and (b^6) being in contact with series (b^4). To make and break the circuit between the battery (b), and the commutator (b′), a switch (b^7) is provided. Each pair of commutator pieces (b^3) (b^4) and the brushes (b^5) (b^6) are so located that when one of the electromagnets, as ($a^2 x$), of wheel (A′) is in the position shown in Fig. 5, the brush (b^6) is just about to be slipped off the commutator piece (b^4), connected with the coil of the electromagnet, the brush (b^5) and its commutator piece for wheel (A) being still in engagement. At least one of the electromagnets is thus always in a position to be magnetized and be in a magnetic field.

"The operation of my invention is as follows: The switch (b^7) is closed, as is shown in dotted lines, and the electric current, flowing, as indicated by the arrows, from its source of supply battery (b), passes through the brushes (b^5), commutator (b), the wire (a^2), around the yoke (a′), thereby powerfully magnetizing the pole sector plate (a^3) and the main plate (a) of wheel (A), which are in contact with the rail (C), through the cable (a^5) to the coil ($a^2 x$), and then through the end portion thereof to commutator piece (b^4), then through brush (b^6) to battery (b). These plates (a^3) (a) are of opposite polarity, and the magnetism immediately passes from the main plate (a) to the keeper or rail (C) to the sector plate (a^3), thus completing the magnetic circuit.

"From the above description of the construction and operation of my invention it will be plain that in the case of a wheel and its rail, for example, the magnetism flows from one pole plate of the wheel to the rail transversely to its length, and then to the other pole or plate of the wheel, and is highly concentrated at the point of contact between the wheel and its rail, and thus a short and massive magnetic circuit is established in the wheel and its rail, and a high efficiency of adhesion between the wheel and its rail results.

"The commutator and brushes are so disposed that after the center of the pole piece of each magnet has come into contact with its rail or keeper and has passed by it then the electric circuit is broken, and the magnet which is approaching the rail is immediately magnetized by the electric current passing around its yoke, and a magnetic field is established between its poles and the rail, the strength thereof increasing while the poles approach the rail. The resultant magnetic attraction is always ahead of the point of contact between the rail and the tread of the wheel until the magnetic attraction at the rear of the point of contact equals that ahead of it, but at this moment the electric circuit is broken by commutator, and the current passes around the yoke of the next magnet, and a



MAGNETIC WHEEL FOR RAILWAYS.

magnetic field is established between the poles and the rail, the strength thereof likewise increasing as the poles approach the rail until the magnetic attraction before and behind the point of contact is equal, at which time the current is cut off. The operation just described continues to be repeated with each succeeding magnetic section or electromagnet.

"It will now be plain that by my invention the poles of each electromagnet may be demagnetized at or before resultant magnetic current passes to the rear of the point of contact, that the magnetic lag is thus avoided, and that the magnetic attraction between the wheels and the rail necessarily tends to move the wheel along the track. Where the wheels are staggered, as in Fig. 1, it will be plain that the tendency to move the wheels along the track is constant."

The same inventor in another patent, No. 709,485, describes an improved induction coil, in which there are two separate magnetic cores, the whole being claimed to have an increased electrical or magnetic efficiency and a simplified construction.

Ohio Electric Light Association.

The eighth annual meeting of the Ohio Electric Light Association will be held at the Chittenden Hotel, Columbus, Ohio, on October 14th, 15th and 16th. A very interesting programme has been arranged, which will include discussions and papers on meters, by H. P. Davis of Pittsburg, Pa., F. O. Vaughn of Lynn, Mass., and F. J. Alderson of Great Barrington, Mass.; steam turbines, by E. E. Keller of Pittsburg; obtaining new business, by E. J. Bechtel of Toledo, George Huyler of Vanwert and L. G. White of Columbus; hot-water versus steam heating, by E. H. McKnight of Middletown, and E. F. Gwynn of Delaware; alternating series arc lighting, by H. W. Hillman and C. R. McKay of Lynn, Mass., Thomas Spencer of Philadelphia, and W. A. Layman of St. Louis, Mo. The entertainment features will include a theater party, electric automobile rides and a visit to Ohio State University.

Institute Proceedings.

The paper of B. G. Lamme of Pittsburg on "The Washington, Baltimore and Annapolis Single-phase Railway," read at the meeting of the American Institute of Electrical Engineers in New York, on September 26th, and printed in the Western Electrician last week, was discussed by C. P. Steinmetz, R. D. Mershon, W. E. Goldsborough, B. J. Arnold, W. S. Franklin, A. J. Rowland, C. O. Mailloux, W. C. Gotshall, H. A. Wagner and E. E. Ries. Mr. Arnold pointed out that the outlined Washington-Baltimore line was not the first single-phase road, as he had taken a contract to build such a road in December, 1899, and the construction and equipment of the road were now well advanced. Mr. Arnold also announced his intention of describing his single-phase railway in a future paper, to be read before the Institute.

At the meeting of the board of directors in the afternoon the following-named associates were elected: J. A. Roberts, New York city; James Adams Baylis, Montreal, P. Q.; David W. Beldon, Phœnix, Ariz.; Adelbert O. Benecke, Newark, N. J.; Herbert Arthur Burson, Montreal, P. Q.; Henry Manning Cogan, Brooklyn, N. Y.; Edward Paul Dillon, Telluride, Colo.; John H. Finney, New York city; Henry Paul Freund, New York city; Harry Parker Gibbs, Champion Reef, Kolan Gold Field, South India; Francis M. Hartmann, New York city; Austin Smith Hatch, Detroit, Mich.; Joseph Mansfield Hill, Orange, N. J.; Cecil Hodgson, Chicago; Carl Hiram Holley, Visalia, Cal.; Harry Pratt Hudson, New London, Conn.; Madone C. Hunter, Columbus, Ohio; Albert Henry Winter Joiner, Boston; R. O. King, Toronto, Ont.; Hugh Leslie, Philadelphia, Pa.; William Clardy Lusk, Schenectady, N. Y.; Henry Knox McIntyre, New York city; Frederic William Myers, Pittsburg, Pa.; Granville Frederick Packard, Binghamton, N. Y.; Hippolyte Parodi, Paris, France; John Pearson, Somerset, Wis.; Carroll Potter, Philadelphia, Pa.; Louis Maxwell Potts, Baltimore, Md.; John Knowlton Robinson, Iquique, Chili; Herbert Raymond Rowland, Steelton, Pa.; Hermann Georg Spengel, Johannesburg, S. A.; Edward George Steinmetz, Philadelphia, Pa.; Horace Burt Tuttle, Cleveland, Ohio; Carl Hans Vom Baur, New York city; Leonard Wilson, Pittsfield, Mass.; Cornelius Wendell Woodward, Philadelphia, Pa.; John Mason Young, Ithaca, N. Y.

The following-named associates were transferred to membership: Thomas E. Murray, second vice-president and general manager, New York Edison Company, New York city; W. S. Franklin, professor of physics and electrical engineering, Lehigh University, South Bethlehem, Pa.; Bernhard A. Behrend, in charge alternating department, Bullock Electric Manufacturing Company, Norwood, Ohio; D. L. Huntington, general manager and chief engineer, Washington Power Company, Spokane, Wash.

Hints to Exporters to Siam.

A German trade journal gives some valuable hints to exporters to Siam, and says, among other things, that illustrated and handsomely gotten-up catalogues and price-lists have only an ornamental value for the Oriental. The latter wishes to convince himself personally of the quality of the goods he buys, and exporters who take this into consideration can expect to do a large and profitable business with Siam, while those who rely on price-lists or traveling salesmen with samples can do business only with great difficulty. As regards the packing of goods, the report says that articles must never be put up in paper. Pharmaceutical and chemical products must be packed in glass or tin and then bedded in sawdust. For other goods, wood shavings are preferable, because sawdust is apt to escape through holes of the enclosing material. Special care must be devoted to the packing of breakable articles. Textile goods should always be baled and covered with water-tight material, and the bales be bound by iron bands. Articles which rust easily, such as bicycles, should always be packed in wooden cases, lined with zinc, and well soldered.

Chicago Electrical Association.

The first fall meeting of the Chicago Electrical Association was held in its rooms on the evening of October 3d. President P. B. Woodworth presided and there was a large attendance. The address of the evening was made by Edward W. Jewell, president of the Jewell Electrical Instrument Company, who talked on "The History of Electrical Measuring Instruments and Some Novel Uses of the Same." Mr. Jewell took up the early development and history of electrical instruments and spoke particularly of the Deprez-D'Arsonval galvanometer. He then mentioned several "freak" or unusual uses of electrical measuring instruments, such as in locating metals and underground streams of water, in signaling, on board ship, etc. The lecture was well illustrated by stereopticon slides and proved to be entertaining and instructive to all present.

DEVELOPMENT OF THE TELEPHONE FIELD.

Ohio Telephone Notes.

United States Telephone Company affairs take on various phases of interest from time to time. It seems that the Barber-Braley matter has not yet progressed far enough to be said to have a bearing upon the situation, and it is hinted now that the Everett-Moore affairs are in such a shape that the syndicate may take several large blocks of the stock. In that event it is rather hard to tell what may be done. This company owns one of the best telephone properties in the country, and there is little doubt that the members of the syndicate are loath to part with it. With the Cuyahoga telephone and one or two other good plants and the lines of the United States company, the syndicate would yet control the cream of the telephone property in Ohio. These properties are in good shape, generally speaking, and with the expenditure of a few thousand dollars most of them would be on a good paying basis.

R. E. Kingery has secured a franchise in the village of Grover Hill to maintain and operate a telephone exchange.

The Marion County Telephone Company has increased its capital stock from $100,000 to $250,000 and will build exchanges at Larue, Caledonia, Prospect, Green Camp and some other small towns.

The Cuyahoga Telephone Company has inaugurated a fire drill under the charge of Traffic Manager Benjamin Johnson. This includes a descent down the fire escape from an eighth-story window, and all the girls, about 160 in number, are required to take part. October 3d was the first time the ladder drill was taken, but the morning shift, 98 girls, formed in line, made the descent from the eighth to the seventh story, and were back in their places in six minutes.

The Ashtabula Telephone Company, Ashtabula, has promised to have its new plant in use by the latter part of November.

The directors of the Madison Telephone Company of Warren have elected the following-named officers: President, Charles W. DeVoe, Orwell; vice-president, Dr. H. M. Fenton, Cleveland; secretary, R. N. Williams, Orangeville; treasurer, E. U. Hyde, Warren. The company will build plants at Geneva, Perry and Madison.

L. E. Steyne of Lewisville has been chosen secretary and general manager of the Woodsville Telephone Company, Woodsville. It is stated that the system at that place is to be greatly improved.

The capital stock of the Cincinnati Telephone Company will be increased $173,350, and 3,465 shares from the treasury reserve will be sold to secure funds to make extensions and improvements. The stock will be sold at par to the old stockholders, at the rate of one share of new stock to 20 shares of the old stock.

The Bainbridge Telephone Company, Bainbridge, is planning the construction of a line from that place through the country to the east and south part of Aurora township.

The switchboard in the office of the Portsmouth Telephone Company, Portsmouth, was damaged by fire, caused by crossed wires, a few days ago. The damage will amount to $600, but the plant was in operation 24 hours after the fire.

At a meeting of the directors of the Hamilton Telephone Company, Hamilton, held a few days ago, all the matters pertaining to the new plant were discussed. The work on the new plant is progressing nicely. The switchboard has arrived and will be put in place as soon as possible. O. M. C.

Indiana Telephone Items.

The Lebanon Telephone Company has increased its capital stock from $5,000 to $30,000.

The Carroll Telephone Company, with headquarters in Delphi, has arranged for the reconstruction of its entire plant, the improvements to cost $15,000.

The difficulty between the labor unions of Petersburg and the Cumberland Telephone Company has been adjusted, the company agreeing to give employment to only home union men.

The South Bend Home Telephone Company, largely owned and controlled by Ft. Wayne capitalists, has given a mortgage for $400,000 on its new plant in South Bend. The managers say the lines will be extended in many directions.

County telephone organizations are being formed in the state. Last week the managers of the Mutual Telephone Companies of Shelby County effected an organization by electing Mr. R. Theobald, of Morristown, president; C. E. Pile of Marietta, vice-president, and D. B. Wilson of Shelbyville, secretary. The purpose of this organization is to give better service to the patrons by providing new devices and improvements, and in order to assist in providing funds for such purpose a fee of five cents will hereafter be charged to everyone using any telephone belonging to these companies who are not subscribers. Another meeting of this organization will be held at Shelbyville on October 18th, after the annual meeting of the Mutual Association at Indianapolis.

The new branch exchange of the New Telephone Company of Indianapolis, at Talbot Avenue and Twenty-second Street, will begin its service to-day. There will be 1,200 patrons served through the branch exchange, and there is capacity to increase it to 3,000. The service will be for all patrons north of Sixteenth Street. The exchange is located in a new three-story brick building and is thoroughly equipped with all the modern improvements. Harry Goldrieck will be in charge, with one assistant, two chief operators and twelve operators. F.

Telephone News from the Northwest.

A local telephone company is projected for Tintah, Minn.

The Richfield, Menomonee Falls and Holy Hill Telephone Company has been formed at Richfield, Wis., to build toll lines to Menomonee Falls and to Holy Hill. Work will be rushed at once.

E. H. Moulton of the Twin City Telephone Company of Minneapolis and St. Paul has made application at Fargo, N. D., for a franchise for a local exchange there. He states a long-distance line will be built to the Twin Cities.

A local exchange is to be installed for Valley Springs, S. D.

The Morton Telephone Exchange Company has been granted a franchise for a local exchange at Morton, Minn.

McD. Williams of Kasson, Minn., has bought the telephone exchange at Claremont, Minn., and will put it in first-class condition.

F. L. Bills of Chicago is securing subscribers at Sioux Falls, S. D., for the installation of a competing telephone system there.

The Emmons Telephone Exchange Company has bought the local line at Emmons, Minn., from H. M. Martinson.

The Elbow Lake (Minn.) Telephone Company has been incorporated with $50,000 capital stock.

The Howard Lake Telephone Company of Howard Lake, Minn., has been incorporated with $50,000 capital stock.

The Eddyville (Iowa) Telephone Company has been incorporated with a capital stock of $15,000. The company will enlarge its field and extend its lines in all directions.

The local telephone company at Clarion, Iowa, will build a rural line to Holmes, Iowa.

The Tipton Telephone Company has sold its exchange at Tipton, Iowa, to the Davenport and Tipton Independent Company.

The O'Brien County Telephone Company has been incorporated at Moneta, Iowa, with a capital stock of $10,000.

The Coon Rapids (Iowa) Telephone and Electrical Company has closed a deal with the Dixon Telephone Company and the Harris-Jewell Company, for their franchises at Coon Rapids and the electric-light plant. This brings to an end the war which has been waged for some time.

A local exchange is to be established at Anthon, Iowa, soon.

The Cedar Valley Telephone Company contemplates establishing a news-bureau department in connection with its rural and toll lines. An information bureau will also be established. R.

Southern Telephone Developments.

A charter has been granted incorporating the Petersburg Telephone Company of Petersburg, Va. The capital stock will be between $50,000 and $100,000. William B. McIllwaine is president of the company, which proposes to operate a telephone system in Petersburg, combining old systems.

The Southwestern Telephone and Telegraph Company of Helena, Ark., contemplates making many improvements in the city and surrounding territory. About $10,000 will be spent in improving the Helena plant. A number of long-distance toll lines are contemplated for Northern Arkansas. T. L. Powell of Little Rock is state superintendent.

The Postal Telegraph-cable Company has under construction lines from Washington, D. C., to Atlanta, Ga., and also a line from Charlotte, N. C., to Jacksonville, Fla.

According to the latest statistics of the corporation commission of the state of Mississippi, it is shown that the telephone lines are assessed at $373,920. There are 27 small companies in the state, some of which have not filed their reports.

At a meeting of the stockholders of the Tidewater Telephone Company, held at Gloucester Courthouse, Va., A. W. Withers was elected president of the board of directors. Some additional extensions will be made, notably to Gwynn's Island.

At Centralia, Mo., a telephone was recently placed near the pulpit in a church where a great revival was in progress, and persons living in several neighboring counties were enabled to hear the service at their homes.

The state of North Carolina has chartered the Washington and Aurora Telephone Company with a capital stock of $25,000. The company has the privilege of building extensive branch lines.

The application of the Cumberland Telephone Company for a franchise at Natchez, Miss., is still hanging fire, pending action of the city authorities.

The Green County Telephone Company of Virginia has nearly completed its lines from Standardsville to Bourbonville. L.

Kentucky Independent Telephone Association.

The fourth annual meeting of the Kentucky Independent Telephone Association will be held in Louisville, Ky., on October 28th and 29th. Many questions of importance bearing upon the telephone situation will be brought up for discussion and action. A comprehensive programme is being arranged for business as well as for the entertainment of members and delegates attending. Each company represented in the association has been requested to bring or send a full report of its system, giving number of exchanges owned, number of telephones, miles of toll line, whether grounded or metallic, and between what points lines run, and also a sketch, showing lines and station and new lines under construction or contemplated. The following-named gentlemen are officers of the association: President, R. V. Bishop, Cynthiana; vice-president, H. K. Cole, Owensboro; secretary and treasurer, James Maret, Mount Vernon; attorney, D. L. Pendleton Winchester; executive committee, A. H. Bastin of Lancaster, D. Prewitt of Pine Grove, J. A. Armstrong of Louisville, R. V. Bishop of Cynthiana and James Maret of Mount Vernon.

Municipal Telephone Control in England.

A. D. Provand of London, England, an expert in telephone matters, who is visiting Ottawa, Ont., is greatly impressed with the future possibilities of the telephone and the importance of guarding the interests of the public. Speaking recently in regard to the comparative advantages of state, municipal and private control, he said: "I think there can be hardly any room for doubt on this point, after the experiences on the continent of Europe and in the United Kingdom. State and municipal control is general on the continent, and, ultimately, there will be no other. The action of the British government in regard to telephones, has been little better than a series of blunders; but we are now, I believe, on the way to have an adequate national development of the service. The inter-town wires are owned and operated by the government, and the local exchanges will, in time, pass into the hands of the muncipalities. There is no doubt that, provided they act wisely, the state and the municipalities can give a better service than any company, when all things are taken into consideration."

A Telephone System Needed in the Madeiras.

Consul T. C. Jones of the Madeira Islands, writing from Funchal, has the following to say regarding the telephone and telegraph in that city: "The last census gives Funchal a population of 50,000 people. The city is spread over a large area, stretching up and down hill, and yet it has no public telephone. The postal service is not of the best. The common communication is by note and messenger. Several of the leading business houses have private telephones. The different villages of this island have telegraph and postal communications with this city. A wire connects with the lighthouse at Point St. Lourenzo, 20 miles away, and gives news of approaching steamers from the north, about three hours before their arrival. The local telegraph charges are six cents for the first word, and one cent for each additional word. The postal service is tri-weekly, and the mails are carried on foot. It seems to me that here is an opening for an enterprising American. An English company got the concession for the electric-light plant, and I understand it pays well."

Independent Telephony in Colorado.

The Harrison Construction Company of Cincinnati, Ohio, will likely gain a foothold in Colorado, if present plans work out right. F. M. Mariott of Delaware, Ohio, attorney for and vice-president of the company, has just returned from Pueblo, Colo., where he organized a company with a capital stock of $300,000 to build a city plant. The company is now seeking a franchise, with good prospects of securing it, and in that event work will be begun on the plant at once. Mr. Mariott also has good prospects at Colorado Springs, and, it is stated, a line will be built into Salt Lake City. The Harrison Construction Company has completed a plant at Texarkana, Ark., and has also built several others at different points in the country. In the event that a foothold is gained in Colorado, the forces will be organized to compete with the company that now controls the whole situation. According to Mr. Mariott, telephones are used to take the place of the telegraph in places far remote from railroads in that state, and there are many of them. Hence it will be a good field for operations.

GENERAL TELEPHONE NEWS.

The Interlake Telephone Company has been incorporated with a capital of $100,000 to operate a telephone system in counties in Western New York. The directors are G. S. Fuller, Albrecht Vogt and J. G. Rochester.

According to reports from Philadelphia the backers of the Keystone Telephone Company assert that they have $25,000,000 capital to carry the business into New York city to compete with the Bell company and finally to extend it to Boston.

The Illinois Telephone and Telegraph Company has just finished two tunnels under the Chicago River, one at Harrison Street and one at Wells Street. These two tunnels, communicating with the company's network of tunnels under the business portion of the city, give connection with the Union and Northwestern railroad depots. These tunnels are six by 7½ feet in size and similar to those under the downtown streets. They are so far below the river bed that, even in case of an increase in the depth of the river, they will in no way interfere with navigation. The tunnels may be used for the installation of a pneumatic-tube mail service. The question is now pending in the council.

Judge Tuley of Chicago has granted leave to 337 members of the Illinois Manufacturers' Association to amend their bill for an injunction against the Chicago Telephone Company so as to enable them to secure a return of the amounts in excess of the franchise rate of $125 a year that they have heretofore paid to the company for telephone rentals. The excess amounts paid in different cases vary, it is said, from $50 to $800, and the total approximates $100,000. The original bill filed in the case prayed for an injunction to prevent the Chicago Telephone Company from charging $175 a year for business telephones on the ground that the ordinance which was procured in 1887 limited the charge to $125. In granting the injunction, Judge Tuley held that it was the duty of the telephone company to supply its most improved service at ordinance rates of $125 a year.

TELEPHONE MEN.

J. H. Eschman, traffic manager of the Northwestern Telephone Exchange Company, located at Minneapolis, has resigned his position and will take an extended vacation. Mr. Eschman has been connected with the Northwestern company for the last 19 years.

Francis M. Buck, second vice-president of the Twin City Telephone Company of Minneapolis and St. Paul, has severed his connection with that company and returned to Chicago. Mr. Buck left the Chicago Telephone Company July 1, 1901, to go with the Twin City Telephone Company, and has done much in the work of developing and elaborating the system, especially in St. Paul, where he has been located. During his incumbency the company has increased the daily calls from an average of 1,838 to 27,000. Mr. Buck retains his holdings in the Twin City Telephone Company.

William E. Harkness of St. Louis, for 10 years connected with the Bell Telephone Company of Missouri, has resigned as traffic manager, having accepted the general superintendency of construction, operating and maintenance of the Consolidated Telephone Company of Buffalo, N. Y. This company is managed by the Frontier Telephone Company, also of Buffalo, of which Willbur Johnson, formerly superintendent of construction of the Missouri Bell Telephone Company, is general superintendent. Mr. Harkness' new work comprehends the incorporation of various Independent companies of New York and Pennsylvania, under the direct supervision and control of the parent company at Buffalo, so as to interconnect them with the other Independent concerns in Ohio, Indiana and Illinois.

MANUFACTURERS AND DEALERS.

The Atwater Kent Manufacturing Works, which manufacture the Monoplex telephone, have lately moved to 112 North Sixth Street, Philadelphia, where they have doubled their floor space. They state that sales of the Monoplex telephones are increasing very rapidly. They are sending out to the trade a handsome head of the Gibson type printed on white behind a dark card which frames the head, making a very attractive picture for an office.

Two complete public-service telephone-exchange systems have recently been shipped to the cities of Port Arthur and Fort Williams, Ont., by the International Telephone Manufacturing Company of Chicago. The shipment comprised several carloads of apparatus, consisting of two 1,000-line capacity lamp-signal, central-energy switchboards, arranged for multiple-board service, together with all necessary central-office apparatus and subscribers' telephones, including two sets of Chloride storage batteries, two Roth charging machines and ringing generators, with General Electric motors. This shipment is said to be one of the first of its kind by Independent telephone manufacturers, and with the high class of the apparatus furnished it may be a large factor in turning the rapidly growing trade of Canada to this country.

Signals for Urban and Interurban Railways.[1]

By G. W. Palmer, Jr.

The many recent disastrous collisions on street railways must have convinced operators and managers that the use of an efficient and reliable signal system would add to the safety and facility of the handling of their traffic. As faster schedules and heavier cars come into use, there is imperative need of a system of operation which will guarantee freedom from accidents caused by cars meeting head on, or by one car overtaking another.

There is only one way to prevent these accidents—namely, to adopt such rules and methods of operation as will insure that but a single car will occupy any block or section of track at any one time. Any signal system which will aid in accomplishing this result is worthy of consideration.

We believe that the steam roads in their early days were confronted with precisely the same problem in relation to signals as the electric roads are now contending with. The steam signals are now probably as near perfect as human skill and ingenuity can make them. They did not, however, spring into existence in their present perfected condition, which has been reached only after years of work and effort to eliminate the defects shown up in practical work.

Electric roads should not, therefore, say "show us a perfect system, and we will adopt it." It is decidedly our interest to encourage the efforts of those who are endeavoring to work out something which will be accurate and reliable and to contribute whatever we can to this end.

It is obvious, however, that even a perfect signal system cannot, after its adoption and installation, operate a road. Careful management, and good discipline on the part of the men are still vitally necessary. We believe that no man should be given a second opportunity to disregard a signal set against him or to break any rule which it has been found necessary to make to insure safe operation. The employment of such a man involves a risk which should not be disregarded.

When electricity was adopted as a motive power on street railways, and especially when lines were built between cities, in some cases paralleling steam roads, and invading a field hitherto occupied solely by the latter, many saw that methods which prevailed during horse-car operation would not do under condition of higher speed, heavier cars and greater volume of traffic.

The need of something which would show that a car was approaching from the opposite direction, or was a short distance ahead going in the same direction, was quickly perceived and the problem attacked by a number, on various lines, but all having a common end in view. Several systems of block signals were put upon the market, and have since their early adoption and use undergone a process of development to get rid of the faults which became apparent by their continued use.

We believe that all single-track suburban and interurban roads should adopt the best obtainable block system, together with a telephone system, which will enable a dispatcher to reach any car crew at regularly established stations.

A signal, to be reliable and efficient, should be quick and positive in action; it should be impossible to set the cautionary or permissive signal at near end of the block before setting the danger indication at the far end; incandescent lamps should not form a part of the main signal circuit, nor should the lighting and extinguishing of lamps be the only visual indication of the signal. This should be supplemented by the movement of an arm or semaphore blade, which will move each time the signal is operated, whether the lamps burn or not. The device will then be operative if the lamps burn out, as sometimes will happen. Manual control affords unauthorized persons a chance to interfere with the signal, and should not be used; the setting and clearing circuits should be closed automatically, and when the signal has been set at danger it should lock so that it cannot be cleared until all cars have passed out of the block. It should be possible to set the signal only one way by two cars entering a block from both ends at the same time.

Special attention should be given to freedom from damage by lightning. As the pressure is liable to fall considerably at the ends of long lines, and also on parts of the system when heavy local loads are carried, the signal should be able to operate through a wide range of voltage, and should not be liable to damage through crossing of the signal circuit with the lines.

There are several differing systems now in use on various roads; one, using simply a circuit of lamps operated by a two-way hand switch at either end of the block, part of the lamps being lit as a permissive signal at the near end, while the balance indicates danger to an approaching car at the far end; this system is peculiarly susceptible to trouble from lightning, and also fails when any lamp burns out. As commonly used, the switch and lamps are in the same box, and generally the car is run into a position where the conductor can easily reach the switch. In most cases the motorman then cannot see the lamps, and depends on the bell signal from the conductor.

The proper method would be for the car to be stopped at a point far enough to the rear of the box for the motorman and passengers to observe the character of the signal, the conductor going ahead and throwing the switch; where the blocks are many, this will cause an annoying delay, which could be avoided by having the switch separate from the signal box, at a point about 100 feet to the rear of it, and at such a height that the switch cannot be reached from the ground. When permission to proceed has been obtained, the motorman should not enter the block until the conductor has struck two bells, thus making the men jointly responsible.

An improved method of operating the signal is by means of a circuit-closer hung overhead and at a point sufficiently in the rear of the box, the circuit being closed by the passage of the trolley wheel; there are devices of this kind now obtainable which are reliable and effective in action.

A better system is one which uses a setting and clearing circuit separate from the lamp or semaphore circuit; most of these, however, can be cleared by the passage of any one car out of the block, and in case of running several cars together, all trolleys but the one on the rear car must be pulled down when passing the switch, or if the leading car clears the block, the car proceeding in the other direction must be notified of the number of cars following; this is an element of danger, as it should be absolutely impossible to clear a block while any car remains.

Some device should be used which will record the number of cars entering the block from either end, and hold the setting circuit closed until all cars have passed off the block. It should also be possible to clear the danger signal from both ends of the block, as it is often necessary for a car to leave a block from the same end at which it entered.

There are certain single-track blocks on the Old Colony Street Railway Company's (Boston) system which are operated by means of what is locally known as the "red stick." This is a small club or billet of wood painted red, which controls the block to which it belongs, and no car is allowed to enter the block without it carries the "red stick," it being replaced by a red lantern at night. This is a safe, but not very flexible, system, the absence of the stick showing one that there is a car on the block, but not the direction in which it is going. Nor does it show when the block is cleared from the other end. In case of delay or blockade of cars going in the opposite direction, the stick could not be carried back and all cars going in the same direction as the one which first entered the block would be held up. It does prevent effectually the "bunching" of cars at one end of the line.

Double-track roads are also feeling the need of some system which will prevent rear-end collisions. Where cars are operated on quick headway and a direct view of the track ahead cannot be had, there is always danger of a car overtaking the preceding one. This is particularly the case at night, and all cars operated on suburban lines should carry a rear-end red lantern. This simple precaution is so obvious that it would seem as though it must have been adopted by every one. Such, however, is not the case.

There has been some work done along the line of cutting off the trolley current from a car which has not the right-of-way, thereby making it impossible for the car to proceed. This scheme seems to us to be a very attractive one, and it is possible that it may be effectively developed.

Too much stress cannot be laid on the necessity of giving careful attention to the proper erection and maintenance of the signal lines and devices. In regard to the lines, their maintenance is more difficult with us than with the steam roads. We are forced to carry many of our wires in streets lined with thick and heavy trees, through which it seems almost impossible to obtain good and reliable construction. In all cases special attention should be paid to keeping the wires clear from the limbs, and a tough and impervious insulation should be used.

Regular and careful inspections of all parts of the system should be made, and everything done which may be necessary to keep it at all times in the best of condition. No devices should be left without care until they fail to work, which they may do at a time when there is the greatest need of their reliable action. Efficient maintenance may be expensive, but one accident which might have been prevented may result in a loss far greater than the combined cost and maintenance of a good signal system.

1. Paper read before the American Street Railway Association at Detroit, Mich., on October 10, 1902.

The Paris Metropolitan Underground Railway Company, on October 5th, opened the first extension of its line along the outer boulevard. The new road extends from Etoile to the Place Blanche. This brings a very important new current of traffic from the northwest to the east, and may double the company's receipts. The main road has been running more than two years, but has never paid a dividend, though the shares are steady at nearly double their par value. Though only a short line from the Porte Maillot to Vincennes, it has killed one large omnibus line, and in seven months has carried over 32,000,000 passengers.

AMERICAN STREET RAILWAY ASSOCIATION.

[*Continued from page 247.*]

right to understand that what they are to pay and to do in making their franchise effectual is nothing more than or different from the conditions of which they had notice and to which they agreed. The rule that there can be no impairment of the obligations of a contract is to be found in the fundamental law of the United States and of every state, and in controversies between individuals no constitutional guarantee is more carefully protected by the courts. And in a contract between the state and a corporation there is no trouble about holding the corporation. If it violates its contracts, or if it does not give the promised service, or duly make the promised payments, the attorney-general is authorized to institute proceedings for its dissolution. But the rule of performance does not work both ways. It appears to bind only the corporation. The state can pass new laws imposing new conditions, and the corporation will have its pains for its protest.

It will not be denied that, inasmuch as our opportunity to earn money proceeds out of a public privilege, we should pay to the public a fair return for what we get. But what we give in the way of service and what it costs us to give it are elements just as much entitled to consideration in the making of the contract as any other; and when the contract is once made it ought to be as little subject to repudiation or change as any other contract. The faithful discharge of our obligations requires a continually increasing investment, the constant incurring of new risks. It is not enough that we shall meet the demand as it exists from day to day; it is necessary that we should anticipate it. And if the profits upon our investment prove in the end to be considerable, that is the reward to which intelligent foresight, courage and good management are always entitled. The spirit that seeks to confiscate anybody's legitimate earnings is unfair and reprehensible, and honest-minded men should be strong to oppose it.

This association has served an honorable and useful purpose for 21 years, but the time may be at hand when the scope of its usefulness can be materially increased. I have already pointed out the injustice which is done corporations by municipalities and the need for public enlightenment, not only on the equity of their cause, but also on the service which they are rendering the public. There is one other point to which, however, I would like to direct your attention, and that is in connection with the broader field of electric railroading which this country will certainly see during the next decade.

I have already referred to the immense mileage of interurban electric railways which has been built during the last few years especially in the Middle West. Many of these roads are hauling freight, and it is a matter of great importance, not only to these roads themselves, but to the cities and towns which they serve, that the facilities which they should enjoy as regards the interchange of freight with the steam railroads should be as free as those between the steam railroads themselves. The first point requisite to this end is to have convenient connections with the neighboring steam railroads, so that the freight cars can be passed from one to the other. The right of the electric company to demand this has only recently been decided in New York state in a case which was contested between the Hudson Valley Railway Company and the Boston and Maine Railroad Company, in which the Court of Appeals reversed the decision of the Appellate Division and rightly decided that an intersection and connection of the electric road and the steam road should be made in the interests of the local shippers. This right should be of great advantage to the electric railroad company, but the full benefit to the local shippers will not be derived until the full privileges of an interchange of freight cars between the two systems shall be as universally recognized as they now are between steam railroads, so that freight can originate on either the steam or electric road. Heretofore, in many cases, the steam-railroad companies have shown an unwillingness to interchange freight with the competing electric roads, on the plea that the latter were not responsible in the same degree as the steam railroads, and by this means considerable freight transportation has been diverted from the electric railroad.

The points just mentioned indicate the broader problems which are being forced upon the electric-railway interests of the country, through the large increase in interurban electric-railway companies, which naturally look to this association as the exponent of their interests. This is only natural, because while these lines do not operate upon the streets, the electrical-equipment problems connected therewith, as well as many of the other questions which arise in connection with their operation are the same as those which interest "street-railway" managers proper. And while it may appear inadvisable to change the name of the American Street Railway Association to accord with the broader field of electric railroading in which many of its members are engaged, it should be understood that the association is not merely a street-railway organization, but its scope covers the entire field of electric-railway transportation. More than this, it may seem desirable to welcome the participation of all companies engaged in electric-railway transportation, for the reason that there is no organization in the country which has accomplished so much, or at its annual conventions and exhibitions

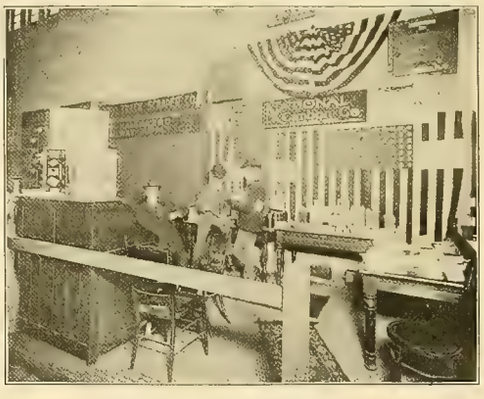
I look forward to the day when the shareholders in street-railway corporations will stand up for their rights as shareholders in the same sturdy spirit which they would at once bring to the defense of their rights as individuals. The great street-railway properties of this country, and even the little ones, are no longer in the hands of a few rich men. They are distributed in hundreds of thousands of shares ranging in par value from five dollars to a hundred dollars among a countless body of the people. The heads of these properties are no longer in any material degree their owners. They are, and are coming more and more to be, simply the salaried employes of a great number of shareholders. They conduct the business of these properties as a trust, and they have nothing to do with the stock market. Their one concern is to earn a dividend for their shareholders and pay it where it belongs. Every shareholder is as much interested to protect the property against unjust discriminations in the laws and to protect its reputation as a business organization as are any of us who are placed for the time being in charge of the property. It is no less their duty than it is ours to insist that public officials shall treat these corporations equitably and honestly.

Stanley Electric Manufacturing Company.

Standard Paint Company.

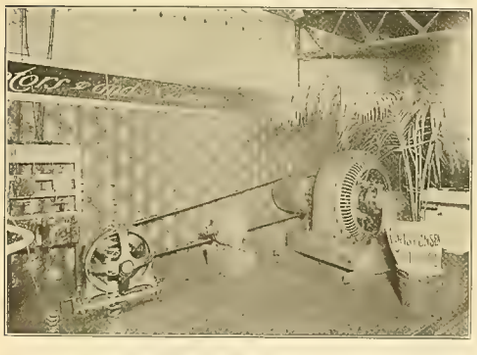
Electric Storage Battery Company.

Kellogg Switchboard and Supply Company.



National Carbon Company.

Crane Company.



Christensen Engineering Company.

Gould Storage Battery Company.

EXHIBITS AT THE DETROIT STREET-RAILWAY CONVENTION.

Chase-Shawmut Company.

can afford anywhere near the same opportunity for instruction to those interested in electric transportation in its different phases. Heretofore no manager or engineer of a trunk-line company which is contemplating or has installed a system of electric traction could join this association except as a representative of some street-railway company; but in view of the interest which is being taken in electric-railway equipment by some of the large trunk-line interests and the undeniable future which electric power will have for such transportation, especially for terminal and suburban work, the question will arise in the near future, if it has not already done so, whether the benefits which this association can confer are available for companies which are not now eligible to membership.

I will not attempt to suggest an answer to this question, but all signs indicate that it will be an

ELECTRIC SIGN ON DETROIT STREET-RAILWAY CONVENTION HALL.

important one during the next few years, if it is not so already.

Official Reports and General Business.

The address of the president was received with marked approval, and Mr. Vreeland received many compliments upon it. In moving a vote of thanks Colonel Heft referred to the paper as "able and courageous." The vote of thanks was unanimously passed.

Secretary T. C. Penington of Chicago read the report of the executive committee, giving the minutes of the several meetings held during the year. Perhaps the most important matter reported was the appointment by President Vreeland on November 29, 1901, of the following-named gentlemen to serve on the committee on standards: N. H. Heft, New Haven, Conn.; E. G. Connette, Syracuse, N. Y.; C. F. Holmes, Kansas City, Mo.; John I. Beggs, Milwaukee, Wis.; E. A. Newman, Portland, Maine; R. T. Laffin, Worcester, Mass.; Will Christy, Akron, Ohio. Other business reported by the executive committee was of a routine character.

The secretary and treasurer (Mr. Penington) reported the present membership of street-railway companies to be 191, including 12 in Massachusetts, 17 in New York, 18 in Illinois, 19 in Ohio, 22 in Pennsylvania, one each in Mexico and Porto Rico and five in Canada. The net gain in membership since last year is 11 companies. The association had cash in bank on October 1, 1902, amounting to $9,948.03.

President Vreeland then read letters of regret from Postmaster-general H. C. Payne of Washington, D. C., Robert McCullough, Chicago, and Charles S. Sergeant, Boston, all ex-presidents of the association.

E. C. Foster of Boston presented the report of the committee on memorials, in which minutes were made of the deaths of Walter V. Crouch, New Orleans, La.; Dell H. Goodrich, Omaha; J. Bannister Hall, Baltimore; C. C. Howell, Knoxville, Tenn., and W. S. Stratton, Colorado Springs.

Noting the presence of Mr. J. C. Hutchins in the hall, President Vreeland very gracefully referred to a recent illness which had prevented that gentleman, as the most prominent street-railway man in Detroit, from taking the part in the opening session which he otherwise would have done. Mr. Hutchins bowed his acknowledgments.

Registration of Transfers.

In the absence of the author, C. D. Meneely of Brooklyn, H. A. Robinson of New York read a short paper on "Registration of Transfers." A brief discussion followed. Oren Root of New York was opposed to the registration of transfers in a city like New York, where the proportion of short cash rides is so great. It might be all right to register transfers on interurban or suburban roads. Mr. Harrington of Camden, N. J., after experiment, was opposed to the registration of transfers. H. M. Sloan of Chicago said that if the transfer is registered at all it should be on a double-register system. E. G. Connette of Syracuse thought the advantages of registering transfers outweighed the disadvantages. John I. Beggs of Milwaukee believed in a double registry for cash fares and transfers. Such a system has a restraining effect on conductors, as the passengers take some interest in watching to see that the cash or transfer is indicated on the proper dial. Mr. Tarkington of Council Bluffs, Iowa, was thoroughly convinced that both cash fares and transfers should be registered. Colonel N. H. Heft of New Haven advocated a system of duplex transfers that he briefly described. This discussion ended the session.

Benefit Associations and Pensions.

Additional letters of regret were read from ex-Presidents Holmes of Kansas City and Roach of Chicago when the association reassembled on Wednesday afternoon.

Oren Root, Jr., of New York presented his paper on "Benefit Associations." He also spoke of the pension system of the Metropolitan Street Railway Company of New York. The employes who are retired under this pension system may be divided into two classes—first, all those employes who are 70 years of age and who have been 25 years in the service of the company; second, all those employes of the age of 65 to 69 inclusive who have been 25 years in the service of the company. All those employes who are 70 years of age are retired by the age limit itself. That is compulsory. And all those employes between 65 and 69 are retired at the discretion of the board of trustees of the pension fund, if they are found in the opinion of the trustees to be incapacitated for active work. The allowance paid to these retiring employes is divided into three classes. If pensioner has been in the company for 35 years or more, these retiring employes are paid at the rate of 40 per cent. of their annual average wage for the previous 10 years. If service has been for 30 years, the men are paid 30 per cent. of the annual average wage for the previous 10 years; and if the service has been 25 years, the men are paid 25 per cent. of their annual average wage for the previous 10 years. This fund from which each of these allowances are made is appropriated solely by the company, and the employes contribute in no way to it. The object in establishing this pension fund is to step in where the Mutual Benefit Association leaves off and to preserve the welfare of the aged and infirm employes and to recognize loyal and efficient service. "We, of course," said Mr. Root, "do not intend that all our employes—for instance, men who are engaged in the operation of the cars as motormen and conductors—shall continue in such positions until they are 65 years of age, at which period they are eligible to retire under the pension, but we do believe that, on the average, a conductor or motorman, for example, can properly operate his car up to, we will say, 55 years of age. And from that time to the time when he is 65, when he is eligible for a pension, we expect to take care of him in such positions as that of transfer agents, switchmen, flagmen, messengers, etc., which positions a man in that time of life can, we think, perform with satisfactory efficiency and without any hardship to the man himself. If a man has been earning an average of a thousand dollars a year and retires under the 40 per cent. clause of the pension system, he will receive $400 a year, or four per cent. on $10,000, which is one-half of one per cent. more than the savings banks pay in New York city. We do not wish our employes to consider, and we do not consider ourselves, that we are going to pay these men this amount in any spirit of charity, but we feel and we believe that they will feel, and do feel, that we are merely paying to them something which they have themselves earned through their years of service and their loyalty to the company."

E. G. Connette described the Mutual Benefit Association of the Syracuse Rapid Transit Company. This association is entirely controlled by the employes. Admission fee is $1 and monthly dues 50 cents. The association has meeting rooms fitted up with pool and card tables and supplied with reading matter. Officers of the company are members of the association, and the interchange of views is helpful. The association is a great success. It pays sick benefits and death claims.

In answer to a question, Mr. Root said that if a man severed his connection with the Metropolitan Street Railway Company he cut off his relationship with the benefit association also, getting no return for the money paid in. Mr. Vreeland explained that this was on the assumption of the insurance companies' principle that he paid for the protection he had while he was in.

John I. Beggs, Milwaukee: I would like to ask, as a matter of finance, whether the Metropolitan company has made an appropriation for its pension fund, revenue from which will meet these pension demands as they accrue, or whether it has made an annual charge against operation.

Mr. Root: The directors of the Metropolitan company have authorized the officials to expend as much as $50,000 in any one year to pay this pension allowance. There is a provision in the regulations which permits the trustees at any time when they consider a payment under this system excessive, to make a revision of the ratio of payments, so that they are not bound by anything they do to-day or a year from now.

Mr. Beggs: If, 25 years from now, an effort is made to reduce the amount that you have paid to employes before that time, will that not be a source of dissatisfaction and a feeling of injustice? It seems to me that it is important that before the pension movement goes too far it should be well considered. There should be rules standardized to govern the financial conditions.

Mr. Root: I do not consider that that condition of overrunning the allowance by the length of service is apt to arise, because I believe that if the employes get to that condition where the payments shall be greater than the amount that we have now appropriated, the benefits the company has received through their length of service will be proportionately greater, and the company can in that same proportion fairly pay the men at the same rate as now. When these things arise, 10 or 15 or 20 years from now, as they may, as Mr. Beggs suggests, we will have to work the problem out on those lines then.

St. Louis World's Fair.

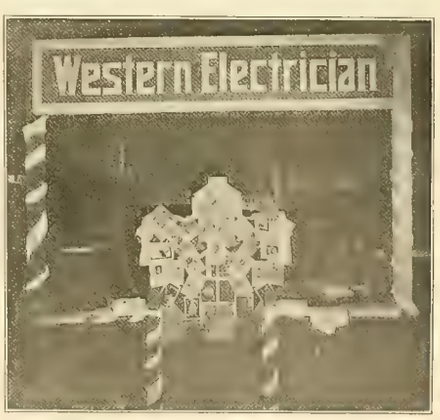
Albion E. Lang of Toledo offered a resolution extending to the transportation and electricity departments of the Louisiana Purchase Exposition assurances of the hearty interest of the American Street Railway Association in the work of presenting street-railway exhibits at the exposition. The resolution was adopted and Professor W. E. Goldsborough, director of the electrical department of the St. Louis Exposition, was given the privilege of the floor and addressed the convention. He invited the association to meet in St. Louis in 1904. The power plant of the exposition will have a capacity of 30,000 horsepower, he said. Among other things, Professor Goldsborough said: "We want to have a track some 1,300 feet in length, double and triple track, as conditions may permit us to make it, on which experiments can be made of all street-railway traffic systems. Whether these be pneumatic, steam, gas or electrical in power, they are all to be exploited. We want to organize the thing on very broad lines. I think you will all agree with me at that time there will probably be a large number of systems using alternating current, as well as the systems we now have using a direct current, and I cannot imagine a picture which will present a greater interest to you than that of seeing these various systems all exploited on the same ground and at the same time by the engineers of the various companies exhibiting there."

Electric Express and Package Delivery.

George W. Parker of Detroit presented a paper on this subject. There was some discussion. The author said that the express business benefited the passenger business. In relation to the electric express business in New York, Mr. Vreeland said that the express company had all the time at least 30 per cent. more business offered than it had facilities to care for. As to the profits or losses of the express company, the speaker could not say.

Miscellaneous Business.

In closing Wednesday afternoon's session President Vreeland urged upon the members the importance of attending the meetings with a serious purpose. He cited the case of the New York Railroad Club, with over 1,200 members, of which he is president, and said: "Suppose a superintendent of motive power is considering the question of compound locomotives, for example. He has had no



WESTERN ELECTRICIAN BOOTH AT DETROIT STREET-RAILWAY CONVENTION.

experience with them and has no data bearing on the subject, and is brought face to face with the problem of what he shall do in regard to the matter. It has probably been suggested to him by his general manager that he attend a meeting of the club and he gets up and asks if any member of the association will give him the benefit of his experience with compound engines. We have in our club such men as Mr. Waitt of the New York Central, Mr. McIntosh of the New Jersey Central, men from the New Haven road and the Erie road, who attend our meetings, who are always ready to give every member of the club the benefit of their experience; and the superintendent of motive power in question goes home the next day equipped to talk to his manager, and this information makes him a better man in the eyes of his management and shows what is going on. He not only gets the information in a general way, but gets actual data from these men. He probably would not have any other means of getting it so easily as at a meeting of the New York Railroad Club. The young men who are connected with the various street railways in the country cannot overestimate the value of this association to them in their work and bringing themselves into prominence. I have seen in the New York Railroad Club a number of men who have secured

prominent positions through a paper read on the floor of that club. The paper was read before the men who represented great railroad systems. Any young man who reads a paper at one of these meetings which shows intelligence and ability to analyze and good judgment, is bringing himself before every man who is connected with prominent street-railroad systems of the United States."

As the committee to nominate officers for the ensuing year the president appointed R. S. Goff, Fall River, Mass.; N. H. Heft, New Haven, Conn.; Richard McCulloch, Chicago; C. Goodrich, Minneapolis, and D. B. Dyer, Augusta, Ga. Adjournment until Friday morning was then taken.

EXHIBIT OF DEARBORN DRUG AND CHEMICAL WORKS AT DETROIT CONVENTION.

Thursday, Supply Men's Day.

Carrying out its liberal policy in relation to the manufacturers and dealers who make exhibits at the convention, no sessions of the convention were held on Thursday, which was denominated "Exhibitors' Day." The day was set aside for the examination of exhibits, which were, indeed, well worthy of inspection. Some idea of the display may be gained by the pictures and exhibit notes in this issue.

Friday, Closing Day.

[By telegraph to the Western E ect ician.]

The convention was slow in assembling on Friday morning. E. G. Connette of Syracuse, N. Y., was made chairman of the committee on standard rules for the government of car-service employes. Robert McCulloch of Chicago was added to the committee, which is to report next year.

Colonel Heft reported for the committee on standards. Among other things, a supplementary return circuit was recommended for standard practice as far as applicable. In other directions the Master Car Builders' standards were recommended. The report was adopted and the committee was discharged with thanks. Undoubtedly the committee will be reappointed by the incoming officers.

Steam Turbines.

E. H. Sniffin of Pittsburg presented his paper on "The Steam Turbine—Its Commercial Aspect." He said that the Westinghouse company would not sell the steam turbine alone, but as a part of a generating unit. A turbo-alternator unit would be sold cheaper than a reciprocating-engine-generator unit. The turbine would be more expensive than the old-type engine, but the whole unit would be cheaper, owing to the less expensive construction of the generator. Mr. Beggs wanted more definite information. He said the Allis-Chalmers Company was experimenting with the steam turbine as well as the General Electric and Westinghouse companies. It should be possible, he said, to buy a steam turbine separate from the alternator. In answer to a question from Colonel Heft, Mr. Sniffin said the Westinghouse company would make as good a guaranty for the steam turbine as for any other piece of moving machinery. A guaranty was not only made, but demonstrated. The turbo-generator must be developed as a complete entity. You cannot simply put a good turbine and a good generator together and get a good unit. The whole piece of apparatus must be developed at once. Colonel Heft and Mr. Beggs thought there was still a great deal of conjecture about what the steam turbine will do in large units, say, of 5,000 horsepower. Nevertheless, Colonel Heft said he was a believer in the turbine. Colonel W. Worth Bean of St. Joseph, Mich., thought the street-railway men should put their money into the steam turbine and develop it as they had done the electric motor. Mr. Wyman of New Orleans said the street-railway men should applaud the experimental work of the manufacturers. He was very certain that the world is on the eve of important developments in steam turbines. B. J. Arnold of Chicago, Mr. Katte, mechanical engineer of the New York Central Railroad, and C. O. Mailloux of New York discussed the subject briefly. The last-mentioned gentleman dwelt on the great advantage of the steam turbine in using superheated steam. He believed the larger turbine would be a simpler and more economical machine than the small one. He believed the steam turbine was the coming machine; in a year it could be said that it had arrived. The fundamental patents were about to expire, and probably all engine builders would enter the turbine field. The steam turbine cannot well be used for direct connection to direct-current machines, owing to the difficulty of commutation on the turbine shaft. The turbo-alternators are also noisy, but doubtless development will remedy this defect. Mr. Sniffin, in closing, said the Hartford 1,500-kilowatt turbine had carried 2,800 kilowatts. The steam turbine could not be considered an experiment. He announced that two 100-kilowatt turbines had been ordered from the Westinghouse people by the De Beers Company of South Africa. They are to be tested by Professor Thurston of Cornell.

Closing Business.

The well-written paper of M. B. Starring of Chicago on "The Adjustment of Damage Claims" was discussed by Mr. Beggs, H. M. Sloan of Chicago and Mr. Robinson of New York. "Signals for Urban and Interurban Railways" were discussed in a brief paper, read by G. W. Palmer, Jr., of Boston. There was a brief discussion. "Discipline of Employes by the Merit System" was considered in a paper sent in by W. A. Satterlee of Kansas City and discussed by Mr. Harrington of Camden, N. J.

Officers for the ensuing year were elected as follows:

President, Jere C. Hutchins, Detroit, Mich.

First Vice-president, W. Caryl Ely, Buffalo, N. Y.

Second Vice-president, W. Kelsey Schoepf, Cincinnati, Ohio.

Third Vice-president, P. S. Arkwright, Atlanta, Ga.

Secretary and Treasurer, T. C. Penington, Chicago.

Executive Committee, H. H. Vreeland of New York, R. T. Laffin of Worcester, Andrew Radel of Bridgeport, Conn., Walter P. Read of Salt Lake City, and Williard J. Hield of Minneapolis.

An invitation to hold the next meeting in Chattanooga, Tenn., was received and referred to the executive committee.

The annual banquet was held in the evening. The new officers were installed and adjournment was taken without day.

EXHIBIT OF SPEER CARBON COMPANY AT DETROIT CONVENTION.

Street Railway Accountants.

While the American Street Railway Association was in session the sixth annual convention of the Street Railway Accountants' Association was held, H. C. Mackay of Milwaukee presiding. On Wednesday F. A. Blades, comptroller of the city of Detroit, welcomed the association. President Mackay delivered the annual address. A paper on "The Collection and Reporting of Fares On City and Interurban Lines," was presented by William C. Sampson of Anderson, Ind. Another paper, read by J. R. Shurtz of Camden, N. J., was on "The Stationery Storeroom." There were also reports from the committee on standard material and supply accounting and on standard form of report for electric railways.

Master Mechanics Organize.

Pursuant to a call issued by Thomas Farmer, superintendent of motive power of the Detroit United Railway, a meeting was held at power station A on Thursday afternoon to organize an association of master mechanics of street-railway companies. Mr. Farmer presided and a committee on permanent organization was formed. At a second meeting on Friday afternoon the subject was further considered, and it was decided to meet in Cleveland on January 12, 1903, for the purpose of forming a society.

The Evanston Yaryan Company of Evanston, Ill., which was recently granted an amended ordinance for its hot-water heating system, has turned on the heat on its residence service. In the city buildings, however, there is no heat, for the City Council failed to make a provision to this effect in the franchise recently granted after so much discussion. The heating company recently issued circulars notifying consumers that a charge of $1 per annum for each gallon capacity of the hot-water tanks in residences would be made. This amounted in no case to less than $30, and the cost of the heating service was thus increased. Many were arranging to install gas burners for heating water, and to forestall this the company has now issued another circular in which the price is fixed at 60 cents a thousand gallons, meter measure.

Convention Notes and Exhibits.

A conservative estimate places the attendance at 2,500.

Porter & Berg, Chicago, gave away a unique souvenir in the form of a matchbox.

President J. D. Maguire of the Magnet Wire Company put in an appearance on Wednesday.

The Sterling Varnish Company was represented at the convention by S. S. Schenck and A. S. King.

George Searing bobbed up serenely, and, as usual, looked after the Peru porcelain and the Hart switch interests.

C. W. Cobb, Cleveland representative of the Western Electric Company, was on hand during the entire convention.

The National Carbon Company made a most interesting display of carbons. Its exhibit attracted much attention.

H. C. Eddy, the energetic representative of the American District Steam Company, could be seen strolling through the exposition at all hours.

W. L. Arnold and R. G. Arnold represented the Arnold Electric Power Station Company of Chicago. Mrs. W. L. Arnold accompanied her husband.

Secretary and Treasurer Penington again demonstrated that he is the right man in the right place by his assiduous efforts for the success of the meeting.

George L. Lindsley of Lindsley Bros., Chicago, the well-known pole dealers of the Northwest, spent a few hours on Thursday at the street-railway exposition.

John A. Stewart, so well known throughout the Middle West, as the handler, buyer and seller, of second-hand electric-lighting and street-railway apparatus, was on hand.

The Nernst Lamp Company's representatives at the convention were A. E. Fleming and G. J. Stanley of Pittsburg; George C. Ewing, Boston, and Walter Floyd, New York.

The capacity of the hotels was exceeded by the demand for accommodations for the street-railway and coal-strike conventions. Late comers were put to all sorts of shifts to secure sleeping places.

George W. Conover, purchasing and forwarding agent for Independent telephone companies, made a hit with his long-legged matches, which asked the question, "Can you match my prices on telephone material?"

Westinghouse, Church, Kerr & Co.'s representatives at the convention were E. H. Sniffin and C. M. Vail, New York; H. H. Kerr, Chicago; W. Franklin, Detroit; S. A. Jenkins, Boston, and H. J. Raynor, Detroit.

Beautiful weather favored the convention, and trolley rides, yachting trips and other excursions were numerous. About 300 ladies were in attendance, and ample arrangements were made for their entertainment.

One of the most welcome visitors at the street-railway convention was Frank G. Bolles of the advance and foreign-sales department of the Bullock Electric Manufacturing Company of Cincinnati. Mr. Bolles this time made no attempt at an exhibit, but nevertheless contrived to let it be known that he was on hand. Lehman B. Hoit of the Cleveland office of the Bullock company was also in attendance.

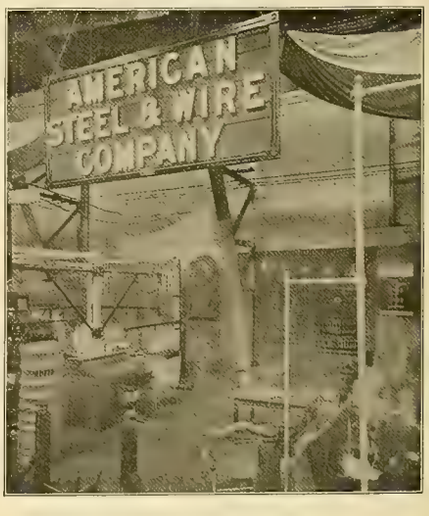


EXHIBIT OF AMERICAN STEEL AND WIRE COMPANY AT DETROIT CONVENTION.

The Standard Underground Cable Company, as usual, came strongly to the front, in the persons of J. R. Wiley of Chicago, H. P. Kimball of New York, F. S. Viele of Pittsburg, and A. A. Anderson. The Standard company made the usual handsome exhibit of samples, showing street-railway cables of all kinds. The most important fact, however, promul-

gated by the body of representatives was that the company is now pushing the product of its new copper-rod and wire mill at Perth Amboy, N. J.

The Standard Pole and Tie Company of New York presented an acceptable souvenir in the form of a wooden penholder, octagonal in shape and a perfect reproduction of one of the company's poles in miniature.

The H. B. Camp Company made no attempt at a very extensive exhibit, but nevertheless, the large line of samples displayed in a corner of the exposition hall told its own story of one of the most successful conduits in the country.

The "Carr" of the Drug and Chemical Works saw that the handsome exhibit of the company was well looked after. Mr. Carr came down on the Chicago convention train, but made the mistake of not bringing Mr. Edgar and Mr. Eddy with him.

Edgar H. Hammond of the Chicago office of the American Electrical Works did the honors for Providence, R. I., and Chicago as well. Mr. Donahoe of the Chicago office was prevented from attending through absence on long business trip.

R. H. Pierce of Pierce, Richardson & Neiler, the consulting engineers of Chicago, got in on Thursday morning for a look around. Mr. Pierce was kept busy responding to the greetings of the people who told him they were glad to see him.

The convention badge was artistic and depicted in bronze the landing of Cadillac. White, blue, red and orange ribbons denoted ladies, delegates, visitors and accountants, respectively. The badges were honored for free transportation on all city and interurban lines.

Assistant Secretary Putnam A. Bates of the Crocker-Wheeler Company arrived on Thursday. Mr. Bates, being by profession an electrical engineer and a business man as well, found much to interest him in the investigation of the various new street-railway appliances.

Western Manager E. F. Kirkpatrick of the McRoy Clay Works of Brazil, Ind., came down from Chicago with the western delegation. He presented a neat souvenir. Mr. McRoy was prevented from appearing through an accumulation of business, due to several months' absence abroad.

Rossiter, MacGovern & Co. of New York, the well-known second-hand machinery dealers, were fully represented at the street-railway convention by Frank MacGovern, J. Warren Archer and the company's St. Louis representative, J. Pierce. Rossiter, MacGovern & Co. made no exhibit.

When John H. Fry, assisant general passenger agent of the Detroit United Railway, was appointed chairman of the exhibits committee exactly the right selection was made. Mr. Fry won the admiration of all by his unfailing courtesy and helpfulness amid the strain of many importunities and distractions.

William M. Porter represented the Alphaduct Manufacturing Company of 522 West Twenty-second Street, New York. This company is now introducing a flexible fireproof and waterproof conduit for electric wires. Mr. Porter made no attempt at an expensive exhibit, but his good line of samples created considerable comment.

Secretary and Treasurer William M. Smith of the Chicago Insulated Wire Company appeared, as usual, but this time "boiling" with an extra amount of enthusiasm over the merits of Chicago insulated wire. Mr. Smith has a right to feel encouraged because the sale of his company's product has increased to a remarkable extent.

The American Steel and Wire Company made an extensive exhibit showing a full line of its standard wires and cables. The company's exhibit was in charge of C. S. Knight, Jr., manager of the electrical department, Chicago, who was ably assisted by W. E. Bogue, George Chandler, N. H. Vansicklen, J. A. McQuade and J. D. Sutherland.

One of the Georgia delegates was George O. Nagle, manager of the Savannah Electric Company, which supplies the people of that city with railway service as well as electric light and power. Mr. Nagle is pleasantly remembered as the former superintendent of the Chicago City Railway Company, and he was warmly greeted by his northern friends.

A large electric sign and a street festoon of incandescent lamps made the main entrance of the convention hall conspicuous at night. Inside a liberal use of electric-lighting signs and decorations made a brilliant spectacle. On the City Hall the permanent "Welcome" sign in lamps was supplemented by the words, "American Street Railway Association."

Incandescent-lamp men strolled in one by one on Wednesday morning. Manager M. K. Eyre of the Buckeye Electric Company, arrived from Cleveland. Pressure of business at the home office prevented Mr. Eyre from remaining over until Thursday. Incidental to the Buckeye lamp, it may be said that the little pamphlet which Mr. Eyre recently originated, descriptive of the scientific merits of the Buckeye lamp, has been received with exceptional favor on the part of the lamp-buying trade. Instead of explaining that the Buckeye lamp is "the best," as is done by so many manufacturers, Mr. Eyre promulgated a number of logical and sound reasons why the Buckeye lamp was selling from month to month in such increased quantities.

Manager John Speer of the Speer Carbon Company made a most interesting exhibit in the gallery of the exhibition hall of the Speer street-railway carbon specialties. Mr. Speer has made a great success of his company at St. Marys, Pa., and his recent additions in the way of machinery have put him in a position of having unexcelled facilities in the carbon field.

Western Manager Thomas G. Grier made his usual convention trip to the street-railway gathering in Detroit. Mr. Grier distributed cards advising people that it was a good thing to use American Circular Loom flexible conduit. This has been known to be a fact for many years, but "Tom" presented it again in his own manner. Mr. Grier also talked about Nungesser batteries.

The Standard Traction Brake Company's representatives at the convention were J. R. Ellicott and C. R. Ellicott, New York; G. A. Hager and C. C. Farmer, Chicago; P. J. Myler, Hamilton, Ont.; A. B. Brown, Buffalo, N. Y.; S. D. Hutchins, Columbus, O.; W. Cummins, Cincinnati, O.; I. B. Clarke, E. H. Dewson and F. C. Newell, Pittsburg; F. V. Green and A. J. Brislin, New York.

The Maltby Lumber Company of Bay City, Mich., filled its space in exposition hall with an interesting line of photographs, illustrative of the white-cedar business. These photographs showed different operations throughout the company's Michigan woods. The Maltby yards at the River Rouge, and also at Pinconning, Mich., were pictured. Excursions were made daily to the Rouge yards.

Of course, the Columbia Incandescent Lamp Company of St. Louis, Mo., appeared, and this time President W. O. Garrison thought enough of the street-railway people to come in person. During the last year the Columbia company has greatly increased its facilities. The Columbia railway lamp has been in use and done excellent service on the leading street railroads of the United States for many years.

Vice-president and Secretary Bleecker S. Barnard of the Standard Vitrified Conduit Company of New York made an exhibit with C. J. Herrington, and also one at the Hotel Cadillac in Parlor "E." Mr. Barnard has been most energetic and aggressive in the introduction of Standard vitrified conduit, and his company's present successful standing in the street-railway and telephone work has been largely due to his efforts.

Manager H. S. Doyle of the railway and mining department of the Western Electrical Supply Company, St. Louis, arrived on Wednesday morning. It was a matter of regret that President H. K. Gillman did not likewise come on from St. Louis. Rumor has it, however, that the Western Electric Supply Company's business has of late increased to such an extent that convention trips on the part of its officers have had to be somewhat less numerous.

Captain G. H. Hurd did the honors for the Crane Company. Captain Hurd exhibited valve fittings and pieces of flanged pipe, illustrating the new Crane method of putting flanges on pipe. This method is in reality a new process, originating with the Crane Company, for the rolling of pipe into flanges. The company feels confident that this process will ultimately supersede that in which flanges are shrunk upon pipe. The process excited so much interest that Captain Hurd was kept busy continually explaining its merits.

The John A. Roebling's Sons Company was represented by the following-named gentlemen: George C. Bailey, manager Chicago office; H. L. Shippy, manager New York office; W. P. Bowman, manager Cleveland office; W. L. Doyle and U. S. Tingley, Trenton, N. J.; also G. W. Swan, New York; M. R. Cockey and A. B. Connover, Chicago. Mr. Bailey distributed a very pretty souvenir in the shape of an address book, gotten up in two different colors, one for the ladies and one for the gentlemen. Mr. Shippy distributed a souvenir key-ring, which was unique in its construction.

The Garrigus mechanical boiler cleaner was not, strictly speaking, on exhibition, but appeared in the person of President Charles Alexander of Coe, Smith & Co. Mr. Alexander was joined at Detroit by Western Manager W. R. Mason of the company. Mr. Mason has only had charge of this business for a few months, but under his experienced handling, his novel boiler cleaner has made its way into a large number of railway, lighting and power plants in the territory adjacent to Chicago. Mr. Mason's early training in handling electrical machinery and his large western acquaintance have no doubt had much to do with the present exceptionally good outlook.

Eugene Munsell & Co. and the Mica Insulator Company were represented at the convention by Charles E. Coleman, manager for both concerns at Chicago. Mr. Coleman had a prominent location in the center of the hall, in the space selected by William Wharton, Jr., & Co., Philadelphia. Micanite and Empire insulating materials were exhibited in various forms. The two concerns report a heavy demand for all their mica and micanite specialties, and have just completed an addition to their already extensive works at Schenectady, which will give them an increased capacity of 6,000 square feet of floor space, enabling them to execute all orders speedily.

The Stromberg-Carlson Telephone Manufacturing Company appeared with an exhibit applicable to the telephonic needs of street-railway men. The exhibit was exploited by J. J. Nate and A. J. Rousseau. There was shown in operation a miniature combination telephone switchboard, in which there were visual line signals, and lamp line signals; also magneto toll-line signals. There were, too, the various combination cord equipments for interconnection between different systems. A special display was made of telephone apparatus designed to meet the demands of street-railway and other transportation companies, such as weatherproof telephone boxes, train-dispatcher sets and other street-railway telephone specialties.

The Crocker-Wheeler Company issued invitations for a trolley trip on Thursday afternoon, to the Rochester power plant of the Detroit United Railway. Special cars started from Congress and Griswold Streets, in Detroit, and a large company spent a most enjoyable afternoon. The party was in charge of Chicago Manager Julian Roe and St. Louis Manager W. H. Wissing. Since Mr. Roe's acquisition of the management of the Chicago office the Crocker-Wheeler business in the West has increased to such an extent as to warrant his title as one of the stars in the electrical-machinery business. Mr. Roe is now looked upon as one of the most skillful salesmen in the West, and, backed, as he is, with apparatus of such exceptionally high character, his career has been the envy of many of the western machinery men.

The space occupied by the Gould storage-battery exhibit in convention hall contained an extensive line of storage batteries, including the small battery used in telephone and alarm-service systems, automobile batteries, car-lighting batteries and the large central-station type for railway and lighting-station use, besides an extensive display of photographs of some of the company's numerous plants. The Gould people also showed the process of spinning the lead, the electrochemical treatment of the lead, the different standard plates, full details of the operation and construction of the batteries, with the special advantages that this cell possesses in connection with rotary converters for high-speed traction work and rapid acceleration. These applications and special features were explained by W. W. Donaldson, manager of sales; E. W. Draffen, manager of the Chicago office, and Albert B. Herrick, consulting engineer.

The exhibit of the Electric Storage Battery Company, in the north-central portion of the armory, consisted of numerous cells illustrating the various types of the Chloride accumulators. One of these cells, consisted of 67 type-G plates in a lead-lined tank, being similar to the ones installed in the first battery operated by the Detroit United Railway. A differential railway booster, together with its switchboard and a constant-current switchboard, also made a part of the exhibit. The following-named officers of the company were present: Charles Blizard, manager of the stles department; J. Lester Woodbridge, engineer of the sales department; G. H. Atkin, manager of the Chicago office; Rudolph H. Klauder, manager of the St. Louis office; E. Vail Stebbins, manager of the Cleveland office, and Messrs. Lockwood and Seaman of the Michigan Electric Company, who represent the company in Detroit. Many of the delegates visited the three batteries of Chloride accumulators installed for the Detroit United Railway.

The appearance of the Christensen Engineering Company at the street-railway convention with its new line of alternating and direct-current lighting, power and street-railway apparatus, excited much comment. Knowledge of the fact of the company's extensive works at Milwaukee, and ability and backing to handle contracts for large direct-current and alternating-current apparatus, leads to the conviction that this company will shortly become a strong factor in the manufacture of electrical machinery. F. L. Hutchinson, since the company has reached a position to push for large electric-lighting and power contracts, has been appointed manager of electrical sales. Mr. Hutchinson is now busy perfecting the sales organization. His headquarters are at Milwaukee, but the necessities of his organization work carry him all over the United States. The Christensen Engineering Company's interests were cared for by the following representatives: F. C. Randall, J. T. Cunningham, J. J. Neff, J. F. Dixon, Jr., and J. H. Denton, New York; W. W. Power and William Gobel, Philadelphia; H. N. Ransom and J. J. Riley, Cleveland; J. E. Eldred, Jr., and C. P. Tolman, Chicago; N. A. Christensen, Charles D. Knight, W. L. Waters, J. C. James, W. J. Richards and F. L. Hutchinson, Milwaukee. Among the apparatus shown were a straight air-brake school equipment and an automatic air-brake multiple-unit equipment, both of which were in operation. There was

also a Christensen portable motor-driven air compressor in operation by means of a hook connection to a trolley wire. The company also exhibited some of its new electrical machinery, including a 250-kilowatt, three-phase, 2,200-volt alternator, a 30-horsepower, 500-volt, open-style motor, and a four-horsepower, 500-volt enclosed-style motor.

The Kellogg Switchboard and Supply Company, manufacturer of telephone apparatus, made an interesting exhibit in space 80. The exhibit consisted of the company's standard telephones, of the magneto and common-battery type. A number of the common-battery telephones were connected up to a small common-battery switchboard, the operation of which attracted considerable attention. Among other things exhibited were receivers, transmitters, induction coils, jacks, keys, relays, cords and miniature incandescent lamps, all of the company's own manufacture. Advertising Manager Martin and Ray H. Manson of the engineering department had charge of the exhibit, and made up a very attractive display.

Western Manager Frank H. Clark of the Helios-Upton Company, Chicago, came over to Detroit to look after the street-railway interests in the matter of storage batteries. Up to a comparatively short time ago the Helios-Upton Company devoted itself more particularly to automobile batteries and other cells suitable to comparatively small work. The Helios-Upton cell, however, has proved itself so eminently suitable for heavy service, that of late, under the western management of Mr. Clark, the company has been most aggressively pushing its business in the matter of the application of the Helios-Upton cell to the heaviest sort of street-railway power and lighting work. The 1,600-ampere-hour battery which the company introduced a year or so ago, into the plant of the Kansas City Electric Light Company, has demonstrated its efficiency under the most trying conditions. Incidentally, it may be also said that Mr. Clark is now installing a 168-cell, 3,000-ampere-hour battery in the plant of the Grand Rapids Edison Company.

In the exact center of the exhibition hall was located the exhibit of the Stanley Electric Manufacturing Company of Pittsfield, Massachusetts. When the delegates began to arrive Wednesday morning this exhibit was particularly observed and remarked upon on account of its finished condition. The principal feature was one of the Standard S. K. C. rotary converters, similar to those in use on the Flint division of the Detroit United Railway and elsewhere. The exhibit was essentially a complete S. K. C. sub-station equipment, including, besides the rotary, a three-panel switchboard. Much of the success of the Stanley company's representation at the convention was due to its energetic Michigan representative, Joseph E. Lockwood, president of the Michigan Electric Company, who directed the installation. The Stanley company was represented also by Dr. F. A. C. Perrine, president of the company, Messrs. Van Deventer, Arnold and Beggenthal of the Chicago office, S. T. Dodd, engineer of the railway department, D. B. Rushmore, from Pittsfield, and Mr. Hough from the New York office. Ray D. Lillibridge, in charge of publicity details for the Stanley company and other large manufacturers, was on the ground during the convention. The rotary exhibited has been sold to the Indianapolis and Eastern Railway Company of Indianapolis, Ind.

The General Electric Company's exhibit was located in the corner of the annex and occupied 2,000 square feet of space. The principal feature was an installation of the type-M control now in use on the Manhattan elevated railway in New York city. This exhibit was mounted on a frame which permitted free examination of the parts during its operation and showed the rise in voltage which, of course, corresponds to the increase in speed of the motors. To indicate this rise in voltage a number of incandescent lamps were used, grouped in the form of the company's monogram, which started at a dull red and gradually went up to full candlepower. Other General Electric apparatus for electric-railway service exhibited consisted of a line of railway motors of various sizes, including the 25-horsepower GE-66 motor, which has been adopted by the Manhattan Railway Company. A Brill 27-E truck was shown with two GE-57 motors mounted upon it and equipped with the General Electric new type of shoe for use on the protected third-rail system. This latter was here exhibited for the first time. A type-H electrically controlled oil-break switch with a capacity of 300 amperes at 12,000 volts made a very interesting operating exhibit. The entire exhibit was arranged for convenience of examination by visitors and the attractive reception space at the center of the exhibit made a pleasant resting place for the delegates. A feature of considerable interest which formed a part of the General Electric Company's exhibit at the convention was a 50-foot interurban car lent by the Jackson and Suburban Traction Company and used by the company in demonstrating the system for operating such cars. This car is equipped with the type-M control and four GE-66 (125-horsepower) motors. It was located on the Detroit United Railway's tracks at a point near the convention hall, and was used by the delegates and their friends for rides around Detroit. Among other representatives of the General Electric Company were General Eugene Griffin, J. R. Lovejoy, J. J. Mahoney, R. H. Bloch, L. R. Pomeroy, C. C. Pierce, B. L. Sunny, G. D. Rosenthal, J. H. Livsey, E. H. Mullin, F. H. Gale, J. B. Peveor, J. C. Calisch and T. P. Bailey.

A large and interesting exhibit was made by the Westinghouse Electric and Manufacturing Company, chief interest centering in a 1,500-kilowatt rotary converter. This machine is of the same design as those which have been ordered by the Rapid Transit Subway Construction Company of New York city, and is, except for some details of the frame, practically the same as the 1,500-kilowatt rotary converters furnished to the Manhattan Railway Company of New York city. These machines hold the record of being the largest of their kind ever constructed. A full line of multiple-control apparatus was shown, consisting of apparatus for two cars with two No. 131 controllers and four No. 50-C motors, all arranged on trucks for operation. Of railway motors there were exhibited one No. 50-C railway motor, one No. 76 and one No. 81. These are all large motors, adapted for suburban, interurban and elevated-railway service. The transformer exhibit included a number of the type-N transformers. Several three-phase type-C induction motors were also shown. The remainder of the exhibit comprised several devices, known as detail apparatus and included a cell-type diverter, which is a form of resistance used in starting street-car motors; a canopy switch, used to open the trolley circuit on street cars; an automatic car circuit-breaker, designed for the protection of electric-railway equipments; an automatic circuit-breaker for direct and alternating-current circuits; an iron fuse block for street cars; direct-current illuminated-dial voltmeters and ammeters; and a low-equivalent lightning arrester. The Westinghouse Electric and Manufacturing Company was represented by the following-named gentlemen: F. H. Taylor, L. A. Osborne, Arthur Hartwell, W. H. Whiteside, C. E. Skinner, A. Whitley and J. M. Duncan of Pittsburg; T. P. Gaylord, C. W. Regester and Irvin Dryer of Chicago; C. D. Humphrey of Cincinnati, O.; R. E. Drake of Syracuse, N. Y.; C. W. Underwood and W. E. Parker of Buffalo, N. Y.; George B. Dusinberre of Pittsburg, Pa.; F. B. H. Paine of New York; J. R. Gordon of Atlanta, Ga.; R. S. Brown of Boston, Mass.; N. S. Braden of Cleveland, O.; D. D. Pendleton of Pittsburg, Pa.; B. T. Brady of Syracuse, N. Y.; H. B. Shute, N. W. Storer, S. W. Kier, H. P. Davis, P. N. Lincoln, M. Baxter, C. Renshaw and H. N. Cheny of Pittsburg; C. F. Medbury, W. B. Wriaks and Mr. Armstrong of Detroit; J. L. Crouse of New York.

The Christensen Engineering Company Enters the Electrical Field.

The Christensen Engineering Company of Milwaukee has just placed upon the market complete new lines of "Ceco" electrical machinery, including direct-current motors and generators, alternators and transformers. For several years this company has been manufacturing electric motors for driving air compressors used in connection with the well-known Christensen air-brake equipments on electric cars. More than 6,500 of these motors are in satisfactory service throughout the world. The company has also built a large number of motors of various capacities for driving large air compressors used in general commercial service, and all the motors for driving machine tools and shafting in its own works. In order to manufacture these motors the company has maintained for years an extensive equipment, particularly suited to the purpose. Some time ago it was decided to increase the company's manufacturing facilities greatly and to develop a complete line of electrical machinery of the highest grade.

The policy of the Christensen Engineering Company has always been not to place any apparatus upon the market until the entire work of development has been satisfactorily completed. The high reputation and remarkable success of the air-brake apparatus are largely due to this policy. Therefore the company has made no announcement regarding its electrical apparatus until the various lines were completely developed and severely tested. The results seem to prove that these machines are in design, construction and performance worthy of the high reputation now accorded to the Christensen air-brake equipments.

The company is now prepared to build machines up to 1,500 kilowatts in capacity, suitable for general power, lighting or railway service. The line of Ceco direct-current motors known as type C. E., ranging in capacity from two to 50 horsepower, is illustrated in Figs. 1 and 2. These motors are made in three styles, open (Fig. 1), semi-enclosed and enclosed (Fig. 2). The standard styles are belted, but any motor can be geared or direct-connected to the driven machine or shaft. The C. E. motors are for general service in industrial establishments of every kind where a high-grade, durable and reliable machine is required.

The frame or magnetic yoke, to which the poles are secured (Fig. 2), is cylindrical in shape. It is composed of a single steel casting. The bearing brackets are secured to the frame by bolts. The terminals are mounted on top of the frame, where they are not liable to be accidentally touched, but where they are readily accessible in case it is desired to change the connections in order to reverse the direction of the motor. The two bearings are supported by two end brackets, which are identical and interchangeable, so that the motor is symmetrical and pleasing in appearance. The semi-enclosed style is the same as the open, but with the addition of four perforated, malleable-iron cover plates, which can be quickly and easily removed or replaced. The enclosed style is the same as the semi-enclosed, except that the cover plates are solid instead of perforated. Either style of cover plates will fit into the open-style motor, consequently the same motor may be used as open, semi-enclosed or enclosed.

The field poles are built of laminated sheet steel, thereby avoiding eddy-current losses. The larger machines have four poles (Fig. 3), and the smaller sizes are built with two only, thus permitting the use of a commutator that can be insulated far more satisfactorily than is possible in small machines of the four-pole construction. The poles are bolted to the yoke, so that a rigid construction is obtained, and the poles are easily removable without disturbing the armature. The field winding is composed of machine-formed coils, accurately wound by automatic machinery. Any field coil can be readily and quickly removed without disturbing the armature by simply withdrawing the pole, as explained above.

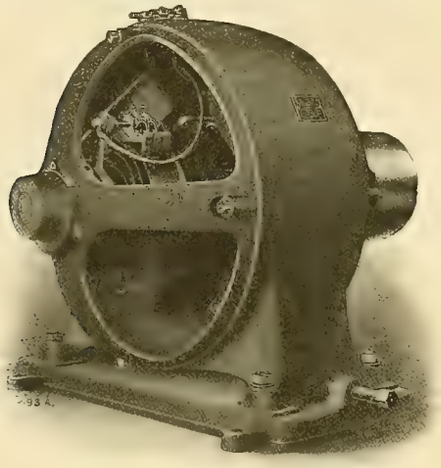


Fig. 1. 30-horsepower, 500-volt Type.

Fig. 2. 20-horsepower, 220-volt Enclosed Type.

CHRISTENSEN ENGINEERING COMPANY'S NEW CECO MOTORS.

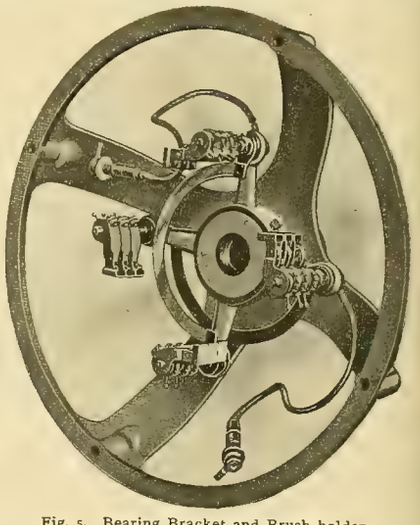


Fig. 5. Bearing Bracket and Brush-holder.

The armature core is built up of punched disks of soft sheet steel, slotted around the periphery, to receive the armature winding (Fig. 4). These disks are re-annealed and insulated after being punched before assembling. The shape of the punching is such, that, when assembled on the steel shaft, openings are provided for ventilation parallel to the shaft. Additional ventilation is secured by the use of radial air ducts.

The armature coils are all machine-wound. Those for the smaller motors are of wire, while those for the larger sizes are composed of copper bars. The coils are all carefully insulated, then dipped into a bath of special insulating compound, and finally placed in a drying oven until they are thoroughly baked. Surface bands are used to retain the coils in the slots on the smaller sizes, while the same result is secured in larges sizes by the use of retaining wedges, placed in specially provided notches near the top of each slot.

As the core and poles are constructed of soft laminated steel, it is evident that the magnetic circuit, which consists of these three elements, is of the highest permeability, and the efficiency of the motor is therefore correspondingly increased.

The commutator (Fig. 4) is built up of copper segments, insulated from each other, by sheets of the highest grade of mica, of hardness corresponding to that of the copper, so that a smooth and even wearing surface is presented to the brushes. Pure hard-drawn Lake copper is used. The segments are of generous length and depth, insuring cool running, and allowing ample margin for wear. The commutator is easily removable from the armature shaft, tapped holes being provided in the face of the commutator sleeve for that purpose. As the commutator is usually the cause of more trouble than all other parts of a motor combined, unusual care has been given to the design and construction of this important element of Ceco motors.

Carbon brushes are used, and the brush-holders (Fig. 5) are of the Christensen company's coil-spring reaction type. They are very simple in design and reliable in operation. The brush-holder studs, to which the holders are secured are mounted upon a yoke, which is fastened to the inner side of the bearing bracket. Each brush can be readily adjusted and any brush can be quickly and easily removed while the motor is running. The brush-contact area is in all cases ample for the current to be commutated, the current density being very low and at the same time consistent with economical design. Wear of the commutator is provided for by radial adjustment of the brush-holder studs. After the brushes are properly set no shifting is required, and the motor operates without noise and without sparking.

The bearing surfaces are generous in area. Self-aligning babbited bearings, with the well-known self-oiling ring arrangements, are provided. The motors are mounted on a cast-iron sub-base, which is composed of a single casting, thus insuring perfect alignment. Belt tension is accomplished by moving the motor upon the sub-base in the usual manner.

The ventilation of the armature and commutator is remarkably good, thus insuring a low temperature while running continuously. The Ceco motors will operate at their rated loads without the temperature of the armatures rising more than 30° C. The rise in temperature of the field coils under these conditions will not exceed 40° C., and of the commutator 45° C. These machines will operate from no load to full load with the brushes in a fixed position without sparking. They will also operate for two hours with 25 per cent. overload and for two or three minutes with 50 per cent. overload without injurious heating or sparking.

These motors will operate in any position in which the shaft is horizontal. This is accomplished by shifting the bearing brackets on the frame, so that the oil chambers remain in the proper position, whether the motor is secured to the floor, the ceiling or the side wall.

A rigid system has been established for the inspection of the parts of each machine while under construction, and there is no poor material or workmanship to hide under canvas, rope, or other "protecting" material. When completed each machine is given a severe running and high-insulation test. Then the frame is rubbed with a good filler and painted. All bright parts are polished, so that, in addition to being compact in design, substantial in construction and superior in performance, each machine presents a graceful and pleasing appearance.

All the Ceco alternators (Fig. 6), whether belted, engine-type or direct-coupled, are of the revolving-field (Fig. 7) type, thus leaving the armature stationary, and easily accessible. By this form of construction the difficulties of properly insulating the armature coils, which have caused much trouble in rotating armatures, are eliminated.

The frame consists of cast-iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole, so that it may be wound or rewound for single, two or three-phase, as required. The armature frames for the belt-driven alternators are cast in one piece, while the frames for the direct-driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each Ceco alternator are of the same size and shape, so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service.

The poles are built up of laminated steel upon a cast-iron spider, which is mounted upon a forged-steel shaft. In the large sizes the laminated poles are assembled upon a steel ring, which is carried on the shaft by means of the cast-iron spider. The individual poles are in all cases easily removable with their coils, without dismantling the machine. The field coils are composed of rectangualr copper strap, bent on edge. The collector rings are made of cast iron, and carbon brushes are used, thus reducing to a minimum the tension required, as well as the wear of the parts. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, Ceco alternators can be wound for any voltage up to 15,000. The temperature rise when running continuously with full load at any power factor will not exceed 35° C. in the armature, or 40° C. in the fields. At 25 per cent. current overload, the corresponding temperatures will not exceed 40° C. and 50° C. The machines are all designed so that they will carry satisfactorily a 50 per cent. current overload for two hours at any power factor without injurious heating.

The Christensen Engineering Company is entering the electrical manufacturing business with exceptional advantages. Its new and enlarged works, into which the company moved from South Milwaukee about two years ago, provide every modern facility for the most rapid, accurate and economical manufacture of its product. The equipment of machine tools, cranes, special machines, etc., is unusually extensive, modern and complete. The foundation for a 250-foot extension to the main machine shop, which is 186 feet in width,

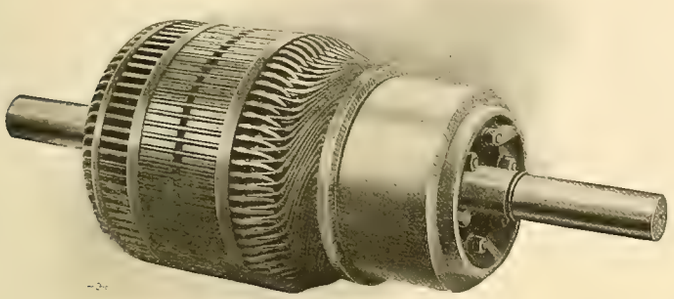


Fig. 4. Armature for Ceco Direct-current Motor.

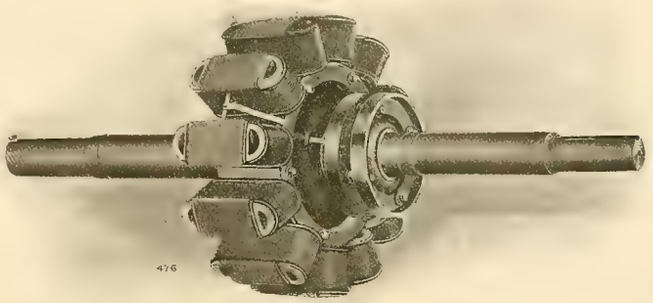


Fig. 7. Revolving Field for 250-kilowatt Alternator.

CHRISTENSEN ENGINEERING COMPANY'S NEW ELECTRIC MACHINERY.

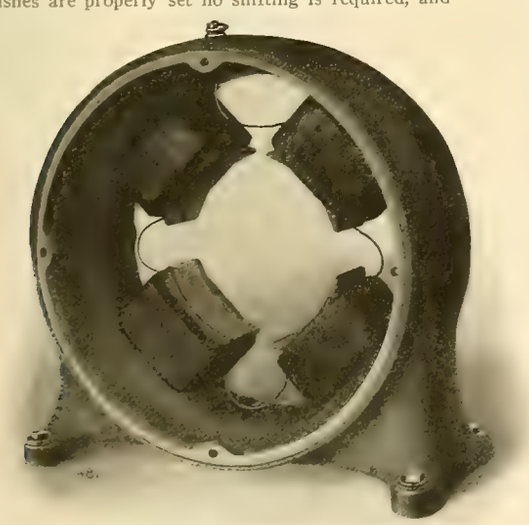


Fig. 3. Field for Ceco Direct-current Motor.

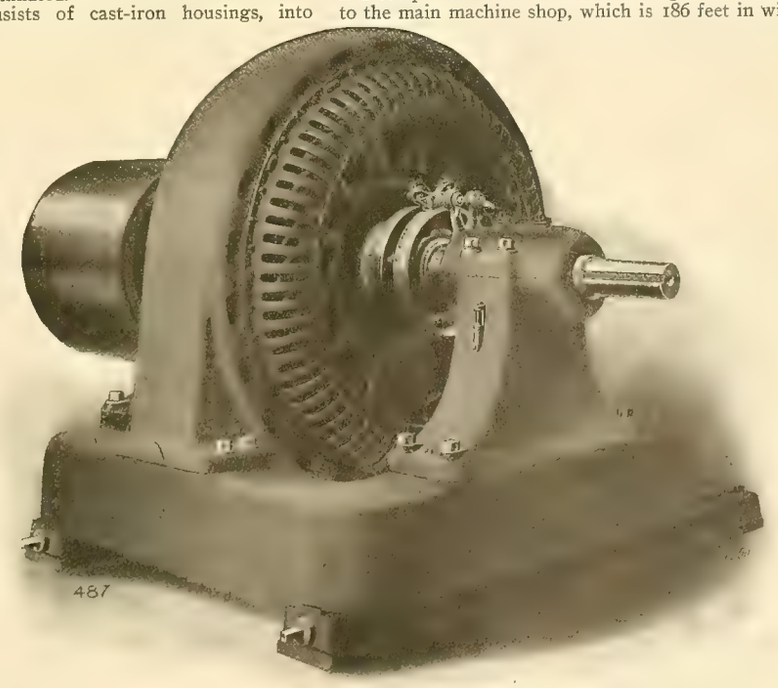


Fig. 6. 250-kilowatt Three-phase Alternator.

CHRISTENSEN ENGINEERING COMPANY'S NEW ELECTRIC MACHINERY.

has just been completed. There are three stories, and this extension will provide 88,000 additional square feet of floor space.

John I. Sabin's House Burned by Remarkable Accident.

San Jose (Cal.) papers of September 26th report a curious accident. This is a condensed account: "Some miscreant created great havoc along the lines of the Standard Electric and Sunset Telephone Companies on Thursday by severing the wire which bears the high-voltage current from the plant of the former company at Twin Lakes. This wire, which is of heavy aluminum, was broken by a missile, which struck it and caused it to fall across the wires of the telephone company. By the contact made in this manner a short-circuit was formed and the 40,000-volt current from the Standard wire was shunted through the leads of the Sunset Telephone Company in this city.

"In San Jose hundreds of telephones were burned out, and it will take the company many days to repair the damage. All the trunk lines here were burned out and rendered useless. Manager Gilkyson applied to San Francisco immediately for aid, and it is thought that he will be able to have things working properly in a few days.

"The Standard people themselves were as badly injured as anybody. The local transmission station had to be shut down and the engine of the United Gas and Electric Company brought into use. At Redwood the switches, fuse blocks and other apparatus for handling this great current are one mass of melted copper.

"No one was hurt or received any severe shocks, so far as reported. Manager Gilkyson stated to-day that the occurrence is the first of the kind happening since the two circuits have been in operation, and that it was an accident which could not have been foreseen or guarded against.

"One of the most serious results of the crossing of the wires was the destruction of the fine country home of the president of the Pacific States Telephone and Telegraph Company, John I. Sabin, near Mountain View. The Sabin home, known as "Liberty Hall," was located in a large oak grove, near the foothills, and was one of the handsomest structures in that part of the country. Mr. Sabin, in order to keep in constant communication with San Francisco, had a complete system of long-distance apparatus in this house. The many wires running there carried the great electrical force which caused the fire.

"The firemen in the vicinity could not cope with the flames, as their apparatus for fighting fire was limited. Mr. Sabin, who recently spent a week at the place with his family, is in Chicago at the present time. The other members of the family are stopping in San Francisco, and no one was at the place except the caretaker. While the extent of the loss is not fully known, it is believed to be in the neighborhood of $20,000."

Use of Juniper for Poles.

In 1900 the Standard Pole and Tie Company of 44 Broad Street, New York city, decided to open and maintain a southern office. Accordingly, the secretary and treasurer, Fred L. Merritt, was sent South to open such an office. Maxton, N. C., was chosen as the most suitable location, it being in the center of the best timber section of the state. From this office the orders were sent to the different mills controlled by the company, and to this office also the inspectors reported daily. While Mr. Merritt was in the South, the vice-president, E. G. Chamberlin, was actively engaged in the North meeting the trade and securing orders. It was soon demonstrated that the juniper pole, which the company was introducing, was a ready seller. This pole is what is technically known as southern white cedar. It is a swamp growth, remarkably free from butt rot, of close grain and great lasting qualities. Its straightness and symmetry, added to these qualities, have caused its popularity.

Anticipating the demand for these poles, the Standard Pole and Tie Company began to accumulate a large stock of this material. The company bought large swamps and began to work the timber out, and at the beginning of this year's business it had a stock of over 30,000 poles, cut, piled up, and ready to ship. The company claims to be the only concern carrying a stock of these poles on hand. In spite of the large stock on hand and the fact that it was shipping into its yard all the time, the orders have come in so fast this year that the company has had all it could do to make satisfactory deliveries.

Besides the round juniper poles the company has manufactured and sold great quantities of octagonal pine poles. These are sawed from the best quality of long-leaf yellow pine, dressed, painted, and the butts treated with one coat of dead oil of coal tar.

The company decided recently to build and operate a large cross-arm mill at Brooksville, Fla., in the heart of the Florida heart-pine belt. Mr. Chamberlin is superintending the erection of the mill, which will be ready January 1st. The mill will have a capacity of two carloads of arms a day, and the timber will be of an excellent quality.

CORRESPONDENCE.

New York Notes.

New York, October 4.—The illuminating of the three new bridges that are to span the East River in a few years is New York's latest problem. The plan of illumination is to be entirely different from anything that has been used in the way of bridge lighting and is being worked out by Henry Y. Hornbostel, consulting architect of the Bridge Department. It is a fairly easy thing to light a bridge, but to light it so as to beautify it when seen from a distance is another matter. As it stands to-day, and has stood for years, the old Brooklyn Bridge, as soon as darkness settles down, is one of the most often quoted and impressive sights of this country, the great structure over the river almost fairylike with its lights, being the finest spectacle of the water front. The new East River Bridge will have ropes of incandescent lamps that will outline the floor of the bridge. But more than this bare outline seems to imply will be done. The ropes of bulbs crossing the river, extending to the approaches on either side, will also be carried up the high steel towers, outlining them and throwing all the essential parts of spans, abutments, massive cables, beams, and trusses into view, making up a night picture that New Yorkers will wonder at once it is completed. For the Manhattan Bridge Mr. Hornbostel proposes to light the entire structure from one end to the other by lights from his towers alone. Each tower will have at its top eight lights, each pair illuminating the roadway just below it on either side. A roadway of light will thus correspond with the roadway actual, and, arranged with precision, will become a part of it. The architect says that no evil effects need be anticipated from the concentration of so much light, as it will not be noticed any more than is the sun at midday.

On October 3d a public hearing of the Pennsylvania Railroad tunnel franchise was held. Mayor Low succeeded in securing the rescinding of the approval of the Rapid Transit Commission for the terminal improvements. In regard to his action, the general public have expressed much disapproval. It seems that the mayor was moved by those politically inclined, and not by his better judgment. The hearing brought out nothing new, and the franchise still hangs fire on the labor clauses, mentioned many times before, the "eight-hour day," and the "prevailing rate of wages."

On October 4th H. H. Vreeland, president of the Metropolitan Street Railway Company, made an address before the Metropolitan Street Railway Association on the occasion of its sixth anniversary. In the address Mr. Vreeland said: "It has never before been my lot to congratulate you on so many material advantages. We have increased increased insurance to our members 100 per cent. in the last year. The second great advance is the founding of a pension system—the first of its kind ever organized on a street-railway property. Since the existence of this association questions have arisen more than once involving the relations of capital and labor, and they have been settled amicably and to the perfect satisfaction of both parties. It has been proved to the men employed that 'the open door' of the management was not a mere name but an actual fact."

The probability of the immediate building of the proposed tunnel for the New York and Brooklyn Railroad Company under the East River was emphasized on the third inst. by the purchasing of a parcel of real estate at the southwest corner of Water and Beekman Streets for the railroad company. Excavation is to be begun at once on this site for the tunnel. The company plans to carry passengers from borough to borough only, and it has been said that the fare is to be 2½ cents. It is planned to have the tunnel 98 feet under water level. July 16, 1904, has been announced as the time of its completion. The tunnel road will be double-tracked, and is expected to run from the vicinity of Park Row to the dock line in Brooklyn. The cost of the tunnel and equipment has been estimated at from $4,000,000 to $6,000,000.

The Manhattan Railway Company's new electric service was installed on Sixth Avenue between Rector Street and Fifty-eighth Street on the morning of October 1st. It is estimated that the completion of Manhattan's electrical installation will effect savings that will show a 10 per cent. increase in net earnings.

On September 30th, W. W. Wheatley resigned his position of superintendent of the surface lines of the Brooklyn Rapid Transit Company. Mr. Wheatley's assistant, W. B. Yearance, has also resigned.

The following incorporations have occurred since last week:

M. B. Foster Electric Company, New York; capital, $1,000. Directors, M. B. Foster, New York; T. F. Freund, Bayonne, N. J.; F. H. Corduan, Brooklyn.

Camp Electric Construction Company, New York; capital, $10,000. Directors, C. F. Camp and F. E. Southard, New York city, and Alexander Gregory, Brooklyn. O.

Southern Developments.

Charlotte, N. C., October 2.—An English syndicate, represented by J. F. McKaughlin of Toronto, Canada, is said to be back of the scheme to develop the upper falls of the Potomac River for industrial purposes. The scheme would include the operating of the trolley lines of Washington. About $5,000,000 is involved.

A new trolley line for Richmond, Va., is assured by the acceptance filed by the Jenkins Rapid Transit Company. The line will be double-tracked.

An application has been made for a charter for an electric line, to run from Cleveland, Tenn., by way of Benton to Ducktown, Tenn. The estimated cost will be $400,000.

The Washington (D. C.) Traction Company, General George H. Harries, president, contemplates a line from Laurel to Brookville, via Sandy Springs, Md.

The merger of the Memphis (Tenn.) Electric Light and Power Company and the Equitable Gas Company has been passed as an ordinance by the City Council. The city thereby gets $1,000 worth of free gas annually, while the saving to users of electric lights and gas will be $90,000 annually.

J. T. Crass and associates will soon begin the building of an $80,000 electric street-railway system in the Decaturs in Alabama.

The Lubbock Electric Company of Lubbock, Texas, has been incorporated by C. E. Spath and others with a capital of $2,500.

Arrangements have been completed for the purchase of the local lighting plant by the city of Covington, Tenn. The price agreed upon is $11,500. The plant will be overhauled and improved generally.

Mayor Mims of Atlanta, Ga., in a recent message, advocates that the city either take steps to obtain cheaper lights from the present company or that active steps be taken looking to the building of a municipal lighting plant by the city.

A project is on foot to build a trolley line between Stoneville and Spray, N. C., the power to be supplied by an electric plant at the latter-named town. L.

New England News.

Boston, Mass., October 3.—The Cape Cod Street Railway Company has been granted a charter. It proposes to build an electric railway 20 miles long from the boundary line of the towns of Bourne and Falmouth, Mass., through the latter town to the Waquoit postoffice. The capital is $100,000, and William M. Butler, F. Apthorp Foster and others are directors.

The Enfield (Mass.) Electric Light and Power Company is preparing to enlarge its plant. It will probably install new boilers and an engine of 250 horsepower, retaining its 100-horsepower engine for emergencies.

The Old Colony Street Railway Company is building a new power house at Newport, R. I. The boilers are being set, while the walls and chimneys are in process of construction.

Westinghouse, Church, Kerr & Co. have obtained the contract for a 6,000-horsepower vertical engine for the new power station of the Union Traction Company at Providence, R. I. The boilers at this station will be fired by mechanical stokers. The chimney is 300 feet high, with an inside diameter of 16 feet.

The Jewell Storage Battery Company is contemplating the enlargement of its plant at Pittsfield, Mass.

Sargent, Conant & Co. of Boston have obtained the contract for entire electrical equipment at the Millers Falls Paper Company's plant at Millers Falls, Mass., which is to be run by electric power. The contract covers generators, motors, arc and incandescent lamps, etc.

In its annual report for the year ended June 30, 1902, the Boston and Maine Railroad Company says that the Portsmouth (N. H.) Electric Branch Railway was extended 1.87 miles, its total length being 18.34 miles. Its construction has cost $470,583. Its gross earnings during the year were $59,203, and its operating expenses during the same period were $54,506. The company's officials believe that the growth of population along this railway will ultimately make it a profitable investment. To June 30th the Concord and Nashua Electric branch had cost $250,879 for construction. The section between Concord and Manchester, N. H. (18 miles long), was opened for traffic on August 11th, 1902.

A wireless-telegraph equipment has been placed on the auxiliary cruiser Prairie at the Charleston Navy Yard. The cruiser Newark is having an electrical plant installed, and will be fitted with a wireless telegraph equipment, and dynamos have been placed on the Culgoa. Naval Constructor Baxter has recommended the construction of a floating machine shop to be used for repairing ships lying at anchor. He recommends electricity as the power for operating the tools.

The Electric Vehicle Company of Hartford, Conn., has constructed an electric victoria for the Duchess of Marlborough, and it has been shipped to England.

Master Francis Peabody, Jr., has finished his hearing on the New England Electrical Contractors' Association suit for an injunction against Local Union 103 of the National Brotherhood of Electrical Workers. The association desires to prevent interference with its members' business by striking members of the union. The suit will soon come before the court for final hearing.

Two months ago the South Norwalk (Conn.) mu-

nicipal government appointed a committee to investigate the municipal electric-lighting plant, and the committee has reported that the plant is in excellent condition and that municipal ownership is a success. The committee recommends that commercial lighting be done upon a meter instead of a contract-basis, and that, in order to encourage small industrial enterprises, the power rate be made one per cent. above all operating expenses, including interest and depreciation.

President Barrett of the Worchester Traction Company says that work on the Interstate Electric Railway between Danbury, Conn., and Golden's Bridge, N. Y., will soon be resumed, and that the road between Danbury and North Salem, N. Y., will be completed this fall. The remainder of the line is to be completed next spring.

The Massachusetts Railroad Commissioners have authorized an issue of four per cent. bonds, running 30 years and amounting to $3,559,000, by the West End Street Railway Company of Boston. Of the proceeds, $3,000,000 will be used in refunding bonds of that amount which will mature November 1st, 1902, and the remainder will be used for permanent additions, alterations, and improvements to the property, made by the Boston Elevated Railway Company during the six months ended April 1, 1901.

The Corliss Steam Engine Works in Providence, R. I., have been transferred from the International Power Company to the American Machine and Ordnance Company. There is little significance to this, as Joseph Hoadley is president of the International Power Company and manager of the American Machine and Ordnance Company.

B.

From the Buckeye State.

Cleveland, Ohio, October 4.—It has been definitely decided by the Legislature in session at Columbus, to include what is known as the curative measure in the new code. This will make valid the franchise granted to the street railways of Cincinnati, which were granted some years ago, for a term of 44 years from the present time, or 50 years, altogether. There has been a great deal of opposition to the measure, but it would seem that it is right and just to make good an act which was passed upon by a city government, which did so with the idea that it had the power and authority.

The Bullock Electric Manufacturing Company of Cincinnati is planning to erect an addition to the present plant, 900 feet long by 177 feet wide. It will be but one story high, and will be used for erecting large machinery. The cost will be about $125,000.

The Hamilton, Glendale and Cincinnati Traction and the Millcreek Valley Traction lines have been formally turned over to the Cincinnati Interurban Traction Company, which is owned by the Morgan-Widener-Elkins syndicate of Philadelphia, which also controls the Cincinnati Traction Company. The roads are operated upon a lease. George H. Warrington, a prominent business man, is president of the new company, and S. C. Cooper is secretary. H. Gordin Gilpin is the superintendent, succeeding W. G. Wagenhalls, who has been very efficient in that position. Ed. Wagenhalls, who has held a position with the roads, has accepted the position of superintendent of the New York and Philadelphia Traction Company. Cars from these lines will run through to Fountaine Square, Cincinnati, hereafter.

It is stated that an arrangement has been entered into between the Mandelbaum syndicate and the Scrugham interests at Cincinnati, by which a line between Cincinnati and Springfield will be established. The Springfield and Xenia Traction Company, a Mandelbaum road, has a line in operation between those two places, and it will be extended to Lebanon, with a branch to Franklin, connecting with the Cincinnati, Dayton and Toledo Traction lines. The Rapid Transit Company will complete its line through to Lebanon, to connect with the other line, but it is understood that the connection will be nothing more than a working interest.

The annual meeting of the stockholders of the Cincinnati, Georgetown and Portsmouth Railroad Company was held in Cincinnati a few days ago, and the old officers were re-elected as follows: President, A. W. Comstock; vice-president, W. R. Todd; secretary and treasurer, R. E. Field; general manager, E. W. White; superintendent, P. T. Dunn. The increase in the net earnings for the year over last year is 43 per cent. The work of converting the road into an electric line is progressing well, and it is stated that cars will be running between Cincinnati and Georgetown within a month. The erection of the power house is almost completed.

All the rights-of-way and franchises for the Youngstown and Southern Electric Railway Company have been secured and are now held in the name of General Asa W. Jones and John H. Ruhlman. It is intended to make this largely a coal road, and 28,000 acres of coal land have been purchased by the promoters. The matter has progressed so far that it has been announced that work on the road will be begun in a very short time now. The road will extend from Youngstown south to Columbiana.

The United States Construction Company of Toledo has been incorporated by L. H. Gould, J. P. Degnan and others, with a capital stock of $10,000, to build electric railroads, telephone plants, electric-light plants and other things of that kind. The prime object is to build the Toledo, Columbus, Springfield and Cincinnati electric road.

It is stated that George Frey of Springfield has succeeded in financing the Springfield and Washington Court House Traction Company, and that the sum of $1,500,000 will be immediately available to build and equip the line. It is the intention to extend it south from Washington Court House to Hillsboro.

W. B. Strang, Jr., of New York states that the sale of the Detroit and Toledo Shore Line has not yet been consummated, but that he expects to be able to make a statement within a short time as to what has been done. With his words goes the meaning, however, that he has a very good chance of disposing of the property to the Grand Trunk Railway Company.

Frank Sherman, superintendent of the power house of the Maumee Valley line at Toledo, was instantly killed by an electric car Wednesday night. It is stated that street-car accidents at Toledo average about one a day of late.

The Ohio and Pennsylvania Traction Company of Cleveland has been incorporated for the purpose of building an electric line directly from Cleveland to Sharon, Pa., where it is expected to connect with another line to Pittsburg. The road will be built on a private right-of-way, and the construction will be the same as that of a steam road in every respect. It has not yet been decided whether the line will go through Warren or whether it will go direct, and have branches to Warren, Niles and some other towns. The capital stock is $10,000, but it is said that this will soon be increased to $2,000,000. Cleveland and outside capitalists are interested in the company.

The Cleveland, Elyria and Western Railway Company has opened its line from Oberlin to Norwalk, through Berlin Heights and Birmingham. A regular hourly schedule has been made over the line. This makes two through lines from Cleveland to Norwalk, the other being owned by the Everett-Moore syndicate, and is a portion of the Lake Shore line. This road is owned by the Mandelbaum-Pomeroy syndicate.

Work is proceeding nicely on the Miami and Erie Transportation Company's line and 56 boats have been purchased and built for use as fast as the electric tow line is completed.

The Zanesville Street Railway Company has sold its lines to the Zanesville Railway, Light and Power Company, just incorporated.

The City Railway Company of Wheeling, W. Va., has decided to increase its capital stock to $400,000.

C. C. Hale has applied for a franchise for an electric-light plant in the village of Forest. He will also put in a hot-water-heating plant.

Dr. Henry has secured a 10-year contract for electric lights in the village of North Baltimore.

The Citizens' Gas and Electric Company of Lorain has increased its capital stock from $150,000 to $600,000 for the purpose of purchasing the electric and gas plants at Lorain and Elyria. The Lorain company has a capital stock of $300,000 and an indebtedness of $239,000, while the Elyria company has a capital of $100,000 and a bonded indebtedness of the same amount, with some floating indebtedness.

O. M. C.

Information from Indiana.

Indianapolis, Ind., October 6.—The Union City, Winchester and Muncie Traction Company has filed articles of incorporation, with a capital stock of $275,000. This company obtained a charter last July, but surrendered it for a new one. The company will build lines to connect Union City, Winchester, Farmland, Parker City, Selma and Muncie. J. E. Lowes is president and John E. Feight secretary.

The Southern Indiana Electric Railway Company, of New Albany and Jeffersonville, has filed articles of incorporation with the Secretary of State. The company will construct an electric line connecting the two cities, a distance of 25 miles. The company proposes to furnish light, heat and power to the general public. The capital is $300,000, and the directors are N. A. Street, C. R. Taylor, N. I. Keefe and M. E. Callender.

The Mitchell, West Baden, French Lick and Jasper Railroad Company has been incorporated with a capital of $100,000. The road will run through Lawrence, Orange and Dubois Counties and connect the above-named cities. The company reserves the right to use either electric or steam power. The incorporators are chiefly St. Louis people. The directors are S. A. Reaves, Princeton, Ind.; W. E. Brown and G. W. Clawson, St. Louis.

Officials of the Muncie and Portland Traction Company, which is incorporated to build a line between Muncie and Portland, through Albany and Red Key, announce that the entire right-of-way has been secured. Franchises have also been granted in Portland, Red Key and Albany. As Dunkirk is so far out of the straight way, the company promises to build a spur from the main line to that place. Dunkirk people are insisting that the line come directly from Muncie to Dunkirk.

Word comes from Connersville that the long-pending negotiations have been about completed whereby the Lake Erie and Western tracks between Connersville and Cambridge City will be used by the Richmond Street and Interurban Railroad. The track is in good condition and requires but little change to make it practicable for running electric cars. It was on the successful conclusion of this contract that the traction company promised to give Hagerstown an electric line. This experiment will be watched with great interest.

The Ft. Wayne and Southwestern Traction Company, operating between Wabash and Ft. Wayne, is hauling large quantities of wood with its motors from the country districts, and is relieving the fuel famine to some extent. The company loads its flat cars and makes deliveries in the hearts of the cities at prices below that charged by farmers from their wagons.

It is now given out that the main offices of the Union Traction Company will be removed from Anderson to Indianapolis. This move is made necessary to operate successfully the Indianapolis Northern road, now building north to Logansport. The syndicate already has offices in Indianapolis, and President McCulloch will become a resident of Indianapolis upon his return from Europe.

A large heating and lighting plant will be erected in Marion, on ground recently purchased from the Big Four Railroad Company, by the Marion Light and Heating Company. It is now certain that natural gas will soon be gone, and the city will be on a coal basis. Steam and hot-water heating will be in demand. The plant will cost $30,000.

The Western Motor Company, of Logansport, has filed articles of incorporation. Capital, $400,000. The company will manufacture automobiles, electric and other motors and do a general foundry business. Dushane and Richard Talbott are the directors.

The Bristol Power Company, of Elkhart, was incorporated on the 1st inst. with $50,000 capital. The object is to construct a dam across St. Joseph River, construct canals, structures and power houses for the generation and production of electric current and power and the transmission thereof throughout Elkhart and St. Joseph Counties, for the use of cities and towns and manufacturers. E. A. Sanders, James Dushane and Richard Talbott are the directors.

F.

On the Pacific Slope.

Seattle, Wash., October 1.—A franchise has been granted by the county commissioners of Whatcom County for the construction of an electric railway from the city of Whatcom to Lynden, Wash., and a surveying party is now to be placed in the field to locate the line. The franchise provides that the actual work of construction must be started within six months from the time of its granting, but the promoters expect to have it well under way by that time. They will soon apply to the council of the city of Whatcom for a franchise to extend the line into the heart of the city.

An independent company, with F. M. Wade, a Portlan, Ore., capitalist, at its head, has presented to the council of Seattle an ordinance asking that it grant a street-car franchise to cover about 20 miles of streets in the city. Should the franchise be granted, as it undoubtedly will be, it must result in a wonderful development of the already rapidly expanding street-car system of this section. The franchise asks for two main trunk lines. One would extend from the tide flats, in front of the city, via Fremont and Ballard, to Fort Lawton, the new Puget Sound army post, situated upon the bluffs above the Sound, 10 miles out from the city. The other would extend east and west from Elliot Bay, to Lake Washington. Branches take in the territory throughout nearly all the northern part of the city. The life of the franchise is to be 50 years. The city will get two per cent. of the gross receipts, and some of the important lines are to be completed within one year. Metal poles will be erected in the business district, and further provision is made for underground conduits in case the city deems it advisable for trolley wires to go underground.

After many delays on account of the difficulty in getting rails and materials from the eastern shops the Seattle-Tacoma Interurban line, the longest electrical railway in Washington (36 1-5 miles), began its first regular service between the cities of Seattle and Tacoma on the morning of September 26th. The road has been in course of construction for the last 2½ years. It is to be operated by the Puget Sound Electric Railway Company of Seattle and Tacoma, and is to be operated by the third-rail system. The power is obtained from the Tacoma Railway and Power Company, the Snoqualmie Power Company, and the Seattle Electric Company. At Kent, a midway station, there is a well-equipped rotary sub-station. The roadbed is well built and the entire road cost in the neighborhood of $2,000,000.

The county commissioners of Pierce County have granted to this same company a franchise for a term of 30 years for the construction of three more lines. One line is to be an elevated railway, leading from Puyallup Avenue, Tacoma, in the direction of the tide flats. Two lines are to lead from that city into the Puyallup Indian Reservation. These lines are designed as interurban feeders, and to develop the property on the east side of the Sound. This newly organized company expects to invest more in new work in Pierce County within the next two years than has been invested altogether in Tacoma, and between Tacoma and Seattle within the last two years.

The Great Northern Railroad Company will aban-

don a portion of its line between Fairhaven and Bellingham, and run its trains over the new waterfront line known as the Chuckanut Cut-off. As there is much valuable timber and five large shingle mills along the old line, the Great Northern has decided to operate the road as an electric line as a feeder to the main line, connecting at Bellingham and Fairhaven.

The Seattle Electric Company has asked the City Council of Ballard for another franchise to extend its lines in that city by the construction of a line on Third Avenue, from Ballard Avenue to Broadway.

The city of Seattle will construct a municipal lighting plant at Cedar Falls. Engineers have already completed the work of building a dam at that point. The river is now dry, and they can proceed to test the character of the earth to determine on the proper and exact site for the plant. Bonds amounting to $500,000 for the construction of this plant will be sold by the city next spring.

A sum of $40,000 will be raised from various funds to carry on the work this winter. When this new municipal lighting plant is ready, the corporation committee of the city does not intend there shall be numerous private-lighting concerns in operation.

L. E. C.

PERSONAL.

Elmer F. Carter of Swissvale, Pa., an electrician at the works of the Westinghouse Electric and Manufacturing Company, died on September 28th, at the age of 30 years.

Robert C. Bliss has been appointed manager of the Western Union Telegraph Company in Cincinnati, Ohio. Mr. Bliss was transferred from a similar position in Springfield, Ohio.

Rollin D. Larrabee died on October 2d at the home of his brother, Rev. Edward A. Larrabee, Chicago, after an illness of several years' duration. Mr. Larrabee was 39 years of age and a graduate of Harvard. He was an electrician and was for some time employed by the Western Electric Company.

A. S. Roseberry, chief electrical engineeer of the Cincinnati Gas and Electric Company, was killed by electricity on October 6th at the electric plant at Charles Street and Central Avenue, Cincinnati. It is stated that he was constructing an arc-light testing machine, when he received a shock of 5,000 volts and was instantly killed.

T. M. Gathright, superintendent of the Camden Interstate Railway Company, with headquarters at Huntington, W. Va., has resigned. Mr. Gathright goes to Fairmont, W. Va., where he accepts a position with Colonel J. A. Fickinger, who looks after Senator Camden's extensive mining interests, which are located in that part of the country.

George R. Cooke, for several years superintendent of the Interstate Consolidated Electric Street Railway Company's system, recently died at East Providence, R. I. He was connected with the Highland Street Railway Company, of Boston, when its motive power was changed to electricity, and when that company became a part of the West End Company's system, he remained with the latter company. About two years ago he assumed the superintendency of the Pawtucket (R. I.) electric railway system, in addition to his position with the Interstate company, and since then his headquarters have been in Pawtucket. Soon after he was stricken with paralysis, from which he never fully recovered.

ELECTRIC LIGHTING.

The Ord Gas and Electric Light Company of Ord, Neb., has been incorporated with a capital stock of $12,000.

The Chemung County Gas Company (gas and electricity) of Elmira, N. Y., has been incorporated with a capital of $500,000. The directors are Denman Blanchard, A. J. Miller and M. H. Arnot.

An election will be held in Lincoln, Neb., on November 4th, to vote on the proposition of issuing bonds to the amount of $55,000, the proceeds to be used in the construction of an electric-lighting plant.

At a meeting of the City Council of Chicago on October 6th an ordinance granting a 10-year franchise to the Monroe Electric Company, to operate a lighting plant from 145 to 171 Market Street, under the sidewalk, was passed. The compensation is to be 10 per cent. of the gross receipts per year.

ELECTRIC RAILWAYS.

The Evansville and Princeton (Ind.) Traction Company certifies to an increase of capital stock from $10,000 to $60,000.

The Washington (D. C.) Post gives the following: "The electrical roads of the country have a nominal capital of $1,600,000,000, employ 300,000 persons, who are paid $250,000,000 a year, and run 60,000 cars over 20,000 miles of track. Ten miles of electrical road are building to one of steam."

Mayor Capdeville of New Orleans, La., sent a message to the New Orleans Railways Company on the night of the 5th of October to the effect that the railway company must have its cars in operation throughout the city by 10 o'clock the following morning. The company attempted to comply with the order, but the police protection was inadequate, and the two cars started from the barns were taken possession of by the strikers and practically ruined. It is feared that the state militia will have to be called out, as public sympathy is entirely with the strikers and special police cannot be obtained.

Glens Falls, N. Y., is again under the protection of the national guard. Hudson Valley Railway strikers, through their rioting again, forced the military-control move. It is said that the strikers held possession of the town for four hours on the night of October 5th, and that the local police were powerless. Considerable damage was done to the railway company's property during this night, and the following morning saw the national guard again in the town.

PUBLICATIONS.

The Royal Electric Company of Peoria, Ill., has issued a bulletin descriptive of its improved alternating-current generator and a price-list of its transformers. The alternator is of the inductor type and is illustrated with its parts in the bulletin. The transformers listed are for use on circuits having a frequency of from 60 to 140 cycles and have capacities up to 30 kilowatts.

A very complete catalogue has just been issued by the Goulds Manufacturing Company of Seneca Falls, N. Y., manufacturer of efficient power pumps for every service. It contains 160 pages and is well illustrated with the various styles of Goulds triplex power pumps and other pumping machinery. Many of the pumps shown are provided with electric drive, and descriptions are given of the electric starters and regulators furnished. Considerable hydraulic data are also given, as well as complete indices of contents and illustrations.

The Electric Storage Battery Company of Philadelphia, manufacturer of the Chloride accumulator, published for distribution at the street-railway convention, a booklet entitled "A Few Illustrations Selected from 220 Installations of the Chloride Accumulator Operated in Street-railway Service." A brief preface, stating the increase in installations of the Chloride accumulator from October 1, 1901, to October 1, 1902, is followed by 11 half-tone illustrations of the interiors of several battery houses, with a brief synopsis of the different installations made for the railway companies represented.

The Crane Company of Chicago now has ready for distribution its new pocket catalogue of its steam goods and fittings. The book is substantially bound in cloth covers and contains 464 pages, four by 6½ inches in size. The catalogue covers the Crane Company's complete line of standard, medium, low-pressure, extra heavy steam valves, cocks and fittings, hydraulic goods in brass and iron, engineers' supplies, tools, pipe, etc., in fact, everything needed in the steam and hydraulic departments of mechanical plants. The book should be in the hands of every engineer, and may be obtained by writing to the home office of the company or to any one of its 15 branch offices.

TRADE NEWS.

The Locke Insulator Manufacturing Company of Victor, N. Y., was recently incorporated with a capital stock of $150,000. F. M. Locke of Victor, C. P. Brown of Shortsville and H. M. Parmele of East Bloomfield, N. Y., were named as directors.

The Cohen Automatic Electric Block Company of Philadelphia, Pa., has been incorporated with a capital of $1,600,000. The object of the incorporation is the manufacture of electric signals and appliances for railways. The incorporators are G. W. Cohen, George F. Meale, C. L. Stevens and J. B. C. Wheeler.

J. G. Brill & Co. of Philadelphia, Pa., recently purchased the property of the American Car Company of St. Louis, Mo. The amount paid for the property was $375,000. The new company has the following board of directors: J. W. Allison, F. W. Thompson, H. B. Denker, James Rawle, S. W. Curran, W. M. Lycett and W. H. Heulings.

At a meeting of the directors of the Standard Electric Manufacturing Company of Niles, Ohio, recently, it was determined to double the capacity of the factory. J. P. Gilbert of Warren, Ohio, was elected secretary and manager, and the work of further promoting the plant will begin immediately. Mr. Gilbert has been engaged with the Packard Electric Works, in Warren, for the last eight years.

The Vindex Electric Company of Chicago states that it is putting on the market a transformer especially designed for the operation of a single arc lamp. This is furnished in what it calls its style H. By giving special attention to the design of the transformer for this particular purpose, the company says it is able to produce a transformer that operates at an unusual high frequency, regulates much better than ordinary 10-light transformers used for this purpose and has only a slight rise in temperature when operating continuously under a load. Such excellent results have been obtained with this transformer that it should interest every central-station man operating alternating arcs.

The electrical trade, especially the supply contingency of the West, will be interested to know that Sales Agent John W. Brooks, who has for years represented Pass & Seymour, porcelain manufacturers of Solvay, N. Y., and who, during the summer time was seriously ill with typhoid fever, has fully recovered and is again actively looking after Pass & Seymour's western interests. The porcelain business of Pass & Seymour has grown to such an extent that Mr. Brooks has given up the agency of the Crouse-Hinds Electric Company of Syracuse and all other lines that he has been representing, and will in future devote his entire time to Pass & Seymour's interests. Under his charge the switch business of the Crouse-Hinds Electric Company has reached such proportions that it, likewise, now requires the exclusive attention of a western representative. Consequently, the Crouse-Hinds company has just established a store of its own at 133 South Clinton Street, Chicago, under the management of F. F. Skeel. Mr. Skeel came West at the time of Mr. Brooks' sickness, and it has been decided to make him western manager of the Crouse-Hinds business. Mr. Skeel has been prominent in marketing the Crouse-Hinds goods throughout the East, and is well fitted for his present responsible position.

BUSINESS.

The Babcock & Wilcox Company has been awarded a contract by the Underground Electric Railway Company of London, England, for 128 mechanical stokers, to be connected with 64 boilers, for installation in the new power house at Chelsea, London.

The Electric Appliance Company of Chicago is putting forth strenuous efforts just at present to keep abreast of its orders for incandescent lamps. The enormous run on this article the company attributes to the good qualities of the lamp, which is the Packard lamp.

The Illinois Car and Equipment Company of Hegewisch, Ill., just outside of Chicago, has recently purchased a large amount of electrical apparatus which will be used for the operation of wood-turning machinery. An order on the Westinghouse Electric and Manufacturing Company includes two 250-kilowatt and one 200-kilowatt, two-phase alternators, together with a four-panel switchboard and the following induction motors: Two 100-horsepower, five 75-horsepower, and one 50-horsepower.

The Western Electrical Supply Company of St. Louis, general selling agent for the new-type Peerless incandescent lamps, states that, owing to the popularity and exceedingly large demand for this lamp, the factory has largely increased its capacity recently, and while it is making even better lamps than ever, on account of the very greatly increased facilities, the company is offering this lamp at a slightly lower figure than ever. The company states that this lamp is thoroughly high grade in every way, and that it has met with unusual success with it. It is sold subject to the strongest of guarantees.

Among the useful things originated by William Roche, the well-known inventor of the New Standard dry battery, may be mentioned the New Standard flashlight and gaslighter, for home use. For the automobile his Autogas battery sets are used by the best chaffeurs in the country. He says the double porcelain insulated plug (one-inch standard pipe thread) is becoming appreciated now, allowances being made in the drawings of a few of the best gas and gasoline engines built in this country for this plug. There is no ground on one pole of the coil when this plug is used. Mr. Roche reports excellent business on his Autogas battery. This battery consists of eight cells, connected in series with taps on five cells, beginning at the fourth cell of the series, thus enabling the operator to use either four of the eight, or five, six, seven or eight to get the necessary current strength as the cells weaken from use. By thus using one cell at the time in addition to the four original cells the coils are not endangered in any way.

In commenting upon the work of installing 1,250,000 feet of conduit, covering 40 miles of streets, for the Cincinnati Gas and Electric Company, the Cincinnati Enquirer said recently: "In regard to the matter, General Hickenlooper said the other day, that the whole work had been done most expeditiously, and that, considering the shortness of time after the contract between the company and the city was signed until the work was required to be completed, it had been carried on marvelously well. 'G. M. Gest, the contractor,' said General Hickenlooper, 'has handled the business very well, and he has done the work with the minimum of inconvenience to the public. His arrangements for covering the excavations at most frequented crossings, and his use of bridges over the trenches at street crossings, have been productive of the best results, and Mr. Gest deserves a great deal of credit for the way in which he has carried out the enterprise, which is one of the largest undertakings in the way of making conduits that has been done in any of the large cities.'"

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 30, 1902.

709,865. Railway Switch-operating Device. James C. Booth, Monessen, Pa. Application filed May 14, 1902.

A plow carried by a vertically movable shaft on the car is adapted to engage the switch point on either side. An armature lever connected to the shaft is actuated by electromagnets.

709,867. Process of Manufacturing Nitrogen Compounds from Atmospheric Nitrogen. Charles S. Bradley and Dimmitt R. Lovejoy, New York, N. Y., assignors to the Atmospheric Products Company, Niagara Falls, N. Y. Application filed March 9, 1900.

For this and succeeding patent see page 252.

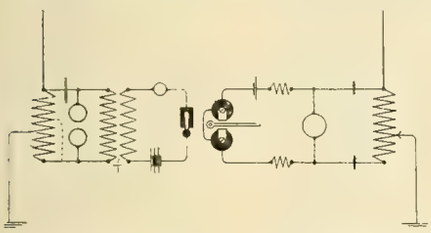
709,868. Apparatus for Subjecting Gases to High-tension Discharges. Charles S. Bradley, New York, and Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignors to the Atmospheric Products Company, Niagara Falls, N. Y. Original application filed March 9, 1900. Divided and this application filed August 29, 1901.

709,878. Manufacture of Rail Bonds. Fred H. Daniels and Horace W. Wyman, Worcester, Mass. Application filed February 7, 1902.

The electrical conductor or bond described consists of a head having a spreader or expander of harder metal inclosed in a central recess therein, and a conductor united to the head by being forged or welded into an open groove extending transversely across the head.

709,915. Control of Electric Motors. Harry W. Leonard, Bronxville, N. Y. Application filed August 26, 1901.

The inventor describes a conveying system in which there are combined two dynamo-electric machines for operating the apparatus, and a main source of electric energy to which the machines are connected. One of the machines operates as a motor through energy received from the source to drive the apparatus, and the other machine operates as a generator driven by the apparatus and supplying energy to the motor.



NO. 710,121.—WIRELESS TELEGRAPH SYSTEM.

709,916. Method of Controlling Electric Motors. Harry W. Leonard, Bronxville, N. Y. Original application filed August 26, 1901. Divided and this application filed December 10, 1901.

The method of varying the tension of a moving cable is described. It consists in causing the cable to drive a generator of electric energy and varying the energy so produced.

709,971. Electrolytic Decomposition of Alkaline Salts. Edwin Edser and Meyer Wildermann, London, England. Application filed March 28, 1901.

The described process of increasing the speed with which alkaline metal existing as amalgam combines with water consists in applying to pieces of carbon a conductive material independent of the amalgam, and then placing the carbon pieces in contact with the amalgam.

709,996. Signal Lamp for Telephone Switchboards. Frank R. McBerty and Frederick H. Loveridge, Evanston, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed May 14, 1900.

The incandescent lamp comprises an open-tubular stem having an enlargement a short distance below its tip, terminal wires sealed to the upper edge of the stem and extending down outside the stem past the enlargement, and a filament carried by the terminal wires.

710,007. Elevator. Joseph Rice, Chicago, Ill., assignor of two-thirds to William H. Reedy and William I. Reedy, Chicago, Ill. Application filed April 8, 1901.

In the elevator are combined a carriage, a track or way on which the carriage travels, a motor mounted on the carriage, cables or strands fixed with relation to the carriage and passing the same on opposite sides of the motor, grip wheels operatively connected with the motor and engaging both of the cables or strands, a lifting cable and means operatively connecting the lifting cable with the carriage at a point between the first cables.

710,045. Electrical Steering Gear. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 23, 1901.

710,050. Constant-current Transformer. Augustine R. Everest, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 4, 1899.

The invention consists of the combination of relatively fixed and movable coils, one of which is attached by suitable means to one end of an oscillating lever. A device adjustably secured to the opposite end of the lever has a curved winding surface, the centers of curvature of parts of which are non-coincident with the axis of oscillation of the lever.

710,052. Apparatus for Maintaining Uniform Resistance in Electric Circuits. Frederick A. Gilbert, Brookline, and Emil O. Lundin, Beachmont, Mass., assignors to the General Electric Company, Schenectady, N. Y. Application filed December 17 1897. Renewed February 3, 1899.

An electric arc lamp provided with series and shunt regulating coils has a controlling magnet in shunt to the arc for cutting out part of one of the coils after a determinate rise of temperature due to starting the lamp, to compensate for change of arc length due to such rise of temperature.

710,055. Electric Arc Lamp. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 24, 1900.

In the lamp are a coil, a spool therefor, a tube which is screw-threaded to one head of the spool, lugs extending downwardly from the other head of the spool, and adjusting screws mounted in the lugs for centering the tube and spool with respect to each other.

710,056. Automatic Circuit-breaker. Caryl D. Haskins, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 14, 1900.

The circuit-breaker comprises a transformer having its primary coil in circuit with a direct-current apparatus, a fragile conductor in the circuit, a block suspended above the conductor and adapted when released to sever the conductor, and means responsive to a current in the secondary coil for releasing the block. Means are provided for expulsively extinguishing the arc formed at the cut part.

710,065. Self-restoring Telephone. Louis J. Loeffler, New York, N. Y. Application filed October 23, 1901.

One claim reads: A signal-wire terminal, a swinging catch forming a talking-wire terminal, a spring for moving the catch to engaging position, an arm carried by the catch, a releasing nose or incline for the catch made to engage the arm, a weight-actuated lever on which the incline is mounted, a contact spring made normally to move clear of the terminals, and a button or handle for moving the contact to the signal terminal, the contact spring being adapted for engagement by the catch when released to clear the signal terminal.

710,067. System of Electrical Distribution. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 31, 1901.

The invention includes a number of inductance coils, the windings of which are traversed by superposed alternating and direct current. There are connections between the windings such that the direct current has no resultant magnetizing effect.

710,068. Method of Maintaining Uniform Resistance in Arc-lamp Circuits. Emil O. Lundin, Boston, Mass., and William A. Paine and Everett W. Burdett, administrators of Frederick A. Gilbert, deceased. Original application filed December 17, 1897. Divided and this application filed April 30, 1902.

The method of regulating electric arc lamps having series and shunt regulating coils is described. It consists in varying the regulating power of the coils when it heats after starting the lamp, inversely to, and to compensate for, change of voltage at the arc accompanying such heating.

710,070. Apparatus for Multirate Metering. Eustace Oxley, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 8, 1899.

Combined in the system are supply mains, a meter or meters for recording the amount of energy consumed at the various points of consumption, means capable of changing the rate of registration of the meters, and an automatic control apparatus operated by current derived from the system for actuating the means.

710,071. Lock. William R. Paige and Henry A. Hoods, Chicago, Ill. Application filed March 1, 1902.

The lock casing has a main keyhole, and an alarm is electrically connected to the lock. Means are provided for operating the lock bolt by the proper key without completing the circuit to the alarm, and spring-actuated sliding means arranged in the casing are adapted when actuated by a false key simultaneously to shift into position to prevent removal of the false key and to complete a circuit to the alarm.

710,072. Electric-railway System. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 28, 1901.

Combined with an electric railway car is a sanding device comprising a rotatable conveyer, a rotating electric motor connected therewith, and means whereby the motorman can start and stop the motor at will.

710,081. System of Electrical Distribution. Charles P. Steinmetz, and William L. R. Emmet, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed December 21, 1899.

710,082. System of Electrical Distribution. Charles P. Steinmetz and William L. R. Emmet, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Original application filed December 21, 1899. Divided and this application filed February 13, 1902.

710,083. Electric Meter. George Stern, Charlottenburg, Germany, assignor to the General Electric Company, Schenectady, N. Y. Application filed December 11, 1900.

An induction meter for three-phase circuits has a main-current winding consisting of a single coil comprising a number of sections each connected in circuit with one of the three-phase mains, a shunt-winding connected between two of the mains, and means for causing the field due to the shunt-winding to be displaced by substantially 90 degrees from the electromotive force impressed upon the shunt circuit.

710,084. Clock Chime. George M. Stevens, Cambridge, Mass., assignor to the George M. Stevens Company, Kittery, Maine. Application filed July 22, 1901.

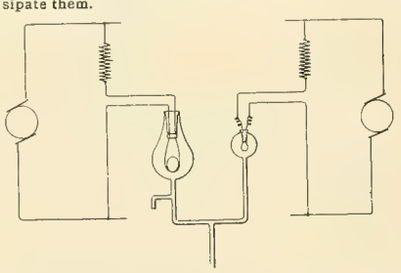
The chime-ringing apparatus comprises a chime of bells, each having a hammer adapted to strike its bell, mechanisms for operating the hammers, electrical circuits including an electrical generator and make-and-break disks adapted to cause the mechanisms to operate and a series of make-and-break disks having contact points arranged to cause the mechanisms to strike the bells in musical order.

710,096. Electric Controller. Wilber A. Carrell, West Homestead, Pa., assignor of one-half to John O. Horning, Pittsburg, Pa. Application filed June 21, 1901.

The regulator or controller described has in combination a series of contact plates connected to resistances, a head carrying contacts and movable along the line of the contact plates, a circuit-changer consisting of electromagnets having contact plates in circuit with the magnets and stationary contact plates, and means for shifting the head and circuit-changer in succession.

710,099. Method of Exhausting Incandescent Electric Lamps of Relatively Low Voltage. Samuel E. Doane, Marlboro, Mass., assignor to the Bryan-Marsh Company, New York, N. Y. Application filed February 7, 1902.

The method consists in first producing a partial vacuum within the bulb of the lamp; second, generating a gas therein; third, passing a current of electricity through the filament of the lamp sufficient to heat it to incandescence, and finally passing an additional current of electricity of higher voltage directly through the gases in the vacuous space so as to act upon the gases in such manner as to dissipate them.



NO. 710,186.—METHOD OF EXHAUSTING INCANDESCENT LAMPS.

710,121. Wireless-telegraph System. Harry Shoemaker, Philadelphia, Pa., assignor to Gustave P. Gehring, Philadelphia, Pa., and American Wireless Telephone and Telegraph Company. Application filed December 11, 1901.

In the system are a transmitter which comprises a source of high-frequency electrical oscillations, connections from the source to the terminals of an autotransformer, and a connection from earth to one terminal of the autotransformer, the portion of the winding so determined operating as the inductance element of a resonant radiating system. (See cut.)

710,122. Wireless-telegraph System. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring, Philadelphia, Pa., and American Wireless Telephone and Telegraph Company. Application filed January 11, 1902.

A conductor for receiving the energy from the natural media is combined with a wave-responsive device influenced by the received energy, a main polarized relay controlled by the wave-responsive device, a second sluggish relay controlled by the main polarized relay and a recording device controlled by the second relay.

710,143. Resistance Coil and Support Therefor. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 26, 1901.

A resistance element comprises two rings of different diameters projecting in opposite directions from an open-work frame. A spiral coil of resistance material surrounds the smaller ring and a number of insulating blocks are mounted in the frame at one side of the coil.

710,158. System of Electrical Distribution. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed October 14, 1901.

A rotary converter and a source of direct-current electromotive force are combined with a number of "star-connected" balancing coils, means for making and breaking connection between the outer terminals of the coils and the alternating-current end of the rotary converter and means for making and breaking connection between the common terminal of the coils and one side of the source of direct current.

710,163. Keyboard Perforator. Donald Murray, New York, N. Y. Application filed July 20, 1901.

An electromagnet is used to operate a striking device by which a series of independent punches perforate a tape or strip.

710,186. Method of Exhausting Incandescent Electric Lamps. Samuel E. Doane, Marlboro, Mass., assignor to the Bryan-Marsh Company, New York, N. Y. Application filed December 10, 1900.

A method of simultaneously exhausting incandescent electric lamps of different voltage is described. It consists in first producing a partial vacuum by withdrawing the air therefrom through a tube or outlet, common to

both; second, forcing a vapor or gas into both lamps for the purpose of further perfecting the vacuum, and, third, simultaneously passing a current of high voltage through the filament of the high-voltage lamp and a current of low voltage through the filament of the low-voltage lamp until they are both sufficiently heated to dissipate the gases which surround the filaments. (See cut on preceding page.)

710,188. Electric Switch. Bartholomew J. Foley, Pittsburg, Pa. Application filed September 22, 1900.

The switch comprises a pair of electromagnets and an armature in position to be attracted by either electromagnet alternately.

710,206. Apparatus for Transposing Electric-circuit Wires So as to Equalize Induction. James O'Brien and John Mattimore, Staten Island, N. Y. Application filed August 12, 1901.

Means for equalizing induction in telephone or other circuit wires are described. They comprise a device mounted on a number of the wires and adjustable longitudinally thereon and within which the wires are crossed, the devices being provided with insulators, by means of which connection thereof with the wires is made.

710,230. Pail-filling and Indicating Device. James H. Wilson, Lowell, Mass. Application filed November 14, 1898.

An electric circuit operating a signal is adapted to be actuated by the operating of a valve.

710,246. Telegraph Fire Hose. Joseph Buchtel, Portland, Ore. Application filed December 16, 1901.

The hose is under the control of the pipeman and has telegraphic means of signaling to a station.

710,257. Magnetic Drilling Jig. Adolph L. De Leeuw, Hamilton, Ohio. Application filed March 24, 1902.

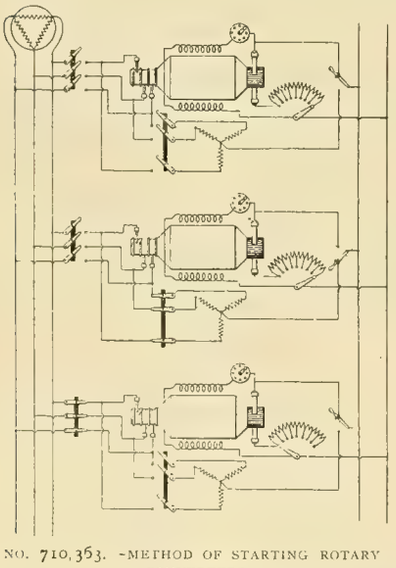
An electromagnet having a polar face is adapted for contact with the surface of the work to be drilled and is provided with a cylindrical guideway having its axis at right angles to the plane of the polar face and terminating at or near the plane of the polar face. A concentric guiding bushing is separably disposed within the guideway and adapted to engage the body of the drill near the cutting lips thereof.

710,264. Electrical Typewriter. Charles Gibbs, New York, N. Y. Application filed April 18, 1902.

The invention comprises a mechanical typewriter provided with levers, a number of magnetic members connected individually with the levers for operating the same, a battery for energizing the magnetic members, a number of brushes connected separately with the magnetic members and provided with contact surfaces, a revoluble member provided with contact surfaces for engaging the brushes, means for actuating the revoluble member, and a manually operated key connected with the cylinder and with the battery for the purpose of closing the circuit thereof.

710,270. Electric Switch. Frederick H. Headley, St. Austell, England. Application filed January 21, 1901.

The switch has four circuit terminals arranged for quick breaks.



NO. 710,363. -METHOD OF STARTING ROTARY CONVERTERS.

710,278. Electric Battery. Timke H. Klinker, Jr., and Richard Gabrielsky, Jersey City, N. J. Application filed April 5, 1902.

In the battery are combined a positive electrode having upwardly projecting tubular members rising from the bottom of the inclosure, a chambered negative electrode suspended in the center between the upwardly projecting members of the positive electrode, and an exciting filling in contact with the electrodes.

710,282. Insulator. Edwin Lefever, Climax, Ohio. Application filed March 29, 1902.

The device combines a body and a support fastened to the body and having an upstanding member provided with tongues adapted to be bent in reverse direction over a feeder or conducting wire.

710,297. Insulator. Ralph S. Peirce, Chicago, Ill. Application filed February 19, 1902.

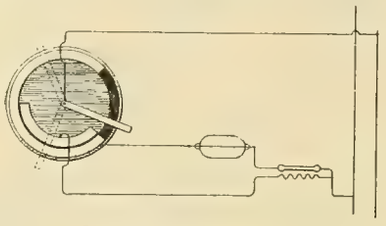
The insulator has a screw-threaded bore, a metal strip projecting within the bore, and a pair of wooden blocks placed against the opposite sides of the metal strip and formed with exterior screw-threads for engagement with the threads of the insulator bore.

710,309. Telephone Transmitter. Mathias Weisser, Milwaukee, Wis. Application filed January 11, 1902.

Parts of the transmitter are a supporting arm a spider or bracket rigidly affixed to the arm a front or body portion rigidly supported from the bracket or spider, and a metallic shell centrally supported between the hub of the bracket or spider and the bearings of the supporting arms.

710,311. Electromagnetic Device for Controlling the Rotation of Shafts. Paul V. Avril, Paris, France, assignor to himself and La Société Mariner, Navoit et Jeanson, Paris, France. Application filed April 29, 1901.

A shaft adapted to be operatively connected to a prime mover carries an electromagnetic device which is adapted when energized to connect the shaft with the prime mover to cause the operation of the shaft.



NO. 710,356. — CIRCUIT BREAKER FOR ELECTRIC-LAMP GLOWERS.

710,318. Toll Apparatus for Telephone Exchanges. William W. Dean, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 14, 1902.

A telephone line extends from a sub-station to a central office. A blocking switch is located at the central office with a magnet connected with the line, and mechanism controlled by the magnet for restoring the blocking switch. A toll device is located at the sub-station and means are controlled in the operation of the toll device for determining the flow of current through the magnet independent of the blocking switch.

710,320. Signaling Apparatus. Howard A. Fessenden, Detroit, Mich., assignor to the Detroit Electric Signal Company, Detroit, Mich. Application filed September 6, 1901.

In the apparatus are combined a signal circuit including a signal adapted to operate progressively, a circuit-breaker and closer included in the circuit, an adjustable operating device for the circuit-breaker and closer, and connecting instrumentalities between the operating device and the circuit-breaker and closer permitting an initial movement of the operating device to the desired extent of its adjustment and a relatively reluctant corresponding movement of the circuit-breaker and closer.

710,333. Selective Calling Appliance for Telephone Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 21, 1898. Renewed May 24, 1899.

Combined with two ringing keys and pivoted switch levers thereof are a pivoted arm, a target or indicator carried thereon, and links between the switch levers and the target lever, whereby the target is set in a different position in the movement of each of the keys.

710,335. Selective Call for Telegraph or Telephone Lines. William Palmer, Jr., Rincon, N. M., assignor of one-half to Charles H. Dascomb, El Paso, Texas. Application filed December 11, 1901.

The selective-call device consists of a pendulum under the control of an electromagnet arranged to be set in motion from a remote point, a notched disk and mechanism for rotating it, and a tripping device for an alarm circuit arranged to be set into action by the notched disk and tripping mechanism.

710,346. Electrometallurgic Treatment of Ores of Copper or Other Metals. Constantin J. Tossizza, Paris, France. Application filed August 6, 1901.

The process of treating electrolytically the impure and ferruginous solutions of sulphate of copper obtainable by the solution of copper ores in sulphuric acid is described. In order to recover the copper electrolytically without special preparation, the electrolytic treatment is proceeded with at a voltage between about two tenths and eight-tenths of a volt with insoluble anodes maintained in contact with sulphurous acid.

710,348. Electrical System of Recording and Checking, as Applied to Railway Signaling. William H. M. Weaver, Macon, Ga., assignor of one-half to Robert J. Speir, Macon, Ga. Application filed June 1, 1901.

An electric train-order apparatus is described. It comprises a despatcher's station, and any number of train-signal-adjusting operators' stations, both the despatcher's and operator's stations being provided with check-signal devices connected electrically with and contemporaneously, automatically, and positively actuated by the movement of the semaphore arm or train signal at the operator's station, the signal being differentiated in kind to show whether it be for danger or safety.

710,354. Wireless-telegraph System. Cornelius D. Ehret, Washington, D. C., assignor to the American Wireless Telephone and Telegraph Company and the Consolidated Wireless Telegraph and Telephone Company. Application filed December 3, 1901.

The method of transmitting intelligence described consists in producing electrical waves, modifying such waves in accordance with the signal sent, receiving such waves upon an aerial circuit resonant with the transmitted waves, and subjecting a wave-responsive device to the excessive potential difference at the terminals of a frequency-determining element of the resonant circuit.

710,355. Wireless-telegraph System. Cornelius D. Ehret, Rosemont, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company. Original application filed December 3, 1901. Divided and this application filed May 29, 1902.

In the system are combined means for generating electrical waves, means for modifying such waves in accordance with the signal sent, an aerial receiving circuit resonant with the transmitted waves, and a wave-responsive device connected to the terminals of the inductance of the resonant aerial circuit.

710,356. Circuit-breaker for Electric-lamp Glowers. Frederick M. Goddard, Pittsburg, Pa., assignor to George Westinghouse, Pittsburg, Pa. Application filed July 20, 1899.

One claim reads: In an electric-lighting system, the combination with a supply circuit, a series-connected glower and ballast device and a heater connected to one side of the supply circuit, of a controlling-switch having a member connected to the other side of the supply circuit and a relatively movable member comprising a short-contact terminal connected to the heater and a long contact-terminal connected to the ballast device, whereby the movement of one of the members relatively to the other serves to connect the glower, ballast device and heater in circuit simultaneously and to maintain the glower and ballast device in circuit after the heater is cut out. (See cut.)

710,363. Method of Starting Rotary Converters. Benjamin G. Lamme, Pittsburg, Pa. Original application filed October 14, 1901. Divided and this application filed February 1, 1902.

The method consists in supplying a direct-current electromotive force of more than half but less than the full normal electromotive force of the rotary converter to its armature winding through a resistance, then supplying the electromotive force to the armature winding through the resistance and "star-connected" balancing coils, then progressively cutting out the resistance until the rotary converter reaches synchronous speed and voltage and finally cutting out the balancing coils and connecting the rotary converter to the alternating-current supply circuit. (See cut.)

710,367. Circuit-breaker. Charles J. Reed, Philadelphia, Pa. Application filed February 17, 1899.

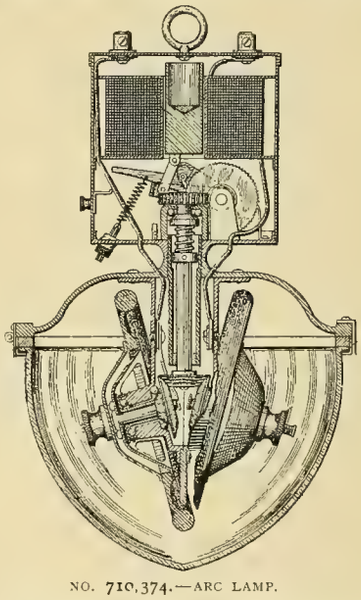
Combined with an electric generator and a main circuit therefor are a normally locked device for opening the circuit which is released by the action of an excessive current to open automatically the circuit and a neutral electrolytic cell or a series of such cells connected in shunt to the circuit-opening device, the cell or cells being short-circuited when the device is closed and being connected in the main circuit in series with the generator when the device is open

710,369. Electric-lamp Glower and Method of Attaching Terminal Wires Thereto. Elijah R. Roberts, Bellevue, Pa. Application filed April 10, 1902.

The method of attaching terminal wires to a tubular glower blank consists in inserting the ends of the wires into the ends of the blank and fastening the same in position by means of paste and then applying a globular body of cement to each end of the glower and the contiguous portion of the wire.

710,372. Decoherer. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring and the Consolidated Wireless Telegraph and Telephone Company, Philadelphia, Pa. Original application filed January 11, 1902. Divided and this application filed June 12, 1902.

The decoherer comprises guideways, a plate movable parallel to the guideways, an electromagnet mounted on the plate, and a hammer pivoted to the plate and in operative relation with the magnet.



NO. 710,374.—ARC LAMP.

710,373. Interrupter for Electric Apparatus. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring and the Consolidated Wireless Telegraph and Telephone Company, Philadelphia, Pa. Original application filed January 11, 1902. Divided and this application filed June 13, 1902.

The interrupter comprises an eccentric, a reciprocating member engaged by the eccentric, a terminal of the interrupter on the reciprocating member, a pivoted member, a leaf-spring secured to the member, and supporting the second contact of the interrupter, and means for rotating the eccentric.

710,374. Electric Arc Lamp. Albert F. Shore, New York, N. Y., assignor of two-thirds to Daniel N. Hurlburt, New York, N. Y. Application filed November 9, 1899. Renewed February 15, 1902.

In an arc-striking mechanism for arc lamps are combined a shaft movable longitudinally in its bearings, a rack on the shaft meshing with gearing regulating the movement of the arc carbons, a lever turning freely on the shaft and controlled by the current flowing in the circuit, and means on the shaft and its bearings for producing a longitudinally directed motion of the shaft. (See cut.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, OCTOBER 18, 1902. No. 16

Independent Belted Motors in Chicago Printing Plant.

During the last few years electricity has been growing very rapidly in popularity among Chicago printers, and especially has the method of connecting independent electric motors to the individual presses received approval. In this way a great economy of power is obtained; the plant is made more reliable; a much greater variety of speeds can be secured; the work is kept cleaner, due to the absence of line shafting. In short, the printer is enabled to do more work in a given space, do better work and produce it more quickly, thereby reducing cost of labor and increasing profits.

One of the most complete and scientifically equipped plants in town, from an engineering point of view, is that recently installed in the new premises of the Corbitt Railway Printing Company, located at 383-389 LaSalle Street, near Harrison. This installation consists of about 20 General Electric direct-current motors and was planned and installed by the engineering and construction departments of the Chicago Edison Company in accordance with the latest practice for such installations. The old presses, as well as additional ones which were bought at the same time, instead of being operated, as formerly, by variable-sized pulleys from a line shaft, were each provided with an independent motor.

The plant was completed last April, and since that time not one motor has given any trouble, the operation of the entire outfit having been a complete success. The cost of current has been an agreeable surprise, and at the same time it has been possible to do more and better work from the same presses than ever before.

The General Electric Company has designed a special class of variable-speed motors for printing presses, and 10 of the Corbitt presses were equipped with these motors. These were all flat-bed presses, as follows:

1 Cottrell 38 by 56-inch four-roll perfecting press
1 Cottrell 46 by 60-inch four-roll press
1 Cottrell 43 by 60-inch four-roll press
1 Cottrell 42 by 56-inch four-roll press
1 Cottrell 38 by 52-inch four-roll press
1 Cottrell 38 by 52-inch two-roll press
1 Cottrell 43 by 62-inch two-roll press
1 Cottrell 35 by 52-inch two-roll press
1 Whitlock 25 by 35-inch two-roll press

The 10 motors driving these presses were divided in size as follows: One of 7½ horsepower, three of five horsepower each, four of three horsepower each, and two of 1½ horsepower each. These motors were developed from standard slow-speed motors, the 7½-horsepower printing-press motor being developed from the 10-horsepower, slow-speed frame, the five-horsepower from the 7½-horsepower slow-speed frame, the three-horsepower from the five-horsepower, and the 1½-horsepower from the two-horsepower. They are so designed that when running with no external resistance in either field or armature circuit they will run at a speed of 650 revolutions per minute, with the exception of the 7½-horsepower, which runs at a speed of 550 revolutions per minute. By introducing resistance into the field circuit the speed may be increased up to 950 revolutions per minute on all motors except the 7½-horsepower, where the maximum speed is 800 revolutions.

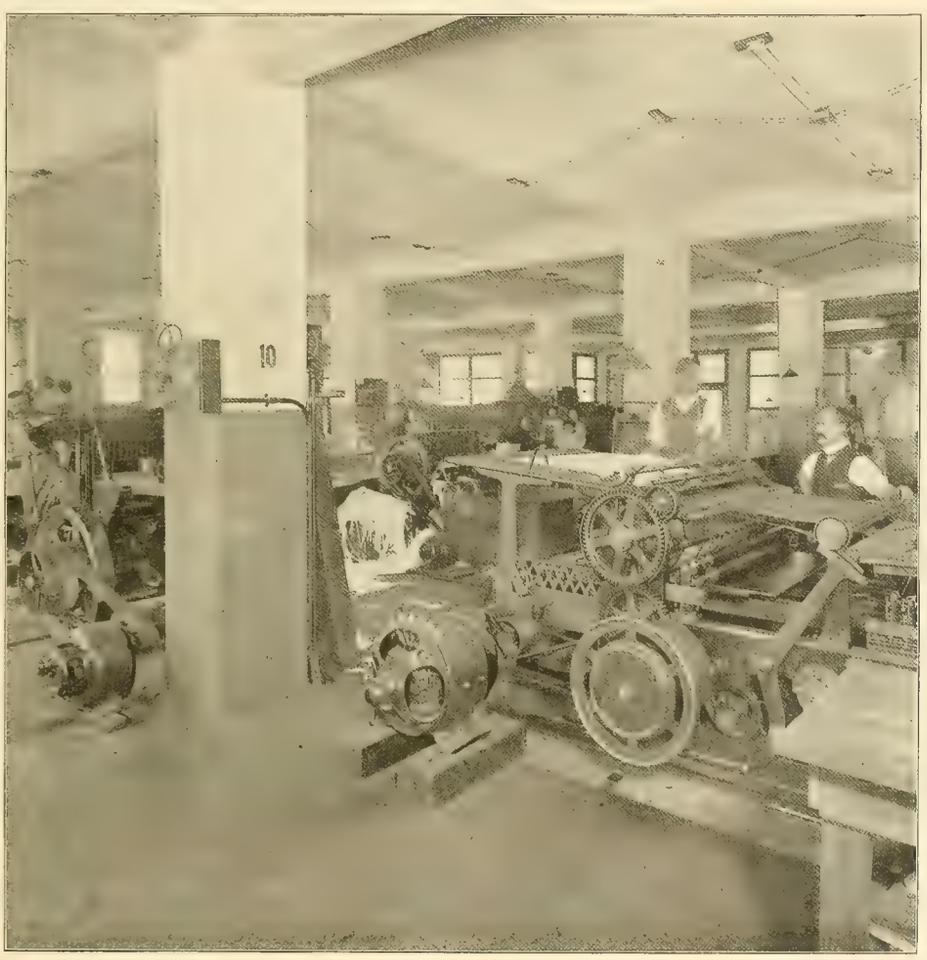
With each motor is also installed a speed controller which regulates the speed of the motor by introducing resistance into the armature circuit, and is not only used in starting the motor, but also has about 10 speeds, including two back-up speeds. This controller will cut the ordinary running speed of the motor down to about 350 revolutions, if necessary, and, while the press is in operation, the motor may be reversed at any time, using the two back-up speeds.

In addition to this wide range of speed, the motor is connected to the Edison three-wire system through a triple-pole, throw-over switch. By throwing this switch the voltage in the armature circuit may be changed from 220 volts to 110 volts, thus reducing the speed of the machine 50 per cent. When the armature is running on 110-volt current the same variation may be secured by means of the field resistance and the resistance in the armature circuit, as above described, so that it is possible to secure any range of speed that may be desired.

As will be seen in the accompanying illustrations, the triple-pole, throw-over switch is in each case mounted on an extension of the field-controller front, and this switch, with the field controller, is placed on a post near the press. The controller which introduces resistance into the armature circuit is mounted directly on the press by means of iron supports.

All of the wiring connections between the controllers and the presses are installed in iron-armored conduit. The conduit is fastened to the press and the floor by iron clamps, and not only protects the wiring, but keeps it out of the way of the pressmen. The controller resistance, instead of being mounted upon the press, is placed underneath the press in an out-of-the-way location, the wiring connections between the resistance and the controller being installed in iron conduit. These 10 motors are all compound-wound, as is customary with motors operating under such variable loads and speeds. The controllers were manufactured by the General Incandescent Arc Light Company and are provided with removable segments and automatic release.

In order to appreciate the advantage of the arrangement above described, it might be well to state the ordinary conditions when operating from a steam plant. These presses were formerly run from a line shaft, four different speeds being secured by different-sized pulleys. The presses would operate at speeds ranging from about 900 to 1,700 impressions an hour. By the old method it was necessary, in changing the speed of the press, to make a difference of several hundred impressions, while, by the new method, a variation as close as five or 10 impressions per hour is secured. The great advantage of this in getting out work will be readily appreciated by the practical printer.



INDEPENDENT BELTED MOTORS IN CHICAGO PRINTING PLANT.—MOTORS DRIVING PAPER CUTTERS AND PRESSES.

In addition to the above-described special press motors, there are three one-half-horsepower, shunt-wound motors, which operate three small presses. There are also a two-horsepower, compound-wound motor which operates a large paper cutter, a two-horsepower motor which operates two large folders, two one-fourth-horsepower motors which operate two book trimmers respectively, and one one-half-horsepower motor which is used on a round-cornering machine and a single folder. One one-half-horsepower motor is used to operate a stitcher, and two one-fourth-horsepower motors operate a trimmer and stitcher, respectively.

All of the 10 special printing-press motors are provided with belt-tightener heads. This enables the motor to be as near to the press as may be desired, and allows the use of a small driving pulley on the motor without danger of any slipping of the belt. After careful experimenting with the different methods of connecting motors to presses, this has been adopted by the General Electric Company as the most practical and satisfactory, all things being considered. Perhaps the only criticism that can be offered on the installation is that the motors appear somewhat large for the work which they have to do. It appears, however, that the policy of the General Electric Company has been to use a larger and heavier motor than has heretofore been customary with printing-press drive, owing to the unusual demand made upon motors in this class of work.

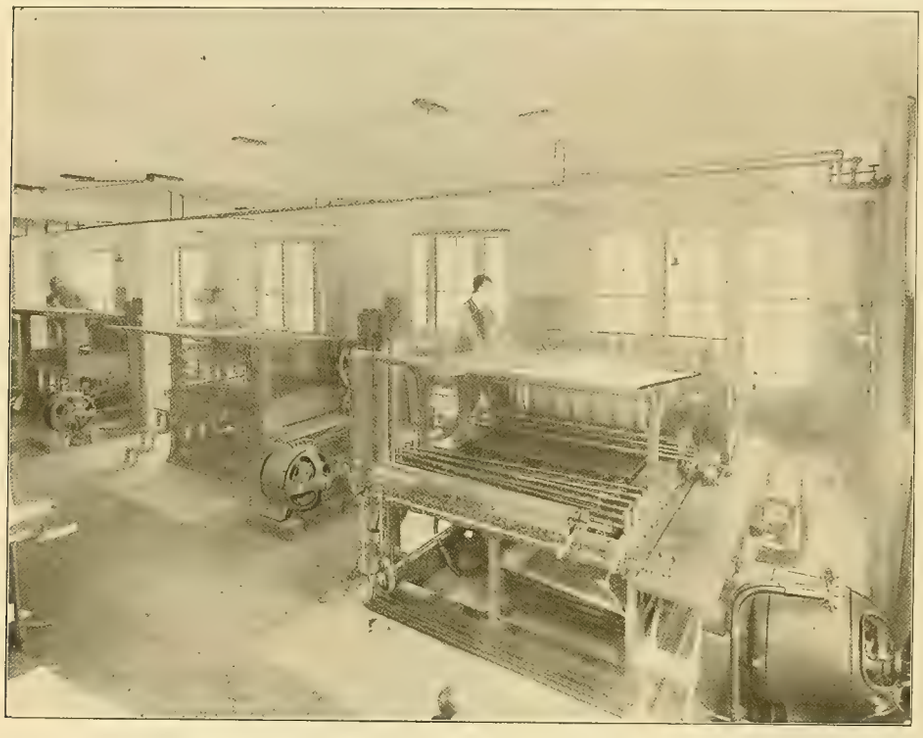
Street Railway Accountants' Association.

At the concluding session of the Street Railway Accountants' Association in Detroit last week the report of the committee on a standard form of report for electric railways was exhaustively discussed. The report was approved and the committee continued, with power to make modifications in conference with the National Association of Railroad Commissioners. The following-named officers were elected for the ensuing year: President, Henry J. Davies of Cleveland; vice-presidents, Irwin Fullerton of Detroit, D. Dana Bartlett of Boston, C. J. B. Hogarth of Denver; secretary and treasurer, W. B. Brockway of New Orleans; executive committee, H. C. Mackay of Milwaukee, O. M. Hoffman of Lancaster, Pa., and Elmer M. White of Hartford, Conn.

The Street-railway Problem in Chicago.

By Frank I. Bennett,
Chairman Local Transportation Committee.

A proper understanding of the transportation problems confronting the city of Chicago necessitates a brief history of street railways in this city. The first authority for the construction of street-car lines was an ordinance passed by the City Council in August, 1858. This ordinance authorized several individuals to construct, equip and maintain street-railway lines, and the grant was for a period of 25 years, and until the city should elect to purchase the property of the parties receiving this grant. At that time there was no specific authority vested in the city to grant franchises to street-car lines. The persons receiving this grant, in order to fortify their interests, on February 14, 1859, secured an act of the Legislature incorporating the grantees in the prior ordinance as the Chicago City Railway Company. The life of the company, by this act, was fixed at 25 years, and authorized the construction of car lines on the south and west divisions. By the same act of the Legislature, the North Chicago Street Railway Company was incorporated, with authority to construct lines in the north division of the city. On May 23, 1859, these companies were incorporated, and were by an ordinance of the city of Chicago given franchises upon certain streets for a term of 25 years. In February, 1861, the Chicago West Division Railway Company was incorporated, and shortly thereafter the Chicago City Railway Company transferred to the West Division Railway Company all of the lines controlled by it in the west division of the city.



INDEPENDENT BELTED MOTORS IN CHICAGO PRINTING PLANT.—MOTORS DRIVING CYLINDER PRESSES (PAGE 269).

Early in 1865, what is commonly known as the "99-year act" was passed by the Legislature. This act extended the life of the three corporations above named to 99 years, and attempted also to extend the rights theretofore granted to the individuals and the three companies named, and such rights as had been given by the ordinance of the city of Chicago. After the passage of this act, public indignation was aroused over the attempt to take from municipal control the regulation of the street-car lines. Governor Oglesby vetoed the so-called "99-year" act, and it was passed over his veto.

When the new constitution of the state was adopted in 1870, a provision was inserted requiring the consents of any incorporated city, town or village to the location or operation of street-car lines. In 1872 a general act for the incorporation of cities and villages (which was later adopted by Chicago) was passed. This act contained a provision that thereafter no grant could be made for a longer term than 20 years. The so-called "Horse and dummy" act—passed in 1874—also contained this limitation.

In 1883 the city claimed that the franchises had expired. The companies, on the other hand, claimed that, by virtue of the act of 1865, their rights extended for 99 years.

Prior to 1883 there was much controversy concerning the right of the city to collect license fees for cars, and, after some litigation, an agreement was made that the license fees in arrears were to be paid by the companies, and their rights to occupy the streets were extended for a period of 20 years. This agreement, however, contained the provision that none of the existing rights of the companies, if they had any, as to a longer term, should be affected.

At about this time the cable system was installed. The general plan of the cable system was to convey the passengers to the heart of the city over the principal highways, leading to the various divisions of the city, by means of cable power and to feed these lines by cross-town lines, requiring the use of transfers.

In the early '90's electric power came into use, and many franchises were then granted in the various divisions of the city for what is known as the "trolley system," comparatively few of which run to the downtown district.

When the cable system was adopted it was thought to be the proper solution of the transportation problem, and, in fact, for a number of years, it was so far an improvement over the slow method of horse cars, that it was thought that Chicago had the ideal system. As time has passed, however, these cable systems have, by reason of the heavy tax, and wear and tear, reached a state where they are now in a most dilapidated condition and totally unfit to perform the service which is required of them. Many of the cable lines now haul electric motor cars from outlying districts into the heart of the city. The roadbeds for cable lines were constructed to carry the weight of the cable grip cars and the trailers, which are very light as compared to the heavy 10 to 25-ton motor cars, which contain their own mechanism for propulsion. The placing of this extra weight upon the roadbeds and the additional load upon the cables has resulted in destroying many of the roadbeds over which they are hauled, and has reduced the life of the cable to a point where it renders continued service of the cable very uncertain and results in very frequent interruptions of traffic. These cable lines have been so taxed by the additional weight of these trailers that it has reached the point now where it is not practical to add any further cars to the already overloaded system. In fact, it is conceded by all of the companies that we have reached a point where the cable must be abandoned.

In 1903 20 years after the making of the extension agreement, as above referred to, the city of Chicago contends that the rights of the companies will cease and terminate as to these arteries and as to all lines embodied in the agreement of 1883. The companies, on the other hand, contend that their rights still continue to the end of the 99-year term, dating from 1865.

It is conceded on all sides, that the transportation facilities, as they now exist, are wholly insufficient to take care of the street-car traffic. The rolling stock is wholly worn out and the downtown terminal facilities are so congested that a betterment of the service could not be had without substantial reconstruction of the various surface lines.

Chicago is probably unlike any other large city in this country as to the question of local transportation. While in New York city there is at present no rapid transit outside of the elevated roads, if they may be called rapid transit, our rapid transit is largely supplied by the various steam railroads entering the city. The south and southeast are served by the Illinois Central express and suburban trains. The south of the city is served by the Chicago, Rock Island, Chicago and Eastern Illinois, Lake Shore and Michigan Southern, and the Chicago and Grand Trunk railroads. The west and southwest are served by the Illinois Central, Chicago, Burlington and Quincy, Chicago and Northwestern and Wisconsin Central railroads. The north and northwest are served by the Chicago and Northwestern and Chicago, Milwaukee and St. Paul railroads. In addition to these steam roads, we have the various elevated roads running to the various divisions of the city, some of which provide express service. Our problems of transportation are therefore limited chiefly to the surface lines, serving more particularly the population in the city proper.

The first problem that confronts us in settling the complex question is the adjustment of the rights of existing companies, probably 60 per cent. of whose lines do not expire for many years to come. I here refer to the unquestioned rights existing by virtue of ordinances granted by the city since 1883. The City Railway Company and the Union Traction Company, which companies control the larger part of these lines, have, through communications to the City Council, expressed a desire to take the matter up with the city, with a view to its adjustment. While admitting the inadequacy of the service, these companies contend that they are not justified nor able to expend a large sum of money, necessary to reconstruct and re-equip their lines, unless an adjustment of the conditions can be made and additional rights given which will authorize the reconstruction of these trunk lines.

Much discussion has taken place as to the proposition of municipal ownership of public utilities, more especially of the street-car service. At the last municipal election a vote was taken upon the proposition which resulted in the declaration by the people that municipal ownership was their choice. While the subject was not presented in the campaign or in the press in such a manner as to advise the voters as to the exact conditions confronting this city at the present time, and although a discussion of these conditions might have resulted in a different decision, yet this wish, as expressed by the vote, should be considered as binding upon legislators, at least for the time being, providing there is a possibility of complying with such expressed wish. Granting, therefore, the feasibility in theory of municipal ownership of street-car lines, what can be done at the present time to that end? As we have seen in the foregoing, 60 per cent. of the street-car lines do not expire for, say, an average of 10 years from this time. As 20 years is the limit of any possible grant, the rights of the companies as to this 60 per cent. are vested for half of that time. It is apparent, therefore, that whether municipal ownership is adopted, or whether grants are made to these corporations, negotiations must be had with these companies as to their vested rights. Again, the city at the present time has no legal power either to own or operate the street-car lines.

A further obstacle in the way is that of finances. To construct and equip a system of street-car lines in this city, including subways, would require in all probability between $50,000,000 and $60,000,000. When we consider the fact that the city's bonded indebtedness at the present time is only about $16,000,000, and that that amount is all of the bonded indebtedness for which there is any authority under the present constitution; when we consider that it is impossible to raise sufficient revenue to construct permanent improvements, such as bridges, to pay public benefits on the improvement of streets, for street intersections, and for the various other improvements, the expense of which should be borne in part by posterity, it will be seen that an attempt to change the constitution and to authorize the issuance of bonds for more than four times our present bonded indebtedness will be seriously considered by the people or the taxpayers before it receives their sanction. Municipal ownership, therefore, is an impossibility at the present time. Had we the full authority and legal right to own and operate these lines, the question of financing the project is so stupendous that it certainly could not be brought about for several years to come.

There seems, therefore, to be but one of two courses to be adopted: Either to grant franchises to existing companies, which will contain the provision that the city may take over the lines at stated times during the grant—say, in five, 10 or 15 years (this would enable the city to secure legislation and to make the attempt so to modify the constitution as to permit the issuance of bonds in payment therefor), or permit the present totally insufficient service to continue and Chicago to remain as a back number as to the street-car transportation until the expiration of the franchises now existing—the last of which, I believe, does not expire until 1917. This last course would seem to be suicidal to the interests of a city which has been so progressive in all other matters and so deficient in street-car service.

Leaving out of the discussion the question as to the rights of existing companies, or to whom new franchises should be granted, and omitting the proposition as to municipal ownership, what should be done to furnish adequate transportation on surface lines in the city of Chicago?

Naturally, attention is first directed to the congested business center into which all lines must lead, and where adequate terminals must be provided. It is obvious at once that adequate terminal facilities

must be provided in order to transport rapidly the great multitude of people who go to the center of the city in the early rush hours and depart therefrom at the close of business in the evening. It is absolutely necessary that the various lines entering the heart of the city shall enter and depart over lines which are not intersected by other lines coming from the various divisions of the city. In settling this question properly, it is necessary, not only to take into consideration the conditions as they exist to-day, but to look to the future, as in the reconstruction of these lines enormous sums of money will necessarily be required.

From the southern division of the city there are but three main thoroughfares, from which the traffic, which comprises about 40 per cent. of the entire street-car traffic of the city, must be transported. From the west division, although the larger division of the city, only about 35 per cent. of the riding public enters the business district. This district must either come through tunnels or over bridges, or both. From the north division, about 25 per cent. of the riding public enters the business district. The west division has numerous streets from which it can enter the business district. The north division, like the south, is limited to comparatively few streets, owing to the narrowness of the city at its southern end and owing to the contour of the Chicago River. The people from each of these various divisions should be delivered at a point as near the business district as is practicable, and this cannot be accomplished in a manner that will care for the increased population of the future without additional tunnels and without subways in the business district.

As has already been stated, it is impracticable to have the lines of one division cross the lines of another. Observation of the conditions which exist on Clark Street, where the lines of the Chicago City Railway Company cross those of the Union Traction Company on Madison, Monroe, Adams and Van Buren Streets, will at once satisfy the observer on this point.

In New York city the plan of subways contemplates a system to be operated entirely independent of the surface lines, and is intended to furnish rapid transit more particularly for the residents of the northern portion of the narrow island upon which New York city is built. As has been heretofore stated, the rapid-transit problem is not in question here as there, and therefore our subways would not be of the same character as those of New York city, but would be used solely by the surface lines for the purpose of passing under the lines from the other divisions and for the purpose of giving additional facilities during rush hours.

Many problems arise at once when the question of subways are taken into consideration. That it is perfectly feasible to construct subways beneath the surface of the streets, without interference with the buildings of the city, cannot be doubted. The principal problem to be solved is how to finance the project, the city being at the present time up to its bonded limit. The question of constructing subways is therefore entirely a financial one. On the surface lines, in the downtown district, trolleys cannot be permitted, and an underground electric system must be installed. Owing to the condition of the soil and the sewers of the city, it is a mooted question as to how far these underground trolleys should extend, as the proper drainage of the conduits is an absolute necessity, in order that the system may be effective when installed. Artificial drainage will undoubtedly be required, wherever the underground trolley is constructed and operated. It is very clear, however, that this must be done in the business district and for a reasonable distance in each direction from the business center. As the contents of these artificial drains will have to be pumped, although the cost of installation of these sewers alone will not be so excessive, yet the question of maintenance of these pumping stations becomes a serious question when the lines are extended for any distance (the construction of 500 miles of underground elctricity would cost probably $65,000,000); for instance, if they should extend over 500 miles or more of the electric lines of the street-car system of this city, the maintenance of these pumping stations would be very expensive.

Having settled the downtown terminals, the question of routing of cars, so as to avoid transfers, becomes an important one. As many of the traveling public, as is possible, should be able to take cars from the business district to their destination without the use of transfers. Where this is impossible, and it will be in some cases, a proper system of transfers should be provided, giving the passenger a continuous ride to his destination. It is thought by those who are well advised on the subject that transfers can be largely done away with. Again, it is conceded that passengers should be delivered from one section of the city to another by transfer from the lines of one company to another, if separate companies should obtain the grants, so that a passenger could go from one point in the city to another for a single fare.

All of the cable lines must be replaced by substituting either underground or overhead trolleys. More modern roadways should be installed, so as to make the roads more comfortable for the traveling public. The operation of single cars in New York city and other large cities has demonstrated the desirability of the change from train system to that of the single-car system. This change, it is thought, will not increase the cost of operation, but, on the other hand, it is claimed that it will decrease the cost of operation, will result in fewer stops for each car and will in a measure relieve the congested condition of the downtown district caused by the delaying of traffic and pedestrians by the passage of these long trains crossing street intersections. The passage of a single car across a street intersection will cause no more obstruction than the passage of an ordinary vehicle. There will be less danger to the public, as single cars can be operated more safely and kept in better control. The use of large cars, such as are now operated on the Clark Street line of the Chicago City Railway Company, will greatly increase the capacity of the lines without increasing the number of cars, say, 75 per cent., and, owing to the double trucks, will be more comfortable to the passengers riding. Again, these cars are of sufficient weight so that proper brakes controlled by mechanical power can be used, and the cars thus kept under better control of the motorman.

When it is considered that the population of this city has doubled in the last 10 years, the necessity for continued increase in the service will become apparent.

The question of rates of fare is also a mooted one. Whether the city should insist upon the lowest fare and omit the question of compensation, or whether it should adhere to the five-cent fare, and require compensation, is one upon which there is much difference of opinion. Owing to the financial condition of the city and to the fact that the operation of cars in the city streets require much additional outlay on the part of the city, which is not borne by the companies, the five-cent-fare proposition with compensation seems to be the most feasible.

Of course, the main question is that of service, and all other considerations should be secondary to the question of furnishing adequate service at all times. Under our existing laws, if franchises are given to private companies, such rights can only be granted for a period of 20 years. In case of grants to private companies, it is contended that the city should reserve the right to require extensions into new territory whenever the demands of such territory require it. Provisions should be made whereby the service should at all times keep pace with the growth of the city, to the end that the transportation facilities shall at all times be sufficient to serve the traveling public.

The question of the kind of rails is a serious one. Considering the transportation problem as one of transportation solely, it would require a certain character of rail, but when this same question is considered with reference to the preservation of pavements and the passage of vehicles over and across the street-car tracks, an entirely different character of rail is necessary. For the propulsion of cars by electricity, it is essential that sufficient bearing surface for the tire of the wheel should be provided, and the difficulty which arises from rails of

Thomas Carey.

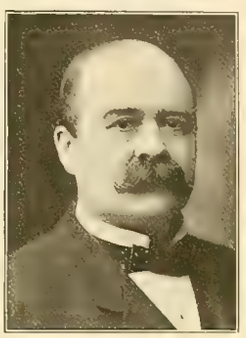
Francis D. Connery.

Henry F. Eidmann.

Milton J. Foreman.

William S. Jackson.

Frank I. Bennett, Chairman.



William Mayor.

William T. Maypole.

John Minwegen.

Walter J. Raymer.

Charles Werno.

LOCAL TRANSPORTATION COMMITTEE OF CHICAGO (EXCEPT ALDERMEN BUTLER AND HERRMANN).

BION J. ARNOLD, CONSULTING STREET-RAILWAY ENGINEER FOR CITY OF CHICAGO.

the grooved pattern, which are essential to the proper preservation of streets, carries with it the objection that the grooves will fill with obstructions unless the streets are kept thoroughly cleaned, and will make not only a rough-riding road, but one that will at times interfere with the best operation of the motors. Our streets must be preserved, however, and the vehicle traffic must be cared for as well as that of the street-car system.

It is therefore clear that so far as possible what is known as the grooved type of rail should be installed.

There are many details as to method of construction, character of rolling stock and manner of operation which would require great length to discuss, and I shall therefore refrain from so doing. It suffices to say that a city of two million inhabitants, which, in 20 years to come, will probably be double that number, should at all times be provided with the best roadways and equipment known to modern science, and that it should not only be installed at the present time, but as new devices and better equipment are brought forward by science, they should be adopted and used in the city of Chicago.

[The City Council's local transportation committee has retained Mr. B. J. Arnold of Chicago to investigate fully the factors entering into a satisfactory solution of the street-railway problem of Chicago, and it is expected that his complete report will be submitted to the committee within a few weeks.—Ed.]

Tentative Plans for World's Fair Intramural Railway.

Preliminary plans for the intramural railway to be built on the St. Louis World's Fair site have been submitted by Weston Bros. of Chicago. Director of Works Taylor, after inspecting the plans, said that the main features embodied would be carried out.

The plan provides for a third-rail road 9.66 miles in length, which will traverse the exposition site in three loops of widening circumferences coinciding at their eastern end. The first loop will skirt the outer line of the Forest Park section of the grounds, passing close to the paling fence and serving the state group of buildings, the Government Building and passing the main picture on its eastern and northern sides. Thence it will pass the Transportation Building on its northern side and run parallel to Skinker Road to the southern end of the grounds, in this way serving the "Pike," or street of concessions, and completing the loop by running close to the fence on the southern boundary. The second loop will serve the Art Building and the fisheries pavilion of the Government Building, running on the summit of Terrace Hill, Art Hill and Government Hill some distance back from the brow. The third loop of the intramural railway will cross Skinker Road, running north of the Administration Building and skirting the northern line of the university tract to the gymnasium and athletic field. Thence it will bend to avoid the Brent farm, which is not included in the exposition site, running close to the Philippines exhibit and the camping grounds and joining the first loop near Skinker and Clayton Roads.

Cars on the three loops will be run in the same direction, as the hands of a clock travel. The main picture of the exposition will be the starting point for all three loops, and it will be possible for a person to board a car there for any point on the grounds. The track will be, as was said in a previous issue of the Western Electrician, elevated throughout most of its course. Wherever it becomes a surface road the third rail will be placed underground in an open-slot conduit. The elevated structure will be built of timber, owing to the impossibility of securing structural steel in a short space of time. More detailed plans will be submitted later on, and the contracts for the construction let without delay.

Electrical Parade in Kansas City.

Brilliant results were attained by the electrical night parade which was a feature of the Kansas City Carnival on October 8th. The floats were arranged to be drawn on the tracks of the Metropolitan Street Railway Company and current was obtained from the trolley wire to operate many-colored incandescent lamps, which decorated the beautiful floral designs employed.

The pageant was headed by a large silk banner of the patron goddess of the carnival, which was illuminated by light from a powerful searchlight. Following the banner came the different floats: Pallas, Magnolia, Pansy, Morning Glory, Wisteria, Sunflower, Moonflower, Pond Lily, American Beauty, Carnation, Poppy, Cornflower, Chrysanthemum, Hollyhock and the Evolution of the Butterfly. The display was a resplendent and beautiful one and excited great enthusiasm.

Electrical Steering Gear.

Maxwell W. Day of Schenectady, N. Y., has invented an electrical steering gear for use in steering vessels, moving signals, turrets, train-control apparatus and the like, that possesses some ingenious features. In the following account the apparatus is described in connection with the steering of vessels. The object of the invention is to simplify existing systems for this purpose and insure a prompt and accurate response by the rudder or the like to the movements of the steering wheel or other controlling handle.

The invention (Fig. 1) consists in a motor (F) geared to the rudder and supplied with current from a generator (A) having two field windings (a) and (a′) wound in opposite directions and two rheostats (B) and (C) controlling the supply of current to the field windings, rheostat (B) being controllable by the steering wheel and (C) being mechanically connected to the motor. When both rheostat arms stand in the same position, the two field windings will be energized by equal currents, and as they oppose each other, no current will be generated and the motor will remain at rest; but if the steering wheel is moved, thereby shifting one rheostat arm and causing a different current to flow through one field winding from that in the other, the resulting differential field will generate a current which will start the motor and cause it to shift the rudder and at the same time swing its rheostat arm until the field winding connected therewith receives the same current as the other, when the generator current will cease and the motor will stop.

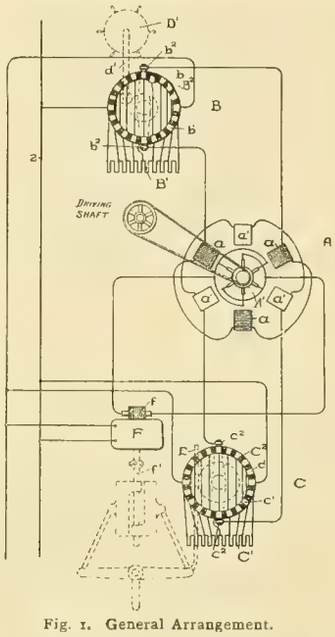
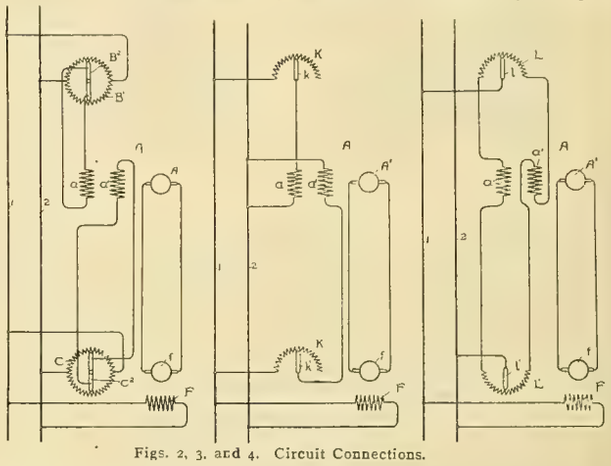


Fig. 1. General Arrangement.



Figs. 2, 3, and 4. Circuit Connections.

ELECTRICAL STEERING GEAR.

The rudder-operating electric motor (F) has its field coils constantly energized by current taken from the lighting mains (1) (2). Its armature (f) is in circuit with the armature (A′) of the generator (A). The shaft (f′) is geared to the rudder head, preferably through a right and left-hand screw, connected with the shaft (f′). Each half of the screw carries a traversing nut, sliding on a guide rod and connected with one end of the rudder-head by a link. One of the nuts carries an arm, on which is a rack. If desired, the rack may be pivotally connected with the rudder-head, as shown in Fig 1.

Mr. Day describes the operation of his invention as follows: "When the brushes (b^2) (c^2) stand in the middle positions, as shown in Fig. 1, there is little or no current flowing to the field windings of the generator, and hence no current is generated by it. Suppose, now, that the steering wheel is turned over to starboard, moving the upper brush (b^2) to the right and the lower one to the left in Fig. 1. This results in shunting more or less of the middle portion of the resistance (B^2) and permits current to flow from the upper brush (b^2) through the coils (a) to the lower brush (b^2). The constantly rotating armature of the dynamo (A) at once sends current through the armature of the motor (F), which immediately starts rotating, causing the nuts to separate from each other and turning the rudder to port. At the same time the rack rotates a gear and causes the upper brush (c^2) to move to the right and the lower one to the left. This shunts the middle portion of the resistance (C′) and allows current to flow to the coils (a′), but in a direction to produce an opposite magnetization to that generated by the coils (a). As the movement of the brushes (c^2) continues the opposing magnetism of the coils (a′) increases until it finally equals that of the coils (a), at which point the armature current has been reduced to zero and the motor stops, holding the rudder in a position corresponding to the angular movements of the brushes (b^2) and (c^2). When a straight course is to be steered again, the steering wheel is returned to its normal position, bringing the brushes (b^2) again to the position shown in Fig. 1 and de-energizing the field coils (a). The field of force due to the coils (d′) will now cause the armature to generate a reversed current and the motor will at once start backward and return the rudder to its amidship position."

The circuits shown in Fig. 1 are diagramed more simply in Fig. 2, in order to facilitate comparison with the modified circuits shown in Figs. 3 and 4. Also in this figure for the sake of simplicity of illustration the rheostat (B′) is shown as comprising two rheostats connected in multiple instead of a single rheostat cross-connected to two sets of contacts, as shown in Fig. 1. In the system of Fig. 1 the connections are so arranged that when the steering wheel and rudder are both at their mid-position no current will flow in the differential field winding of the generator. In Figs. 3 and 4 are illustrated two modified arrangements of the circuit connections, in both of which the sections of the differential field winding are at all times supplied with current.

In the system illustrated in Fig. 3 the flow of current in the winding (a) of the generator (A) is controlled by means of a rheostat (K), operatively connected to the steering wheel, and the flow of current in the winding (a′) is similarly controlled by means of a rheostat (K′), operatively connected to the rudder-actuating motor. The system of Fig. 3 requires a continuous supply of current to the field windings of the generator, with a consequent increase in heating of the windings unless they are made of different character.

In both of the systems illustrated in Figs. 2 and 3 the current flowing in one of the sections of the differential field winding is controlled wholly from the steering wheel and the flow of current in the other section is controlled wholly from the rudder, while in Fig. 4 is illustrated a system in which the flow of current in both sections of the differential field winding is simultaneously and inversely varied by the operation of either of the controlling rheostats.

Overhead Trolley in Paris.

The overhead trolley has now made an advance into the heart of Paris, passing along the Rue Quatre September and the Rue Reaumur. Provisional authorization only has so far been granted for the installation. The overhead trolley has excited no enthusiasm in the press, and the residents are not at all favorable to the movement.

It is stated that the Southern Pacific railroad is behind a scheme for the equipment of rice plantations in Louisiana and Texas with electric power for mill-irrigation pumps and harvesting machinery. Experts say the scheme will revolutionize rice culture, as it solves the cheap-irrigation question. The announcement that a 10,000-acre rice plantation on the Southern Pacific line in Harris County, Texas, will be so equipped has attracted widespread attention.

Electric Express and Package Delivery.[1]

By George W. Parker.

The establishment of the electric service is a boon to interurban towns, to which lines are being rapidly extended in all directions within a radius of from 75 to 100 miles, and in a great many cases reaching towns and villages which have never heretofore enjoyed a railroad connection, or, at the best, in a roundabout way, entailing great delay and almost prohibitive expense. Electric service has also made next-door neighbors of communities between which, before its establishment, even wagon communication was not satisfactory or feasible, so that the electric service may justly be regarded as the chief factor in suburban progress, though not yet a decade old.

GEORGE W. PARKER.

To the lay mind, the express and parcel business of the electric line or system would appear to be an additional and profitable use of the franchise, involving no additional expense beyond suitable rolling stock and the necessary train crew; but my experience has been that the operating expense tends to become greater than that of the passenger service, for the latter calls for no local stations or agents, the company assuming no responsibility before the passenger has been sighted and after he alights, while it does become an insurer of freight or express from the moment of the giving of a receipt until it has taken one, thus necessitating a salaried agent and suitable depot facilities, stationery, etc.

In addition to the foregoing handicap to a profitable operation of the express service, I find myself confronted, in Detroit, by an ordinance which prohibits the use of trailers, and, worse still, which levies a tax of $1 per car per round trip, regardless of whether the car is empty or loaded. This tax is a radical departure from the good old days, when the town or its public-spirited citizens gladly raised a bonus to encourage a railroad connection, and then considered themselves highly favored.

The management of a system should show a proper appreciation of the importance of the express department, and its bearing on the continued and increasing prosperity of the system, in the building up of an interurban patronage, for it seems a necessary conclusion that the out-of-town dwellers will avail themselves of the mail-order and telephone facilities of the large city stores because of the convenient and speedy electric express-car delivery to their doors, and the habit once formed of sending their shipments or orders via the electric express car must eventually result in more frequent trips on passenger cars for personal and wider selections of their requirements.

But it must not be assumed that all branches of the system, or even all towns and villages on a branch, warrant the establishment of an electric express service. The population, situation, products and future of each individual place, and the competition of existing steam roads, if any; also the old-established express companies must be carefully weighed, or that terrible ledger must be faced at the end of the year.

To secure and hold the favor of the public, I have found it necessary to insist upon and maintain high-class service, which means all the little details of careful handling, prompt transit and courteous treatment. This naturally calls for the cooperation of the entire management, especially in the operating department, and the personal attention of the general express agent, and his assistant, at all hours, in all kinds of weather, and the ability to avert disaster when least expected. But he must not at any time neglect his office, to which all matters pertaining to the handling of express should be referred, and from which all instructions as to rates, claims, complaints, etc., should issue. The best results can be only obtained by the employment of a traveling express agent, whose special duties should be the soliciting of business and the securing of routing orders from consignees on shippers, which routing orders are instructions to shippers to forward all shipments in connection with the electric express.

Where the system includes leased or other lines, in addition to its own, a central freight or express depot and a joint agent are absolutely necessary, as a measure of economy and the proper handling of the business. At Detroit, the most important thing to contend with has been the expense of handling, which, prior to the consolidation of the electric lines, was cared for through three separate depots. For instance, express from the Rapid Railway System was handled through one depot; that from the Detroit and Pontiac, Detroit and Wyandotte, Detroit and Northwestern, and the Detroit, Rochester, Romeo and Lake Orion roads through another depot, and that express for the Detroit, Ypsilanti, Ann Arbor and Jackson Railway through yet another. This entailed an expense for each depot of an agent and staff, which only recently has been changed and the stations consolidated in one large joint depot, now located on the corner of Fifth and Congress Streets, in close proximity to depots of steam roads and navigation companies, thus also decreasing cartage expense where interchange is necessary.

The building is 45 by 195 feet. On one side is the team track or driveway, where freight is received and delivered. The illustrations give a fair idea of the traffic handled. On the east side of the shed there are double tracks with accommodations for four cars on each track, with ample room for switching. The interior of the shed is clear of all posts, thus giving ample floor space necessary for prompt receiving, sorting and loading the express and freight. There is also cold storage for the protection of perishable goods.

The joint express agent who would have charge of a depot of this kind must of necessity be an experienced railroad man, also an accountant of no mean ability, as the duties covered are manifold, from the handling of a truck on a pinch, in the depot, to the settlement of his station accounts, which latter job becomes complicated at times from various reasons, such as change in rates, errors of agents, careless checking and handling of freight, etc.

It may be asked to what class of freight or express should an electric service be confined? In this part of the country, the electric express service may be said to have its origin in the transportation of milk, which was originally handled in the small compartment on passenger cars, reserved for baggage, but which has now grown to such proportions as to tax daily the capacity of entire cars.

Tapping a great deal of territory that has hitherto had no railroad connection has necessarily thrust upon the electric express service of Detroit a class of freight that ought not to be carried in equipment of that character, and which cannot be discriminated against. The rates charged being governed by railroad tariffs for similar class of freight are in some cases insufficient, and therefore unsatisfactory from the revenue standpoint.

The rates are taken from the company's regular express tariff, which is governed by the rules of the official classification. The rates on the different commodities handled are according to the value, dimensions and weight of each article. For example, shipments of glassware, furniture or any articles liable to damage from breakage are given a much higher rating than articles that are packed in such a manner as to occupy less space in the express car and which will weigh more than the articles first mentioned.

A system of bookkeeping for the express service on electric lines radiating from Detroit was adopted with a view to handling express and all accounts relating thereto in as simple, practical and systematic manner as possible.

Baggage is no longer carried in and out of Detroit on regular passenger cars, but follows on the next express car at a uniform rate of 25 cents per piece not exceeding 150 pounds. Where the actual weight exceeds the latter-mentioned minimum, the first-class rate named in the express tariff is applied from and to the point to which baggage is going at actual weight. This arrangement was necessary on account of the additional expense involved in the handling of baggage and the low passenger rates in effect which would not allow of a free checking system.

STANDARD INTERURBAN EXPRESS CAR IN DETROIT.

It is still an open question whether compartment cars could not handle both baggage and passengers during certain light hours of the day, thus giving baggage early preference and more suitable care.

Under our present arrangement of checking baggage, a passenger can have his baggage checked from any point on our system at which we have agents, which arrangement, if the passenger is coming to Detroit, includes delivery to all hotels, steamboat landings, railroad depots and residences, is working out admirably in connection with the Detroit Omnibus Line Company. It might be added that this company has representatives to meet all trains and boats, so that the passenger coming to Detroit can, by turning over his checks to one of these representatives, be relieved of all responsibility in connection with his baggage in case he desires to avail himself of the frequent electric service.

There is a future in the parcel feature of the business, if properly conducted, which problem we have not yet been able to solve to our satisfaction, owing in a measure to the peculiar conditions existing at this point. Under our present arrangement we are accepting parcels weighing from one to 50 pounds for a minimum charge of 15 cents going to points within a radius of 40 miles, and a charge of 25 cents when going to points beyond 40 miles. This charge, it must be understood, is for the electric-express service only, with a slight additional charge for cartage, in case the consignee wishes package delivered.

ELECTRIC EXPRESS AND FREIGHT DEPOT AT DETROIT.

INTERIOR VIEW OF ELECTRIC DEPOT AT DETROIT.

[1] Abstract of paper read before the American Street Railway Association at Detroit, Mich., on October 8, 1902. Mr. Parker is general express and passenger agent for the Detroit United Railway.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Independent Belted Motors in Chicago Printing Plant. Illustrated.. ..... 269, 270
Street Railway Accountants' Association 269
The Street-railway Problem in Chicago. By Frank I. Bennett. Portraits 270, 271, 272
Tentative Plans for World's Fair Intramural Railway 272
Electrical Parade in Kansas City 272
Electrical Steering Gear. Illustrated 272
Overhead Trolley in Paris 272
Electric Express and Package Delivery. By George W. Parker. Illustrated. (American Street Railway Association.) 273
Editorial 274
Western Union's Annual Report 275
Electrical Features of the New Government Building in Chicago 275
Receiver for Hudson River Road 275
International Association of Municipal Electricians 276
New Wire Lamp Guard. Illustrated 276
Sterrett Oil Pump. Illustrated 276
The Electric Persuader in Georgia 276, 277
Joint Use of Conduits. By Charles F. Hopewell. (International Association of Municipal Electricians.) 277
Development of the Telephone Field. Illustrated 278
Ohio Telephone Notes 278
Telephone News from the Northwest 278
Indiana Telephone Items 278
Stromberg-Carlson Exhibit at Detroit. Illustrated 278
Kansas City Home Telephone Company 278
Bell Telephone Output 278
General Telephone News 278
Telephone Men 278
Manufacturers and Dealers 278
The Steam Turbine Commercially Considered. (Discussion at Detroit Street-railway Convention.) 279
Report of Patent Commissioner Allen 279
Fort Wayne Electrostatic Ground Detector. Illustrated 280
Wagner Single-phase Motor Upheld in Patent Suit 280
Coal Deposits of the United States. By W. L. Abbott. (Association of Edison Illuminating Companies.) 280, 281
Street-railway Standards. (Report of Committee at Detroit Street-railway Convention.) 281, 282
The Motorman 282

DEPARTMENTS.

Correspondence 282, 283, 284
New York Notes 282
New England News 282
Canadian Intelligence 282, 283
From the Buckeye State 283
Information from Indiana 283
Old Mexico 283, 284
Northwestern Notations 284
Among the Rockies 284
Personal 284
Electric Lighting 284
Electric Railways 284, 285
Telegraph 285
Automobiles 285
Publications 285
Power Transmission 285
Miscellaneous 285
Trade News 285
Business 285, 286
Illustrated Electrical Patent Record 286

SELDOM has the operating companies' side of the discussion of the treatment of quasi-public corporations been so ably, clearly and vigorously championed as was done by Mr. H. H. Vreeland of New York last week in his address at Detroit as president of the American Street Railway Association. The address was not perfunctory or colorless, as such addresses sometimes are. Mr. Vreeland spoke as one who had a message to deliver, and he spoke out in meeting in favor of the rights of the street-railway corporations manfully and withal so cleverly that his hearers listened with increasing pleasure and at the end declared, apparently to a man, that he had made a most valuable contribution to the literature of the problem he so boldly dissected. The address was a thoughtful one, carefully reasoned out and with the ideas clearly expressed. It was printed in full in last week's issue of this journal, and we commend it to the attentive perusal of all who are interested—as every citizen should be—in the solution of the great question of the best means of conducting what are known as public utilities.

A DISPASSIONATE, comprehensive review of the somewhat complicated street-railway situation in Chicago is given in Alderman Frank I. Bennett's interesting article on "The Street-railway Problem in Chicago," presented in this issue. Mr. Bennett expounds the subject thoroughly, and explodes the popular belief that an alderman's acquaintance with public business is only superficial. Anyone desirous of becoming acquainted with the street-railway conditions in the second city in the country should read Alderman Bennett's article.

STEAM TURBINES, considered commercially, elicited the liveliest discussion of any of the topics presented for consideration at the Detroit street-railway convention last week. The paper presented was written by a gentleman connected with a great manufacturing company that is going into the production of turbo-alternators on a large scale. It was, not unnaturally, on the turbine side of the existing discussion in the steam-engine field, and there were some of the street-railway men who, like the gentleman from Missouri, wanted to be shown a few things not stated, particularly why turbines and generators are not sold separately, if desired, as in the case of piston engines. In the beginning of the discussion the doubtful ones, plying questions thick and fast, seemed to have rather the better of the argument, but the friends of the turbine soon rallied and apparently made good their case, retiring with honors. One of the most effective statements in favor of the new type of engines was made by Mr. C. O. Mailloux of New York, who, in a disinterested, logical, convincing manner, told why he believed that the steam turbine had "arrived" or was about to "arrive." It was felt that when an engineer of Mr. Mailloux's standing advocated a comparatively new type of apparatus, carefully giving his reasons therefor, it would be well for others less experienced in this particular branch of work to attend carefully to his views. The convention applauded Mr. Mailloux liberally. It then came out that no one was really opposed to the steam turbine; some simply thought the manufacturers were not pursuing exactly the right policy in exploiting it. The discussion as a whole was very interesting, and, although generally relating to the commercial side of the subject, brought out many new points. A brief summary was telegraphed from Detroit for the last issue of the Western Electrician, while a full abstract is given in this number.

LONG ago it was discovered that of the making of books there is no end, but now it is also known that of the making of books on electrical subjects there is likewise no end. One of the reasons for this is the rapid widening of the field embraced in the science and application of electricity and the consequent eager demand for all the knowledge to be had in books; another, according to the Chicago Record-Herald, which has been making an investigation, is the demand which boys thirsting for electrical information make on the public libraries. The journal in question asked many western librarians the question, "Do boys and girls call for many books outside of the juvenile department?" The answers were affirmative in almost every case, especially as related to boys, and almost every librarian noted the fact that books on electricity are those most eagerly sought. The head of the Galesburg library says that children call for few books outside of the juveniles, "with the exception of books upon electricity, and anything and everything the library contains on that subject is read by the boys." From the Aurora Public Library comes a similar statement. The list of solid works sought by Aurora boys is longer, but it is headed by electricity. Similar responses came from other librarians. The tendency thus shown is certainly gratifying, although we can hardly go to the length of our contemporary in thinking that it "seems to give promise of a nation of electricians," "for nothing is more certain than that we are only on the threshold of an age of electricity." We have a dim suspicion that this schoolboy reading is not dissimilar to newspaper science—rather unsubstantial as a general rule. Nevertheless, the reading of suitable books on electricity by boys is to be encouraged, and if the youthful readers are interested to the extent of making experiments on their own account, so much the better. But there are books and books. While such an abstruse work as Fleming's "Alternate Current Transformers," for instance, would be almost appalling to the youthful beginner, there are so-called "popular" effusions at the other end of the scale that are simply trash. The youth who seeks to explore the field of electrical literature will do well to seek competent assistance as a guide for his wandering feet, else his pilgrimage may be a fruitless one.

EVERYONE will rejoice now that the anthracite-coal strike seems to be at last in a fair way toward settlement. The country will experience a great wave of hopefulness at the public announcement that the mine-owning companies, after rejecting pure arbitration, have suggested that the president of the United States appoint a disinterested commission of five members—in which, however, the miners' union is in no way represented—to which shall be referred "all questions at issue between the respective companies and their own employes, whether they belong to a union or not." The managers of the different anthracite-coal properties agree to accept the decision of this commission. This is arbitration—of a sort, as Mr. Dooley would say. One party to the great controversy is not represented in the tribunal at all, while the other party arbitrarily dictates how the commission shall be constituted. At this writing it is not known whether President Roosevelt will consent to act in the narrow lines laid down for him or whether the United Mine Workers of America will agree to accept the decision of the commission if it shall be appointed. But it is evident that a great step in advance has been taken; the stiff-necked operators have agreed to a settlement framed by a body of outsiders, and the greatest obstacle to a settlement of the strike has been removed. The people of the United States will receive the news with hearty thankfulness. This industrial conflict has been brought home to every hearthstone in the country as perhaps no other strike ever has been. Rich man, poor man, beggarman—one might almost say thief also, did not the black diamonds offer a new variety of plunder—unite in hailing the promised relief with glad acclaim. If the high hopes now raised are justified by the issue, Thanksgiving this year will take on a new and very real significance.

Aside from their gratification as citizens of the republic, the men engaged in the generation of electric current have an especial reason for lively satisfaction at the prospect of a settlement of the strike. In an overwhelming preponderance of their stations steam-driven units are used, and coal is burned for fuel. Of course, very few use anthracite coal, but the lack of hard coal has boomed soft-coal prices in a way painful for consumers to contemplate, and although most of the electric-light and street-railway companies habitually carry large stocks of coal, purchased by contract, nearly all have felt or will feel the pinch of an interference with supply of now over five months' duration. One large central-station company in the West that is equipped to carry a normal coal supply of 30,000 to 40,000 tons, nevertheless purchased large amounts during the present high prices, so that its stock might not be seriously depleted. In New England and the Atlantic-seaboard states a few of the electric companies imported coal from Great Britain. Some of the large companies generously offered to supply their employes with coal for domestic use at cost; others—smaller ones—were themselves brought to a point where a shutdown was contemplated as within the range of possibilities. All are greatly pleased with a prospect of return to normal conditions. Aside from the interdependence of industrial enterprises, convincingly shown by the strike, the especial lesson of the summer, particularly for electrical companies, is the necessity of adequate provision for coal storage.

Western Union's Annual Report.

The annual meeting of the Western Union Telegraph Company was held in New York on October 8th and was exceptionally interesting because it was the first meeting since Colonel Robert C. Clowry, late of Chicago, assumed the presidency. The board of directors was re-elected, with the exception of Stuyvesant Fish, who resigned, and whose place was filled by the election of John J. Mitchell of Chicago. Howard Gould was elected to fill the vacancy created by the death of Mr. Perkins. The president's report is for the year ended June 30, 1902. It shows the capital stock to stand unchanged at $97,370,000, of which $29,495.86 is in the treasury. The bonded debt is $21,504,000, of which $13,000,000 is represented by 4½ per cent. bonds and $8,504,000 by five per cent. bonds. During the year the bonded debt was increased $1,844,000 and the interest charge $54,040 per annum. The business of the year is shown in tabular form as follows:

	Year Ended June 30, 1901.	Year Ended June 30, 1902.	Increase.
Revenues	$26,354,150.85	$28,073,095.10	$1,718,944.25
Expenses	19,668,902.68	20,780,766.21	1,111,863.53
Net revenue	$ 6,685,218.17	$ 7,292,328.89	$ 607,080.72
Interest on bonds	956,160.00	992,580.35	36,420.35
Profits	$ 5,729,088.17	$ 6,299,748.54	$ 570,660.37
Appropriated for dividends	4,868,007.50	4,868,031.25	23.75
Surplus	$ 861,080.67	$ 1,431,717.29	$ 570,636 62
Surplus July 1, 1901			$ 9,319,285.53
Carried to surplus as above			1,431,717 29
Surplus June 30, 1902			$10,751,002.82

Statement of expenses for the year ended June 30, 1902:

Operating and general expenses	$14,727,406.92
Rentals of leased lines	1,568,534.40
Maintenance and reconstruction of lines	3,591,065.17
Taxes	575,331.84
Equipment of offices and wires	318,427.88
Total expenses as above	$20,780,766.21

Following are interesting statistics for typical years:

Year.	Miles of Wire.	Offices.	Messages.	Gross Profits.	Aver. Tolls per Message in Cents.	Average Cost to Company of Message in Cents.
1866	75,686	2,250	.....	.....	.....	.....
1867	85,291	2,565	5,879,282	$2,624,919.73	.....	.....
1868	97,594	3,219	6,404,595	2,641,710.87	104.7	63.4
1875	179,496	6,565	17,153,710	3,229,157.83	54	35.2
1883	432,726	12,917	41,181,177	7,660,349.58	38	26
1885	462,282	14,184	42,096,583	5,700,924.13	32.1	24.9
1895	802,651	21,360	58,307,315	6,141,389.21	30.7	23.3
1901	972,766	23,238	65,657,049	6,685,248.17	30.9	25.1
1902	1,029,984	23,567	69,374,883	7,292,328.89	31	25.7

There were added to the company's system during the year 2,526 miles of poles, 57,218 miles of wire, 329 offices. Of the newly constructed wires, 28,767 miles were of copper.

The number of messages transmitted by the employes of the company, as shown above, was 69,374,883, being 3,717,834 more than for the previous year. These figures do not include the messages sent by brokers, press associations and others over the wires they lease from the company, nor the messages of railroad companies that are sent between their local stations under the terms of our contracts.

The receipts from the transmission of regular commercial messages were increased $1,348,531.34, and from leased wires $451,749.64. Variations in other minor sources of income made the increase in the total revenues for the year $1,718,944.25.

The additional expenses for the year were $1,111,863.53. Of this amount $735,577.07 was incurred for operating and general expenses, $320,640.43 for maintenance and reconstruction, including cable repairs, and $55,176.20 for taxes.

The profits for the year were $6,299,748.54, after paying $992,580.35 for interest on bonds. The amount of the dividend paid on the capital stock was $4,868,031.25, leaving a balance of $1.431,717.69 to be carried to surplus account.

There was expended for construction during the year $2,188,101.03.

In concluding his report Colonel Clowry says: "Since I took charge of your property, in April last, the service of the company in the eastern and southern divisions has been reorganized. I have personally inspected a number of the principal offices, and the lines in the East and South have been carefully examined. All of the larger offices have been visited by officers of the company, who have kept me fully advised as to the conditions, and such changes and improvements in the methods of handling the business have been made as the circumstances called for. By rearrangements of the operating force, and through the substitution of direct-working circuits for repeating or relay offices, a reduction of $388,746 a year in the operating expenses of the company has been effected and the service greatly improved. The system of inspection will be continued and extended until it embraces every office of importance, and a further improvement in the service, with an additional reduction in the expense, may be expected."

Since April 1st contracts have been negotiated and closed with the following-named railroad companies: Southern Railway Company, Atlantic Coast Line Railroad Company and Plant System, Pere Marquette Railroad Company, New York, Ontario and Western Railway Company, Rutland Railroad Company, Pecos River Railroad Company, Tennessee Central Railroad Company, Gulf, Beaumont and Kansas City Railway Company, Mississippi River, Hamburg and Western Railway Company, Virginia-Carolina Railway Company, and the Beaver Dam Railroad Company, Tallassee and Montgomery Railway Company, Silver Lake Railway Company, Kansas City, Mexico and Orient Railway Company, Carolina Northern Railroad Company. These contracts cover over 16,800 miles of railroad.

Electrical Features of the New Government Building in Chicago.

Bids were invited on October 7th by the United States government for the electric switchboard, conduit and wiring and also for the heating system of the new federal building in Chicago on the block bounded by Adams, Clark, Jackson and Dearborn Streets. The building is a very large one, in cruciform shape, with a central dome, and the granite exterior is now about finished. The bids for generators, motors, engines, elevators and ventilating system are to be advertised separately in a short time.

The specifications for switchboard, conduit and wiring contemplate the erection complete in place and ready for operation of an electric-light and power switchboard, also a complete system of conduit for carrying all conductors for lighting, power, telephone and burglar-alarm service, including all main and distributing cut-out cabinets, cut-outs and switches. The generating plant to be installed will have a capacity for 19,200 16-candlepower lamps or their equivalent in ampere capacity and 459 horsepower of motors, provided through 6,550 light outlets and 174 switch outlets. The building is to be wired on the three-wire system, all lamps to be operated at 110 volts on three-wire feeders and motors at 220 volts on two-wire feeders. The leads to the switchboard are to be of paper and lead-covered cables run beneath the floor in vitrified-tile ducts. The switchboard will have the double-bus system, arranged so that each feeder can be connected to the isolated-plant supply or to a service connection with the city lighting mains. The light and power feeders are to be of paper and lead-covered cable from the switchboard to the vertical runways and to be run in vitrified-tile conduit below the basement floor. The principal vertical mains and feeders are to be carried in four runways, located one on each of the four sides of the central dome of the building. These runway conductors are to have slow-burning, weatherproof insulation, and are to be run on porcelain insulators. On each floor there will be main cut-out cabinets at each vertical runway for controlling all circuits in adjacent portions of the building. At central points in each wing there will be distributing cabinets containing switches and cut-outs for all main and tap circuits. The subfeeders, connecting mains and distributing cabinets, will be of rubber-covered and braided wire, run in steel pipe or steel interior conduit.

The switchboard will consist of 13 feeder panels, one totalizing panel and three generator panels. The panels are to be 62 inches high and two inches in thickness, with bases of the same width and thickness and 28 inches in height. Blue Vermont or white Italian marble will be used. There will be 11 lighting panels, each lighting feeder being equipped with one triple-pole, double-throw knife switch (with fuse holder and fuses mounted on back of board), and two round-pattern shunt ammeters, except feeder for patrol lighting. Each of the two power-feeder panels will be equipped with one double-pole, double-throw knife switch, two fuses on rear of board; one single-pole circuit-breaker and one round-pattern ammeter. The totalizing panel will have two totalizing shunt, illuminated-dial, 7,000-ampere ammeters, two illuminated-dial, 150-volt voltmeters, with two three-circuit voltmeter switches and one portable, direct-reading, 250-volt voltmeter with a six-circuit switch. Each generator panel will have one double-pole, single-throw, 3,000-ampere switch, one 3,600-ampere, illuminated-dial ammeter, one 150-volt, round-pattern voltmeter and one dynamo-field rheostat.

All lighting on basement, first and second floors, which floors will be exclusively used for the handling of the mails, will be controlled separately by four feeders, distributing from the first floor. Another set of four feeders will feed all above the second floor, except in corridors and dome. Separate feeders will carry the corridor lights, the patrol lights, the lights in the dome and all lights in the engine and boiler rooms. In the basement all lighting will be by individual ceiling lamps, the brackets in a majority of cases being arranged in special outlets, so as to provide floor outlets for the desk lighting above on the first floor. This same scheme has been carried out wherever possible throughout the building. The lighting on the first floor is to be by heavy and elaborate 16-lamp chandeliers and the floors above by smaller chandeliers. The dome will be lighted by circles of lamps at the third, fifth, seventh and eighth floors, and at the level of the tenth floor, where the dome partially converges, will be a row of about 200 lamps concealed behind ornamental work, so they will throw light on the curved portions of the dome. Above the opening of the dome, a large painting will be suspended from the eleventh floor of the tower on a spherical surface (with convex side downward). This painting will be lighted by a circle of incandescents placed on the crown of the dome or by arc lamps, so that the lamps themselves will not be visible.

In the court rooms, corridors and sub-treasury department special arrangements for lighting will be made, the method in the court rooms including a row of lights around the walls hidden by a cornice or molding, but arranged to throw the light upward, where it will be reflected downward. Throughout the entire building all the lights will be arranged so that in no case will the direct light be visible, reflecting, diffusing and refracting globes and shades being used to obtain this end.

Of the two power feeders, one will take care of all motors in the basement, except engine and boiler rooms, and the other will feed all motors on and above the eighth floor. The schedule of motors for the ventilating system shows a total horsepower of 353, including 27 motors ranging from three to 20 horsepower. Other motors which bring the total capacity up to 459 horsepower will be used in connection with the elevator system, house pumps, bilge pump, ice-water and refrigerating system and deep-well plant.

The specifications for the heating plant call for six 300-horsepower water-tube boilers of the vertical-header type, each to have at least 3,000 square feet of heating surface, two 42-inch drums and the necessary connections and fittings. Down-draft, extension furnaces are to be installed, with grates suitable for burning Illinois slack bituminous coal. Other boiler-room equipment will include a 1,500-horsepower feed-water heater, two feed pumps, an induced-draft apparatus, a fuel economizer and the necessary smoke connections and damper regulator. Coal and ash railways are to be placed, with cars, and an ash hoist will be operated by an electric motor. The building will be warmed throughout by exhaust steam from the power plant, supplemented, when necessary, by live steam. The direct-radiation, two-pipe vacuum system will be used and the ventilation will be accomplished by mechanical means. The minimum amount of superficial radiating surface is to be 39,000 square feet and 16,600 square feet will be used in connection with the ventilating system. Alternate bids will be received for automatic stoking devices instead of the furnaces specified and for hot-water heating instead of the exhaust-steam system.

The generating equipment of the plant will call for three 900-indicated-horsepower, cross-compound, non-condensing engines, each direct-connected to two 300-kilowatt, 125-volt or one 600-kilowatt, 250-volt, direct-current generator. The contemplated layout for the elevators calls for eight passenger elevators in the rotunda, one freight elevator, one employes' elevator, one for the dome and one for the sub-treasury department. The specifications for these elevators will call for machines of the hydraulic type, with alternate provision for electric elevators. Pierce, Richardson & Neiler of Chicago are the consulting electrical and mechanical engineers.

Receiver for Hudson River Road.

On motion of the Colonial Trust Company of New York city, George G. Blakeslee of Kinderhook, N. Y., was appointed receiver for the Albany and Hudson Railway and Power Company of Hudson, N. Y. This company is said to operate the longest third-rail road in the United States. The trust company, which guaranteed the railway company's bonds, asserts that the railway company is bonded for more than it is worth. Officials of the railway company say that the appointment of a receiver is the first step in a plan for its complete reorganization and that the road will continue in operation. Officers of the company are: President, A. C. Salisbury; vice-president, M. E. Stark; general manager, G. G. Blakeslee.

International Association of Municipal Electricians.

The seventh annual convention of the International Association of Municipal Electricians was called to order in the convention hall, Murphy's Hotel, Richmond, Va., on October 7, at 10 a. m., by Marx Gunst, chairman of the committee of electricity of the City Council. He introduced the Rev. Carey E. Morgan, who offered a prayer, and was followed by Governor A. J. Montague on behalf of the state and Mayor Richard M. Taylor tendering the freedom of the commonwealth to the members and guests in attendance. They called the delegates' attention to the fact that the first electric street car was run through the streets of the "City of the Seven Hills," Richmond. Capt. William Brophy responded for the association in his characteristic way, saying in part that the association met yearly to discuss electrical matters and methods as well as to accept the hospitality so freely extended.

The president, A. S. Hatch, then took the chair, and Governor A. J. Montague, Mayor R. M. Taylor and Marx Gunst were unanimously elected honorary members. The president's opening address was in the shape of a paper on "Electrical Government." It was decided to dispense with roll call, the sense of the meeting being that it served no good purpose, and it was the desire of the president to give all the time possible to the discussion of the papers to be presented. W. Y. Ellett, as usual, was in evidence as sergeant-at-arms.

The report of the executive committee was presented, in which it submitted amendments to the constitution which provide that the president, secretary and chairman of the executive committee shall constitute a committee of arrangements, requiring them to meet in the city chosen for the next annual convention and make the necessary arrangements, select and assign papers, etc. William Brophy of Boston, Mass.; W. Y. Ellett of Elmira, N. Y.; F. C. Mason of Brooklyn, N. Y.; Jerry Murphy, Cleveland, O., and Adam Bosch, Newark, N. J., were appointed a nominating committee to nominate officers for the ensuing year. Telegrams of regret from J. F. Zeluff of Paterson, N. J.; J. W. Aydon, Wilmington, Del.; Alexander Henderson, New York, and Morris Mead of Pittsburg, Pa., were read. A general discussion of the paper, "Electrical Government," was then indulged in until adjournment at 12:30.

The afternoon session was called to order at 2 o'clock. The discussion of the forenoon was continued for some time, and then Jerry Murphy of Cleveland, O., presented the secretary with a gold badge from the association, as a token of the members' regard and in appreciation of his faithful work for the success of the convention.

Walter M. Petty then presented his paper on "Municipal Inspection and Control," and a very lively discussion was participated in by Capt. Brophy, W. Y. Ellett, F. C. Mason and Cleon L. Williams of Meridian, Miss. Mr. Williams is a new member, attending for the first time. He related his experience in trying to enforce municipal inspection, mentioning some of the methods adopted to deceive the inspector and what means he adopted to overcome them. His remarks received hearty applause.

Captain William Brophy was elected a delegate to the meeting of the National Board of Underwriters and instructed to use his best endeavors to secure the board's co-operation in adopting rules for outside construction. This closed the session for the day.

On the second day the convention was called to order by the president at 9:30. The paper of William Brophy on "Relation of Electrical Departments to Other Branches of the Municipality," was presented and created a very lively discussion, as did also the paper by Jerry Murphy of Cleveland, Ohio, on "Telephone Service in Connection with Fire and Police-telegraph Systems."

During the afternoon session the applications of C. G. Lundquist of Jamestown, N. Y., and Foote, Pierson & Co. of New York city were presented by the secretary and they were duly elected members.

C. F. Hopewell of Cambridge, Mass., with his paper, "Joint Use of Conduits," created the most animated discussion of any paper presented until R. A. Smith of Norfolk, Va., secured the attention of the members with the question, "What Means or Method is Being Used by Street-railway Companies to Stop Electrolysis; also, What is a Safe Amount of Current that Can be Carried by Cast-iron Water Pipes Without Danger of Electrolytic Action at Joints?" Mr. Hughes of the Standard Underground Cable Company maintained that holding the electrical engineers of the electric-railway companies directly responsible for all damage done would compel them to devise means to protect the water and gas mains. The discussion, which lasted until 6:30, brought out various theories and methods, giving a wide field to select from by those who have this vexing situation to contend with. After adjournment all went to the City Hall as guests of the Board of Fire Commissioners, after which Mr. Hopewell delivered his illustrated lecture on "Fire and Police-telegraph Systems."

The forenoon session of the last day (Thursday) was given up entirely to the associate members, who made exhibits and explained the different articles of their manufacture, those taking part being J. Jones & Son of New York, Standard Underground Cable Company of Pittsburg, Montauk Fire Detecting Wire Company and the Magneto Signal Company of New York. Many novelties were exhibited, suggesting new ideas in the chosen field of those present.

The secretary's report, presented at the afternoon session, showed a membership of 135, not counting those elected at this session, which is a gain of 17 over last year. The treasurer's report showed the total receipts to be $703.60 and expenses $512.97, leaving a balance on hand of $190.63.

The election of officers was the next order, and the following-named gentlemen were elected: President, William H. Thompson, Richmond, Va.; first vice-president, Jerry Murphy, Cleveland, Ohio; second vice-president, A. C. Farrand, Atlantic City, N. J.; third vice-president, W. A. Barnes, Bridgeport, Conn.; fourth vice-president, C. F. Williams, Meridian, Miss.; secretary, Frank P. Foster, Corning, N. Y.; treasurer, Adam Bosch, Newark, N. J.; executive committee, Walter M. Petty of Rutherford, N. J., Elmer G. Loomis of Allegheny, Pa., William Brophy of Boston, Mass., A. S. Hatch of Detroit, Mich., J. B. Yeakle of Baltimore, Md., F. C. Mason of Brooklyn, N. Y., W. Y. Ellett of Elmira, N. Y., G. F. Macdonald of Ottawa, Canada, and William Crane of Erie, Pa.; finance committee, C. F. Hopewell of Cambridge, Mass., Charles Greenwald of New Brunswick, N. J., Ion Simons of Charleston, S. C., and C. R. Newman of Passaic, N. J.

Invitations were received from the cities of Niagara Falls and Buffalo, N. Y., Detroit, Mich., Ottawa, Canada, and Atlantic City, N. J., for the next convention. Atlantic City's claim was presented in an irresistible way by a committee from that city and was selected for the convention of 1903.

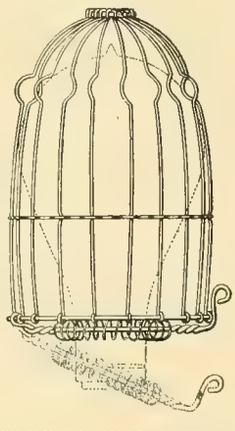
Thursday evening a banquet was served by the citizens of the city. All work was completed and the visitors gave themselves up to a good time, the chairman, Marx Gunst, stating that toasts were formal and uninteresting, so would be done away with, after-dinner talks being the order. This closed one of the most successful conventions held in the history of the association.

The following-named were present:

F. W. Harrington, F. C. Mason, W. J. Watson, C. D. Burdett, Fred Pearce, W. C. Banks, M. E. Malcom, W. H. Niles, P. H. Alexander, G. H. Osterhard, George F. Porter, F. J. H. Kreake and wife, J. F. Haggerty, F. L. Ebberts and wife, J. Jones, Jr., George T. Manson, E. B. Baker, R. D. Brixey, A. P. Eckert, J. B. Taltavall and wife, G. W. Elliott and wife, F. S. Palmer and W. H. Kernan of New York city; W. Y. Ellett, Elmira, N. Y.; A. J. Bell and wife, New Rochelle, N. Y.; Adam Bosch, Newark, N. J.; Thomas Hannan and wife, Pittsburg, Pa.; William Crane, James N. Boyd, Addison Maupin, Henry G. Brandt and J. M. Dumer, Erie, Pa.; C. G. Lundquist and wife, Jamestown, N. Y.; R. E. Moran, Memphis, Tenn.; T. E. Hughes and Paul W. Bossart, Philadelphia, Pa.; William Bradt and wife, Troy, N. Y.; G. F. Brectenslein and wife, Utica, N. Y.; G. R. Downs, Altoona, Pa.; G. F. Macdonald, Ottawa, Can.; Captain William Brophy and F. H. Bibber, Boston, Mass.; H. E. Waterstreet, Amsterdam, N. Y.; E. A. Callahan, Albany, N. Y.; Walter M. Petty and wife and daughter, Rutherford, N. J.; Charles Keppler, L. S. Jones, Marx Gunst, W. H. Thompson and wife, H. C. Warren, R. M. Taylor, C. T. Sydnor and J. W. Kates, Richmond, Va.; Charles Greenwald, New Brunswick, N. J.; F. P. Foster, Corning, N. Y.; Charles Worden, Jackson, Mich.; C. L. Williams, Meridian, Miss.; W. D. Claiborne, Savannah, Ga.; A. S. Hatch, Detroit, Mich.; Jerry Murphy and wife, Cleveland, Ohio; William A. Barnes, Bridgeport, Conn.; L. H. Sullivan, Decatur, Ill.; M. J. Donohue and J. M. Walkins, Niagara Falls, N. Y.; John Leininger, Canton, Ohio; James F. Burns, Schenectady, N. Y.; J. B. Yeakle, Baltimore, Md.; Ion Simons, Charleston, S. C.; H. C. Bundy, Watertown, N. Y.; Charles F. Hopewell, Cambridge, Mass.; W. L. Kent, Lynchburg, Va.; R. A. Smith, Norfolk, Va.; E. H. Forley, Petersburg, Va.; A. C. Farrand and T. H. Thompson and wife, Atlantic City, N. J.; F. E. Pierson and wife, Morristown, N. J.; C. R. Newman and wife, Passaic, N. J.

New Wire Electric-lamp Guard.

The electric-lamp guard shown in the accompanying illustration is known as the "Neverbreak" guard, and is manufactured by the Hamlin & Russel Manufacturing Company of Worcester, Mass. It has an adjustable clamp socket and holds all sizes of



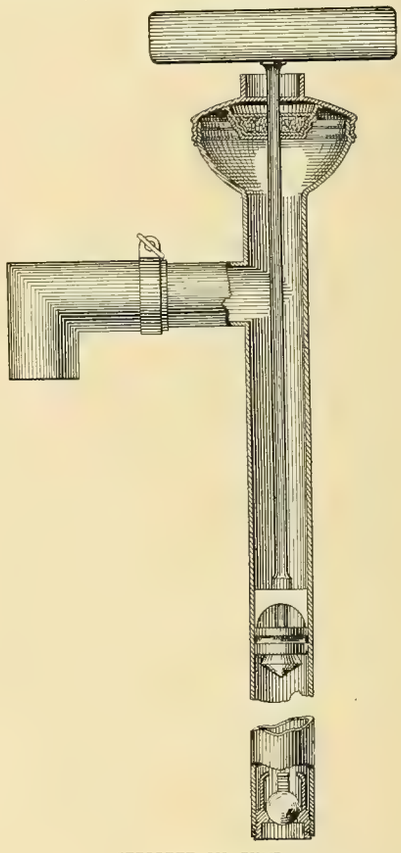
NEW WIRE ELECTRIC-LAMP GUARD.

lamps securely. It is made of steel wire, with a silver-luster finish. The object of the corrugation is to prevent any chance of breaking. There are no screws in the device and the whole is put up in a neat and attractive form. The guard has been recommended by the underwriters in New York, and the manufacturer is receiving many calls for them through this recommendation.

Sterrett Oil Pump.

Among the new inventions just brought to the attention of the mechanical world, and one that should be especially interesting to engineers in all places where oils of any degree are handled and transferred from barrel to tank and for general use, is the oil pump devised and patented by Frank O. Sterrett. This invention pertains to pumps of the class employed for handling heavy oils and its object is to provide a pump having valves of a construction that will permit heavy oils, even when cold and stiff, to pass through them readily. Another object of the invention is to provide a peculiar form of arrangement of stuffing box for preventing the oil being carried up by the stem which carries the plunger and spilled or smeared on the outside of the pump and surrounding objects.

In the accompanying illustration the peculiar formation of the valve and plunger is noticeable. In the bottom of the tube is a ball valve, consisting of a seat screwed into the end of the tube and having an opening wherein is seated a ball. Vertical arms permit the ball to rise and fall without leaving the vicinity of the seat. The lower end of the valve stem consists of a plunger which has a cylindrical portion to fit snugly within the tube; an annular groove in the periphery of this portion fills with oil and serves to make a tight-working joint. The vertical portion acts merely as a guide in keeping the valve in position. The stem carries at its end a tapered block, which rests within a seat of the same



STERRETT OIL PUMP.

taper, being also tapered on the bottom, so as to form less resistance to the oil as the valve descends.

Another distinguishing feature of this pump is the formation of the top of the tube, this being flared to form a head, to which a cap is engaged by means of threads, and forms a guide for the stem. Depending within this cover and surrounding the stem is a chamber consisting of an annular wall to which is fitted a cap. Within this chamber is a metal washer and other packing material. The simplicity of the construction of this pump makes a detailed description of its operation superfluous, and the fact that it is substantially made of brass throughout should make it a satisfactory article, and one that is much needed in the field for which it is intended. It is known as the Sterrett oil pump and is manufactured by the Sterrett Pump Company of St. Paul, Minn.

The Electric Persuader in Georgia.

A rural free-delivery mail-carrier who has a route in Georgia has proven himself to be somewhat of a genius. James A. Giles drives an old and trusty horse, but found it necessary to persuade this horse repeatedly with the lash. Recently the carrier was furnished with a new mail wagon, one of the enclosed type. The horse in a short time learned that his master was loth to creep outside during a rainstorm to ply the whip and on such occasions he would take a very leisurely gait. How to keep the horse's pace up while he remained inside the wagon was Giles' problem. His thoughts at once turned to electricity, the agent which seems to provide for every modern need. Mr. Giles made use

of a telephone magneto, installed within the wagon and put into electrical connection with two copper plates fixed under the harness so as to rest upon the horse's back. Now a turn of the crank answers many strokes of the whip and Giles remains inside his wagon.

Joint Use of Conduits.[1]

By Charles F. Hopewell.

The joint occupancy of a single-conduit system by all classes of electric wires can be considered under two distinctive heads. There are the engineering and the economic sides of the question, but inasmuch as the economic side of the question is dependent upon the engineering practicability of such a system, I will discuss that part of the question first.

The engineering features that I desire to consider are three. These are, respectively, the method of construction, method of operation and the determination of the requisite amount of separation necessary for perfect safety betwen the high and the low-tension wires. As a preliminary to these considerations I wish to consider the question of dangers that are liable to be encountered.

The dangers incident to conduit operations are two, namely, explosions and burnouts. While to many they appear as the same, yet nevertheless they are distinct from each other. An explosion in a manhole, where it almost invariably occurs, is due to the ignition of gas which has accumulated there, either sewer or illuminating gas. The gas can be ignited by an electrolytic spark from a cable sheath or from the wheels of a passing car or other causes. The result is generally the blowing off of the manhole cover, but it seldom results in damage to the cables. These are liable to occur in telephone conduits as readily as in electric-light conduits. This might be called an exterior cause as it results from causes exterior to the cables themselves. Burnouts can be classed as interior causes as they are caused by the breakdown of insulation in the cables. Such breakdowns result in the melting or breaking down of the cables. A distinction should here be made between electric-light cables and railway-feeder cables. In the former case a breakdown results in a ground and not necessarily in a short-circuit, consequently it does not infer a burnout except in the case of an Edison system with its neutral-grounded mains. Of course if there is another ground on a circuit at the time the breakdown occurs, you will then get a burnout, but this should be very rare. In the railway system this is different, as one side of the circuit always remains grounded, so that a breakdown almost always leads to a burnout. The severity of this burnout depends entirely upon the method of operation of the system. These burnouts result in heating the air in the manholes and blowing off the cover. The results are much more serious in many cases, due to faulty method of construction and faulty operation. The Edison tube system I shall not consider, as it is already an obsolete system and is fast disappearing.

This leads me to the question of what I mean by faulty method of construction and operation. Faulty method of construction I consider to comprise all kinds of conduit built of conducting material, such as iron pipe, or ducts with an iron covering where joints every eight feet place the cable in contact with iron rings metallicly connected to such iron cover. In this class of construction you will readily see that a breakdown of insulation immediately charges the entire conduit from manhole to manhole. The current then flows through the breakdown to conduit and from conduit to the lead sheath of the other cables, thereby destroying them. In tile conduits there is no such liability, for it cannot exist.

I desire to call your attention to this very important fact, that I have never been able to learn of a breakdown in a cable in one vitrified duct passing directly to a cable in another vitrified duct, unless such passage of current took place in a manhole. There has never been a burnout in Cambridge, although the Boston Elevated Railway Company has 21 miles of tile duct in that city and has had cable in it since 1897. Moreover, there has never been a burnout in Roxbury, a part of Boston where such a construction is used, where a defect in a cable in one duct has led to the using of a cable in another duct. There have been many instances of burnouts in Boston where the current has passed from one cable to another, but they have always been in cement conduit having an iron shell. All the Boston Elevated Railway burnouts have occurred in conduits of such construction.

Cables, instead of being systematically separated in manholes, have been laid up together, whereas they should all be insulated from each other, but of course bonded to a ground return wire capable of taking the current of any one cable to such ground return, rather than allowing it to pass to any other cable sheath. This bonding is necessary to prevent electrolysis.

Faulty method of operation, which has been the cause of a large number of burnouts, consists in not properly watching the cables and forestalling a breakdown in insulation in the same where the insulation shows deterioration. Another very prolific source of such trouble is the method of throwing the circuit-breakers at the central station back in again when they have once opened. I have known of an instance in Boston where a circuit-breaker was held in until it burnt out in the hand of the attendant.

In the serious burnout in Boston on the street railroads in times past, at Summer Street and Atlantic Avenue, we found that both conditions were present, namely, faulty construction as well as faulty method of operation. The Boston Elevated Railway Company has since given up the attempt to burn out a cross on its feeder, and now leaves its circuit-breaker out after three attempts to close it. Formerly it lined up its operators at the switchboard and threw the circuit-breakers in and thus sent its entire central-station energy through the cable breakdown in order to burn it clear. I will now consider, from the standpoint of practice rather than theory, what the requisite separation should be between the high and low-tension wires to ensure perfect safety.

In joint-conduit construction there are two classes of construction, differing only as to whether all the cables enter the same manholes or whether separate manholes are used respectively for the high and low-tension wires. If each corporation operating cables possesses individual manholes, then such a system will fall under the latter category.

In proof of my contention of the practicability of such a system for joint occupancy by high and low-tension wires, I desire to bring forth the actual condition of construction and operation as found in practice in many of our cities. If it can be demonstrated that such joint occupancy is safe and practical in these cases it will necessarily follow that such construction will be safe and perfectly satisfactory wherever adopted.

I will cite the following cities as possessing conduits jointly occupied by both classes of cables:

New York city.—C. I. Walker, chief engineer of the Empire Subway Company, has publicly stated in a hearing at the Massachusetts Legislature that there are over 20 miles of conduits in New York city where the high-tension ducts are directly over the low-tension ducts, with only a six-inch concrete separation between these ducts. There was also a mile where the two classes of ducts were laid side by side with a separation of 14 inches. These ducts were, moreover, of iron.

Cambridge, Mass.—The West End Street Railway Company constructed in 1897 a mile of conduit for its own wires and wherein the city was given two ducts. The city ducts enter separate manholes built by that company especially for the use of the city. These city manholes are now connected with manholes of the telephone conduit on the same street for the purpose of carrying the city wires from one conduit system to another. Walter R. Eaton, the chief electrical engineer of the Cambridge Electric Light Company, has publicly stated that a combined conduit system using separate manholes was practical.

Philadelphia.—David R. Walker, for 25 years head of the Electrical Bureau of Philadelphia, has stated that the electric-light and telephone wires have been in successful operation in adjacent ducts in Philadelphia for over 10 years. The ducts used were of wood or tile and the cables entered the same manholes.

Rochester, N. Y.—In Rochester, N. Y., the Rochester Telephone Company has had over 250,000 feet of telephone cable in electric-light ducts since May, 1900, and is installing 80,000 feet more. It has experienced no difficulty in operation, although its cables enter the same manholes with the electric-light wires.

Chicago, Ill.—In Chicago over 100,000 feet of high and low-potential cables have been in successful operation for the last 10 years, some of the cables carrying current at 8,000 volts. These cables occupy the same manholes with the low-tension wires, but are grouped on separate sides of the manholes. On Archer Avenue in Chicago the railway company and the city have built a combined conduit system at a very large saving in cost over a separate system.

Baltimore, Md.—There are in use to-day over 5,000 feet of conduit used in joint operation by the high and low-potential wires and occupying the same manholes. The conduit is owned by the city.

The subject of the practicability of the operation of high and low-potential wires in the same conduit has been investigated by two expert and competent commissions. One appointed by President Harrison in 1891 for Washington, D. C., recommended a general conduit system, with separate manholes for the high and low-potential wires and the ownership to be by the city.

Another commission appointed in 1896 to consider the subject of conduits for Baltimore recommended a general municipal-conduit system. Baltimore has already expended over $600,000, out of an appropriation of $1,000,000, for such construction. They have installed a combined-conduit system with single manholes of large size.

In many other cities of this country conditions will be found where high and low-tension conduits are laid side by side or cross each other, so that to all intent and purposes they might have been installed as one conduit system as far as any question of safety was concerned. In Boston many cases of this kind occur, notwithstanding the fact that each conduit was laid separately.

It is good logic to say that if high and low-tension wires can be placed within six inches or a foot of each other without danger, then it must follow that there is no advantage in placing them any farther apart. The theoretical basis of "the further apart the safer it is" means little after a point of safety has once been found and beyond which no accident is liable to occur. This is especially true where such a limit has been found from practical operation.

In concluding my discussion of the engineering features of conduit construction, I will state what I believe to be the best practice regarding such installation.

The conduits to be installed for all classes of service as a single conduit system with a double set of manholes. The system to have a subsidiary distributing system to contain only low-tension wires.

The conduits should be built of non-conducting and permanent material, preferably of tile. Single ducts to be used for high-tension wires, as it gives a double wall between ducts. Low-tension ducts to be of a multiple type. The low-tension ducts to be laid on top of the high-tension ducts and separated therefrom by six inches of concrete cement. (This would not be necessary if proper method of operation were insisted upon.) The distributing ducts to be laid on top of the low-tension ducts. The entire duct system should be embedded in three inches of concrete cement, with a one-inch plank on top. For wide streets a double system of distributing ducts may be necessary, and these should be located one on each side of the street. The subsidiary ducts to enter handholes placed as far apart as possible, yet close enough to prevent any lengthy street excavation for service connection, but not nearer than every other lot line.

The manholes to be installed at street corners as far as possible. One set to be for all high-tension wires and the other set for low-tension wires. The high-tension manholes to be of sufficient size to contain transformers and other devices, as only low-tension wires are to enter the distributing system. Cable in all manholes and handholes to be systematically installed on insulating hangers or shelves.

A system of regular inspection of manholes and handholes should be enforced.

A system as outlined above would do away with the objection raised by Referee Hancock in the case of the Bell Telephone Company versus the city of Rochester, and which was decided in favor of the company last April. The court held in that decision that it was dangerous to place high and low-tension wires in the same conduit system with same manholes under the conditions as they exist in Rochester. The court stated, however, that "No hard and fast rule can be laid down on this particular branch of the controversy. Circumstances and conditions alter cases." This qualification should always be mentioned by the city electricians when they have the case of Rochester presented to them, as it always will be when the cry of danger is raised by the telephone company.

In conclusion upon this point I would say that it is perfectly proper to consider, should you so care to, that the proposed system outlined is a double system of separate conduits, one for the high and one for the low-tension wires, and with the respective ducts embedded in a three-inch concrete cement and entering separate manholes. Any unbiased person would have to admit this, and I believe that the corporations could not convince any court to the contrary.

It is a fundamental rule of economics that the paralleling of railroads is an economic wrong, and it is just as true in regard to conduit duplication. It is further true that all revenue received by any semi-quasi public-utility corporation is derived from the general public. Consequently any increased cost of construction will call for increased revenue, which has ultimately to be paid by the public. No one will deny that several conduit systems will cost considerably more than an equivalent capacity in one conduit system.

Joint use of conduits is equivalent to saying that there shall be only one conduit system and that laid out at one time. The advantages are these:

Decreased cost of construction, and therefore more general adoption of conduit.

Owing to less cost of construction subsidiary underground distribution can be made, instead of the present overhead-distributing system.

Decreased cost of operation.

Economy of the subsurface requirements of our public streets, which are fast being monopolized.

Prevention of the repeated digging up of our streets.

In concluding my paper I would say that regarding the ownership of such conduits, I believe in the conclusion reached by the two electrical commissions appointed by Washington, D. C., and Baltimore, that the ownership should be by the public. A commission appointed by the Massachusetts Legislature in 1897 to report on the street-railway problem came to this important conclusion: "The ultimate full control of the street and exclusive ownership, whatever may be the part of its surface, by the municipality, is, it may be said, now accented in European countries as a fundamental principle of policy."

We see, therefore, that conduits as a public utility of a permanent nature of construction, requiring no operating department for their maintenance, are therefore especially adapted for municipal ownership.

1. Paper read before the International Association of Municipal Electricians at Richmond, Va., on October 5, 1902. Mr. Hopewell is from Cambridge, Mass.

DEVELOPMENT OF THE TELEPHONE FIELD.

Ohio Telephone Notes.

The Marshallville Telephone Company, Marshallville, has been incorporated with a capital stock of $1,000. Those interested are William Beidler, D. W. Kaufman, C. W. Biddle, H. H. Bachman and one or two others.

The New Ottawa County Telephone Company of Elmore has been incorporated with a capital stock of $150,000 by E. D. Harkness, J. G. Steinkamp, George W. Luckey, Homer Metzger and Taylor Fuller. The company will build lines connecting Elmore, Oak Harbor, Port Clinton, Genoa, Put-in-Bay, Woodville and Curtice.

The Greenspring Telephone and Electric Company, Greenspring, has filed notice with the secretary of state of an increase of capital stock from $15,000 to $20,000.

George Metzger of Toledo has returned from Los Angeles, Cal., where he made a thorough inspection of some properties in which Toledo people are interested.

The Central Union Telephone Company and the Youngstown Telephone Company have both made a bid to the Beaver Telephone Company, North Lima, to give it a Youngstown service but as yet nothing has been decided. It is not likely that it will make connection with anything else than an Independent company.

The Central Union Telephone Company has begun to install free telephone service at Portsmouth. No charge is to be made until after 800 telephones are installed, when the regular rate will be applied.

It is announced that the Zanesville Telephone and Telegraph Company will spend about $50,000 in enlarging the system and that the work will be commenced at once. Solicitors will begin a canvass for new contracts and the renewal of those which were canceled because they could not be supplied with service.

The Archbold Telephone Company, Archbold, has increased its capital stock from $10,000 to $20,000.

Senator J. F. Lanning has well-nigh completed the consolidation of the telephone plants in the towns surrounding Norwalk, his home town, and his first report of the earning capacity of the properties now in hand makes a very creditable showing. The towns included in the list are Norwalk, Milan, Berlin Heights, New London, Greenwich, Chicago Junction, Attica, Monroeville, Shelby, Crestline and Sulphur Springs. In the report, however, Shelby, Crestline and Tiro are not included, for the reason that the syndicate does not hold such an interest as to warrant the claim of ownership. The earnings for the last three months are $7,255.78 and the expenses were $3,863.63, leaving net earnings of $3,392.15. The syndicate has a plant under construction at Wakeman, and expects to increase the patronage of the Norwalk plant by 250 subscribers at least. It is thought that the earning capacity of the combined plants can be increased at least $300 per month within a short time.

It is reported that the property of the Sandusky Telephone Company has been sold to the syndicate owned principally by Senator J. F. Lanning of Norwalk, and that it will hereafter be known as the Sandusky Local Telephone Company. The Sandusky plant is one of the best in the state for a city the size of Sandusky, and has been a success from the first. Carl C. Curtis is the manager. It is said that the officers and directorate will not be changed.

O. M. C.

Telephone News from the Northwest.

The Mesaba Telephone Company has enlarged the capacity of its Hibbing (Minn.) office to 300 connections.

The Valley Springs Telephone Company has been formed at Valley Springs, S. D., with $10,000 capital.

Holding, Minn., has granted a franchise for a toll connection to John Strohman, who will build to Elm Dale and connect with the Morrison County Telephone Company's lines. Mr. Holding will build a line to Avon. The Morrison County Telephone Company will connect with the Twin City Telephone Company to Minneapolis and St. Paul, at Princeton.

The Eldora Mutual Telephone Company has begun operations at Eldora, Iowa, with 125 subscribers. This makes the third exchange in the town, the Cedar Valley and the Iowa Telephone Companies also having exchanges.

A. Dixon has sold his telephone system at Coon Rapids, Iowa, to a local company.

W. S. Boze, manager of the Hawkeye Telephone Company at Stuart, Iowa, has retired, to engage in the land business at Moberly, Mo.

The Montgomery County Telephone Company has begun operating its new exchange at Red Oak, Iowa. It starts with 300 subscribers, which is about the same number that the Iowa Telephone Company has.

Dr. Claggett of Menno, S. D., will build a telephone line to Molan.

A local telephone exchange for Ellendale, Minn., is projected.

A telephone company has been formed in Delaware township, near Canton, S. D., and will install a rural line.

Dr. Boardman has sold his local telephone line in Oakes, N. D., to the Dakota Central Telephone Company of Aberdeen, S. D. The line will be considerably improved.

The Iowa Telephone Company has withdrawn its central office at Emerson, Iowa, because of lack of patronage, and has disposed of its subscribers to the Tabor Company.

The Richland Telephone Company of Richland, Iowa, has been incorporated with $10,000 capital stock.

Messrs. Gigax and McGarvy of Schleswig, Iowa, seek a franchise for a local exchange at Charter Oak, Iowa. They own the local exchange at Schleswig.

McDowell & Driftmeir of Clarinda, Iowa, have built during this season between 325 and 350 miles of rural telephone lines and have sold about 640 instruments. They have been advised by their wholesale house that their record exceeds that of any other firm in the country in the matter of rural-telephone-line construction.

R.

Indiana Telephone Items.

The Providence Telephone Company of Providence, Johnson County, has been incorporated. The capital stock is $5,000. The company will establish a local exchange and do a village business, with long-distance connection. The directors are E. A. Deer, G. L. Jefferry, W. M. Province and Thomas S. Blackwell.

The Greenwood Telephone Company has filed additional articles of incorporation providing for the extension of its service and increasing its capital stock from $6,000 to $10,000.

The large force of men on the construction work of the Delaware and Madison Counties Telephone Company are on a strike. The men claim the wages are too low and that some of their tasks should be performed by horsepower.

F.

Stromberg-Carlson Exhibit at Detroit.

In its booth at last week's convention in Detroit of the American Street Railway Association the Stromberg-Carlson Telephone Manufacturing Company of Chicago made an interesting exhibit of telephone apparatus that was especially applicable to needs of the telephone departments of street-railway companies. The accompanying illustration is a view of the booth. Among the apparatus exhibited were a miniature combination telephone switchboard, combination cord equipments, weatherproof telephone boxes, train-dispatcher sets and other specialties and appliances designed to meet the demands of street-railway and other transportation companies. The exhibit was in charge of J. J. Nate and A. J. Rousseau.

STROMBERG-CARLSON EXHIBIT AT DETROIT.

Kansas City Home Telephone Company.

The Kansas City (Mo.) Home Telephone Company is planning to erect a large fireproof building for its plant next year. The company already has an extensive list of guaranteed subscribers and will install a large operating board at the outset. A large force of men is now working on excavations for the underground cables of the system, which will extend to every part of the city. Officers of the company say that service will be begun about July 1st next. The present office of the concern is in the Bryant Building. Ed. L. Barber of Wauseon, Ohio, is president of the company and O. C. Snider, formerly of Cleveland, Ohio, is secretary.

American Bell Output.

The American Telephone and Telegraph Company reports the following outputs of instruments for the periods ended September 20, 1902:

Month:	1902.	1901.	1900.	1890.
Gross output	75,011	75,528	44,190	56,698
Returned	43,334	33,482	30,948	20,073
Net output	31,677	42,096	13,242	36,625
From December 21st:				
Gross output	808,334	683,171	501,354	488,737
Returned	346,689	301,289	220,903	145,227
Net output	461,645	381,882	280,451	243,510
Outstanding Sept. 20th	2,987,251	2,334,698	1,860,956	1,468,760

GENERAL TELEPHONE NEWS.

The Southeastern Iowa Independent Telephone Association held its annual meeting in the Hotel Lacey, Oskaloosa, Iowa, on October 14th and 15th.

J. A. Moss, T. B. Sutton and others have incorporated the Wilkes Telephone and Electric Company of Washington, Ga., to establish a telephone system. The authorized capital is $5,000.

The Interstate Independent Telephone Company of South Omaha, Neb., has been incorporated with a capital stoock of $100,000, and has applied to the City Council for a franchise to build a local telephone system.

It is stated that burglar alarms are being connected with all slot telephones in Chicago, so that in the future it will be a difficult matter for thieves to despoil them of their nickels. Two men arrested for robbing slot telephones are said to have confessed to having robbed over 60 machines within the last eight weeks.

The Missouri and Kansas Telephone Company, between now and January 1st, will spend, it is said, from $8,000 to $10,000 in improving its service in and about St. Joseph, Mo. Nine hundred new drops will be added to the central board and nine more operators put to work. Five more toll lines connecting with Kansas City will be added, and five new toll lines connecting with Maryville, Mo., are being built. The company claims to have 1,700 subscribers in St. Joseph.

The New England Telephone and Telegraph Company of Boston, Mass., has issued a warning about a "Non-Subscribers' Directory" which certain parties are preparing. This directory is to contain the names of people who do not subscribe for a telephone, with the location of the telephone most convenient to their addresses, carrying the impression that these non-subscribers can have the benefit of a telephone service. The company asks its subscribers to do what they can to prevent the publication of this directory.

Officials of the Chicago Telephone Company are credited as saying that the best business in the history of the company is now being done. The growth of party-line service and slot-machine telephones has been phenomenal. Even if defeated in the court proceedings, reducing the price of business telephones from $175 to $125 per annum, officials of the company contend, according to the Chicago Chronicle, that there will be ample gain from the foregoing sources to overbalance loss sustained by forced reduction. A decision in the case is expected in October.

The Western Telephone and Telegraph Company's preferred and common stock and collateral trust five per cent. gold bonds have been transferred from the unlisted to the listed department of the Boston Stock Exchange. There are 160,000 shares of each kind of stock and the bonds amount to $10,000,000. The latter are due January 1, 1932. The company's financial statement, dated August 31, 1902, shows assets in property and securities to be $37,847,669 and in cash $4,141,119. The company has a capital stock (one-half preferred) of $32,000,000, bonds ($256,000 unissued and scrip) $10,000,000.

The Chicago Telephone Company has issued another $1,000,000 of stock. This is the third installment of that amount put out this year under the act of the stockholders at the last annual meeting authorizing the issue of $3,000,000 to pay for extensions and improvements to the company's lines. The full amount of stock now outstanding is $12,000,000, or only $3,000,000 less than the full authorized amount. It is not improbable that the unissued balance will be sold during the coming year to pay for the extensions contemplated by Mr. Sabin and the board of directors. The present business of the telephone company is exceptionally active. New telephones are being installed at the rate of more than 2,000 per month, and the only limit to this growth is the company's capacity to install new instruments.

TELEPHONE MEN.

A. R. Knabenshue has resigned as manager of the Central Union Telephone Company's office at Fostoria, Ohio, and accepted a position of the same nature at Toledo.

F. E. Montague, for several years local manager of the Bell Telephone Company at Richmond, Va., has been promoted to the position of special agent, with headquarters in Richmond.

MANUFACTURERS AND DEALERS.

J. J. Speed, manager of the Cairo Telephone Company of Cairo, Ill., is desirous of hearing from concerns manufacturing combined police and fire-alarm systems.

The Noxem telephone receiver, which has been put upon the market by the telephone department of the Electric Appliance Company of Chicago, is having a large sale among the telephone companies and manufacturers. Circulars giving full description and prices are now being distributed by the company.

The Steam Turbine Commercially Considered.[1]

John I. Beggs, Milwaukee: I have read the paper on steam turbines with a great deal of care, for the reason that two years ago I postponed all progress in the construction of a power house in which we expected to expend a large amount of money on units similar to those installed by the Manhattan Elevated Railway Company in New York, because the matter of steam turbines was then being seriously agitated, and I did not wish to proceed with the work at that time and have some one say five years hence that it was a mistake to spend three millions of dollars on a power house with reciprocating engines, when it was about to be demonstrated that the steam turbine was destined to displace the reciprocating engine. There is one point which has not been touched upon as fully as many others, and that is the relative cost of the generator by itself to be connected to the steam turbine; in other words, you have left out apparently the differentiating cost as to the turbine itself and the generator to be connected to it. Is the reduced cost due to the reduced cost of the generator rather than to the turbine?

Mr. Sniffin: That question is not so material when you consider that the companies are either offering or expect to offer these turbine units as complete outfits. It makes no difference what the steam or electrical end costs individually, so far as we have the comparison of the cost of the complete unit. In a general way it may be said that the electrical end of the unit is lower in cost of manufacture than the large revolving generator that goes with a reciprocating engine. It is not the purpose of the Westinghouse Company to furnish the steam turbine alone, but to furnish the generator with it as a complete unit.

Mr. Beggs: This is really a manufacturers' paper, and Mr. Sniffin has proceeded with the conclusions urged in that paper as a maximum cost upon lines which it will hardly be possible to be followed by those who are going to pay for the units. There are two or three concerns in the United States at the present time which are developing the steam turbine in connection with generators, but I do not think that those of us who are spending millions of money in the construction of power plants are going to be satisfied to depend upon two electrical manufacturing concerns for the construction of the steam turbine, which is a mechanical device and entirely independent of the electric generator. For instance, the largest manufacturers of steam engines in the world are located in the city of Milwaukee, the Allis-Chalmers Company, and I do not suppose for one moment—indeed, I know as a matter of fact—that it proposes to have its business taken from under it, by even the Westinghouse or General Electric Companies, and it is to-day experimenting on a large steam turbine. Therefore, it is important that we know what the differential cost is, and know how the varying elements are reached in considering the expense of constructing a power plant, including that of the generator. One of the important points, which is entirely ignored in the paper before us, is the effect of the greatly reduced cost of the generator to be attached to the steam turbine because of the high speed at which it must necessarily run. I believe the lowest speed at which it is considered you can make a large turbine operate successfully is about 750 revolutions per minute. Is that correct?

Mr. Sniffin: Yes.

Mr. Beggs: Those gentlemen who know the difficulty we have had of getting the electrical manufacturers to build a generator of sufficiently low speed to operate satisfactorily with the larger types of Corliss engines that are now being built, know how much they have had to pay because of the slow speed. I thoroughly understand the great desirability to the two or three large electrical concerns of compelling the purchase of the entire unit; but where there are only about two electrical manufacturers to-day (there may be a third in the future, and very likely a fourth) that can build a 5,000-kilowatt generator which we would be justified in making a contract for, there are almost a score of concerns in this country that can build a turbine to run at 750 revolutions per minute, because of the greatly reduced size and weight of the parts to be used. When I go into the market to buy a steam turbine I want to buy it as a piece of mechanical apparatus and not as a piece of electrical apparatus. It becomes a very different proposition whether you buy it in two parts from two concerns, or buy it from one concern, if you have absorbed the saving in the generator that would be realized, and turned it in as an excessive profit on the turbine.

N. H. Heft, New Haven, Conn.: I would ask Mr. Sniffin what history the steam turbine manufacturer has behind him, and what he proposes to give to the purchaser in the way of a guarantee as to the cost of maintenance if we buy this steam turbine?

Mr. Sniffin: In my paper I believe that I said something about the cost of the maintenance that was found in a station in England, where something like a dozen turbines have been used. It is true the steam turbine has behind it not as many years of history as the reciprocating engine. It has, however, sufficient history behind it to show that there is no reason why a steam turbine, properly built, should not be less in maintenance cost than a reciprocating engine, which must be so by virtue of its very nature. I do not know what could be said about a guarantee of repairs; you could hardly get a guarantee of repairs on a reciprocating engine or any piece of moving machinery. That feature is gauged not only by its excellence of design and construction, but by the way in which it is handled. I think I can best answer that question by saying that the Westinghouse Company in manufacturing a turbine is willing to make for it the same guarantee as to maintenance which it will make for any other piece of machinery which it produces.

Referring to the question of the cost of the steam turbine, I can only say that the turbo-generator unit itself is to be developed as a complete entity. You cannot have a good turbine and a good generator, and put them together and conclude they are going to make a good unit, unless they have been developed with relation to each other. As our friend has said, there are not many concerns in the turbine business at the present time. There will be, doubtless, many more. There are a good many generator builders and, doubtless, many of them are expecting to find occasion to build generators for steam-turbine use. Let them go ahead—the more the merrier.

Mr. Heft: I have been trying to get some data as to steam turbines for a year. I have gone to Hartford to see the plant that was erected there. I have been to Hartford three times and every time I have been there the plant was not running. It was shut down because they were changing something. They told me that there had been some little changes which were necessary. I asked the General Electric people to direct me where I could see a plant in operation. They replied that they had one at Schenectady that they were experimenting with, and that they were taking many orders for steam turbines. That won't go with me. I have got to know what you are going to do before I will buy one.

Mr. Beggs: What the steam turbine will do when it comes to large units is as much a matter of conjecture on the part of the manufacturers of to-day as on the part of those who are considering buying steam turbines. If the steam turbine is going to simplify the matter of regulation, and make it possible to run generators in parallel with a greater degree of success and a reduction of all the contingencies likely to arise which cause trouble, it seems a much simpler matter to build a generator to operate with that piece of apparatus, than it is to build a generator to operate with a reciprocating engine, the governing of which is such a delicate matter. This is a very important matter to us; it is especially important when we come to consider that the price of a 7,500-kilowatt generator alone runs anywhere between $65,000 and $75,000. It becomes an important question whether a piece of steam apparatus is being developed which will cut the cost down to $15,000 or $20,000—of course, these figures are only approximate. I think the association is indebted to Mr. Sniffin for what he has given us in his paper, notwithstanding the fact that the information is somewhat limited.

Mr. Heft: I want to say to the members that I am not opposed in any way to steam turbines, but on the other hand I am a believer in them. I think for the operating of generators they will eventually become a great commercial success. But I believe a manufacturer coming before this body should come here with some data, some history, regarding the turbine, so that we might know under what conditions we were buying the machines.

W. Worth Bean, St. Joseph, Mich.: The turbine engine, like the electric motors and generators a dozen years ago, is a new thing, and we should not be afraid to put our money in as we were obliged to before. That is the way we developed the other industry. Let us do that now with the turbine.

C. O. Mailloux, New York: I am now about installing a plant containing two units which is sought to be operated by the same condensing plant. I see no reason myself why it would not be possible to operate any number of units with the same condensing plant, though it might be well for very large units to have a condenser for each unit. The cost of the condensing apparatus, as far as my investigations have disclosed, is somewhat larger than the cost with an ordinary steam engine. This is due to many reasons. It is also a fact that the exhaust piping has to be done more carefully, and is of larger diameter. That, however, is offset by many other advantages, one being the ability to use superheated steam of almost any temperature without mechanical detriment to the engine. I have had occasion to design large plants in which I have seriously considered the question of using superheated steam, and found much to my sorrow that in many of the engines, as at present constructed, there is a limit to the temperature that can be allowed in high-pressure steam, owing to the danger, when you reach a temperature of 500 degrees Fahrenheit, that lubrication will become almost impossible. With a steam turbine, on the contrary, there is no limit to the temperature of superheating that you may attain beyond the melting point of the material of which the engine is made. I see no reason why you could not run a steam turbine at a point where it would be cherry red, and glow in the dark, if there was any advantage in it. Of course, we all know there is a great advantage in superheating steam. I believe that the steam turbine in that respect is bound to be a very important element in a new way of using steam in steam engines.

Until two years ago, I think, no units had been attempted which were of greater capacity than 300 kilowatts. The two units which I have ordered are 400 kilowatts each. My own observations lead me to believe that the larger turbines will be much simpler machines—more practical, as well as more economical. I have been presented by the turbine people with a brilliant prospectus looking forward, in which we will have economies of something like 10½ or 11 pounds per indicated horsepower, or the equivalent thereof. Now, gentlemen, I think you will all concede that such brilliant promises are worthy of investigation, even if we have to make a large discount on them, but even then we will be doing very much better than is possible to be done with the very best reciprocating engines. The reciprocating engine is in a high state of perfection. It is not a machine to be despised, but I believe at the same time that the turbine is the coming machine. I am not prepared to say that I believe that it has arrived, but I believe in a very few years, perhaps in a year, it will be possible for us to say conscientiously that it has arrived and is going to stay. I have reached that conviction partly by discussing the matter with makers of reciprocating engines, who have all confessed to me that they are looking to the turbine with the greatest attention. Many of them stated that they believed themselves that it is the coming machine, and they told me with some satisfaction that they hoped to be able to go into the business themselves, if there were no great fundamental patents likely to interfere. Some of them assert that they believe there will be an opening for them to enter the field. Hence we as engineers and as users of steam engines, and as companies also who have to install plants need not fear that there will be lack of competition that will be sufficiently keen to keep the prices down.

One of the difficulties of steam turbines to-day is not so much mechanical as it is electrical. The fact is that the steam turbine cannot be successfully used for direct-connected direct-current generation. In the case of large units, where it is attempted to put the armature on the turbine shaft direct, instead of putting it on the countershaft, the hope of making it successful appears to have been abandoned on the direct-current machine. The turbine is admitted by its best friends to-day to require alternating generators. A further detail of the defects is the fact that these machines make considerable noise. That appears to be more of an electrical defect than a mechanical one. It is largely related, probably, to the design of the dynamo. This problem is receiving attention, and it is hoped that in another year or two it will be fully eradicated. I do not think that there need be any apprehension on the part of regulation. I have myself watched carefully, both here and abroad, and find that the direct regulation of the machine will compare at least favorably with any of the existing reciprocating steam engines, and it is my opinion that on the score of economy we should use it to-day.

1. Abstract of a discussion of a paper presented by Edward H. Sniffin before the American Street Railway Association at Detroit, October 10, 1902. The paper was printed, in abstract, on pages 248-250 in last week's issue of the Western Electrician.

Report of Patent Commissioner Allen.

A report of the business of the United States Patent Office for the fiscal year ended June 30, 1902, submitted by Commissioner F. I. Allen to the secretary of the Interior shows that there were received during the year 45,562 applications for mechanical patents, 1,807 applications for designs, 139 applications for reissues, 1,849 caveats, 2,460 applications for trademarks, 1,020 applications for labels, and 270 applications for prints. There were 27,387 patents granted, including reissues and designs, and 1,864 trademarks, 750 labels and 163 prints were registered. The number of patents that expired was 20,335. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 4,123. The total receipts of the office were $1,491,538.85. The total expenditures were $1,329,924.63, and the surplus of receipts over expenditures, being the amount turned into the treasury, was $161,614.22. The number of applications filed during the last year is greater than during any other recent year, and it is, in fact, the greatest in the history of the Patent Office, having for the first time exceeded 50,000. This is in spite of the fact that the number of design patent applications is less by 561 than for the preceding year.

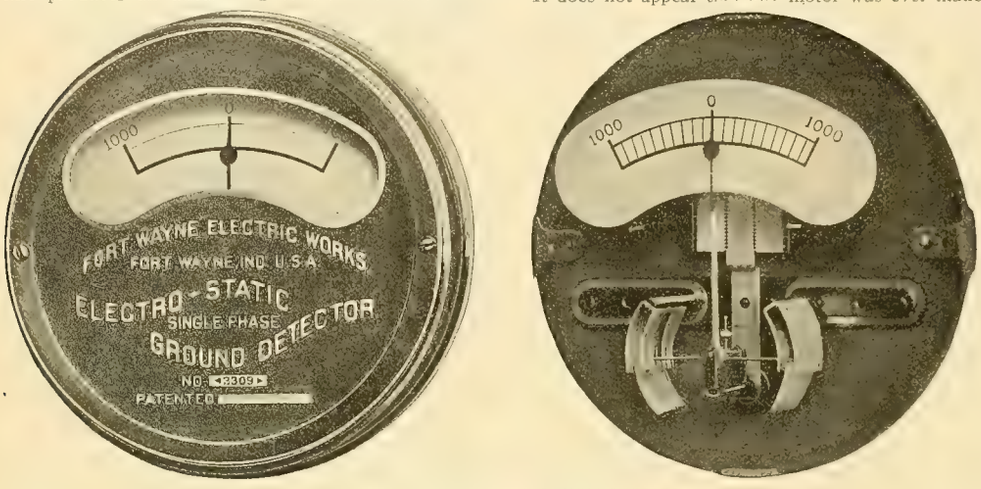
During the last year the scientific library has been in large part established in new quarters, and it only awaits the completion of a small portion of the new steel stacks, for which Congress has already provided sufficient funds, to be entirely installed in its new quarters, where its usefulness will be much increased.

The increasing use of aluminum as a substitute for copper in transmission lines is brought to notice by the following purchases: The Massachusetts Electric Company recently bought 500,000 pounds of aluminum, to be used for transmission lines. Another Boston firm is said to have bought a somewhat larger amount.

Fort Wayne Electrostatic Ground-detector.

The electrostatic ground-detector, recently placed on the market by the Fort Wayne Electric Works of Fort Wayne, Ind., is an exceedingly simple instrument and possesses many features not found in other instruments. In theory, also, it differs somewhat from other ground-detectors.

In all types of electrostatic ground-detectors the principle of the electrostatic voltmeter is employed, the deflecting torque being created by the attractive force between elecrically charged surfaces. In most single-phase ground-detectors the line terminals are connected to two plates, or two sets of plates, which are stationary, while the movable plate or vane is connected to earth. When no ground exists, the movable member is attracted equally by the two stationary parts connected to opposite sides of the line, but as soon as one side of the line is connected to earth, or grounded, the partial neutralization of the charges on the movable vane and the grounded line produces an unbalanced condition between the



FORT WAYNE ELECTROSTATIC GROUND-DETECTOR.

attractive forces of the two stationary plates and the movable vane and causes a deflection of the pointer attached to the vane toward the grounded side. The amount of the deflection indicates the strength of the ground, a direct ground throwing the pointer to the limit of its motion in the direction of the grounded side, while a leakage or partial ground is indicated by a slight deflection.

In the Fort Wayne single-phase electrostatic ground-detector, shown in the accompanying illustrations, the line terminals are connected to stationary members, composed of sheet aluminum stamped and pressed into a shape not unlike a double rake with curved, pointed teeth. The charge produced by the line potential is concentrated on these points according to a well-known law of electrostatics. The movable member consists of two similar sets of points carried on opposite ends of an arm mounted on a shaft set in jewel bearings. These points are free to move in or out between the double sets of stationary points. The moving parts are in no way connected to the circuit, but receive their charge from a set of points that are charged by another group directly connected to the earth. A delicate torsion spring connects the shaft to these stationary points, and, together with a light adjustable weight on the shaft, maintains the pointer at zero position under normal conditions.

The application in this instrument of the theory of the concentration of an electric charge at a point makes practical the use of an extremely light moving part, which is still further lightened by making it of aluminum. The result is a sensitive instrument, whose accuracy is permanent, since wear on jewels or shaft is inappreciable.

The entire mechanism of the instrument is rigidly mounted on and thoroughly insulated from a solid metal base, which is designed for mounting on switchboards. The cover is easily removed without disturbing the adjustment or connections, which are all made from the back. The scale is silvered-brass, mounted in the top of the case, similarly to other round switchboard instruments. The middle of the scale is the zero, or "no ground" position of the pointer.

The instrument is connected permanently in circuit through graphite sticks carried on hard-rubber insulators, mounted on a marble base, designed for mounting on the back of the switchboard.

The resistance of these graphite sticks is sufficient to protect the instrument and the circuit from accidental grounds or short-circuits within the instrument itself.

These ground-detectors may be used on two or three-phase circuits, two instruments being required in either case. For two-phase, two-wire circuits two ground-detectors and two sets of three graphite resistances are employed, while but one set of four resistances and two instruments are necessary for two-phase, three-wire or three-phase circuits.

The design and construction of these ground-detectors are of the highest order. They are furnished with either polished brass or oxidized finish to conform to other standard switchboard apparatus.

Wagner Single-phase Motor Upheld in Patent Suit.

By a decision handed down by Judge W. K. Townsend of the Southern District of New York, October 10th, the right of the Wagner Electric Manufacturing Company of St. Louis to manufacture its single-phase motor was upheld. The suit was brought by the Thomson-Houston Electric Company (General Electric Company) against the Wagner company and A. H. Mustard, and infringement was alleged on the first and second claims of complainant's patent, No. 430,328, granted June 17, 1890, to Elihu Thomson for an alternating-current motor. The testimony in a former suit showed that the modified method which defendants purposed to practice would not infringe plaintiff's construction of the patent.

Among other things, the court said:

"It does not appear that any motor was ever made

under the patent in suit. The complainant does not manufacture single-phase motors, except for small fans, and these are not made under the Thomson patent. The defendants are extensively engaged in the manufacture of single-phase motors. The practical development of such motors was attended with serious difficulties. Certain patents under which defendants manufacture their motors have materially contributed to the success of this type of motors.

"The respective contentions of the parties are primarily directed to the interpretation of the term, 'locally closed circuit' as used in the patent. The determination of this question appears to be decisive of the issues involved. The defendants claimed and have satisfactorily proved that the term 'locally closed circuit,' as used by this patentee in prior patents and generally, means a circuit disconnected from the main line. It refers to a circuit which does not extend from the source of energy, but pertains to the local place and no other. And defendants claim that the patent in suit is limited to a motor having its coils on a locally closed circuit after, but not before, the initial impulse of rotation is received.

"Herein, then, lies the difference between the two devices. In order to start the Thomson motor, you open a switch and the current will be conducted into the armature; and if you close that switch, the current stops. Defendants' motor starts by induction, and the motor coils are on locally closed circuits at starting, in the sense that the circuit pertains to the armature only.

"On the former trial complainant's experts admitted that in the Thomson patent the coils were not on a locally closed circuit at starting, but only on the attainment of the required speed. Thereupon defendants purchased the Anthony, Jackson and Ryan patent No. 389,352, one of the patents under which the alleged infringing device is manufactured, and in which the armature coils are at starting and always on locally closed circuits. They have developed this class of motors, as already stated, and are now met by the contention that this patent in suit, a mere paper patent, by a broad interpretation of its terms, may be so extended as to embrace the defendants' construction. The effect of this interpretation would be to give the complainant the benefit of the broad claims rejected by the Patent Office for which the present claims were substituted.

"Whether such a confessedly simple step as that taken by Thomson involved invention, or whether its confessed impracticability deprives it of all claim to utility, it is not necessary to determine.

"The defendants are entitled to the benefit of the rule requiring a narrow construction of such a patent. Upon said construction there is no infringement, and the bill may be dismissed."

J. Edgar Bull and Charles Neave were counsel for the complainant, and A. C. Fowler represented the defendants.

Bids for the proposed electric-light plant for Verndale, Minn., exceeded the estimate.

Coal Deposits of the United States.[1]

By W. L. Abbott.

Upon the original composition of the peat bed [vegetable matter of the carboniferous period] and its subsequent treatment as regards heat, amount and duration of pressure, and folding and crushing of the seam, depend the characteristics of the coal of each locality. If the heat and pressure have not been great enough in amount or duration, the coal still retains many of the features of peat and is called lignite. Under more favorable conditions it becomes bituminous coal, and if the coal measures with their included seams of coal be crushed and folded, anthracite coal is formed. A further continuation of this process changes the anthracite to graphite. If a coal bed contains a considerable amount of resinous matter it is called a fat or coking coal. If it is free of this material it is called a lean or splint coal. If it is rich in volatile matter it is a long-flame or gas coal. If it contains but little volatile matter it is termed short-flame, smokeless or semi-bituminous.

The anthracite mining operations of Eastern Pennsylvania are for many reasons the most interesting and, considering their extent, the most productive in the country.

These operations, which are scattered through a narrow district about 90 miles long, and which appear on the map like small dots when compared with the great extent of the larger coal deposits, had an output for 1901 of 53,000,000 tons, equal to one-fourth of the entire bituminous output of the country, and, if heating value is considered, it is about equal to the entire bituminous output of the United States outside of the Appalachian coal district.

The coal measures of the anthracite field in Eastern Pennsylvania lie in comparatively long and narrow basins of considerable depth.

In composition the anthracite coal follows the general rule in an increase of the volatile matter to the west, the composition of the coal of the Lykins Valley approaching that of bituminous coal.

Mining in these basins presents more difficult problems than in the bituminous seams which lie nearly horizontal; while the anthracite coal beds, for most of their extent, are at an angle of 30 degrees or more. The northern basin, which has 11 workable coal seams in the lower measures, has been the field most developed, because mining is less difficult than in the other localities.

The depths of the different basins have been quite accurately determined except that of the southern, which is variously estimated at from 2,500 to over 3,000 feet. The most conservative estimate, that of the Pennsylvania Geological Survey, has been used in making the section of the coal measures, which shows the depth of this coal basin as 2,500 feet, in which the measures are much folded and crushed together.

The anthracite coal seams are the thickest of our coal measures, running up to as high as 50 or 60 feet in the Mammoth bed; those of six or seven feet, however, offer the most satisfactory mining propositions.

Interstratified with the coal seams are layers of slate and rocks. This is especially true of the thicker beds. In the mining this slate and rock comes out with the coal and is hoisted to the surface, where it is separated from the coal at an expense which sometimes equals the cost of bringing the coal to the surface.

These scattering basins are all that is left of the eastern portions of the Appalachian coal fields, and they only escaped erosion because of the deep folds into which they were forced.

Considering now the bituminous coal fields of Pennsylvania, West Virginia and Ohio, it may be remarked that the great Pittsburg vein, which is quite persistent over most of the area indicated, and has a thickness of from four to 12 feet, is the most valuable coal deposit in the country. This vein in 1900 produced 52,000,000 tons, and outside of the operations in the valleys of the Youghiogheny and Monongahela, its possibilities have scarcely been appreciated. The following extract is taken from the Coal Trade for 1902:

"The Pittsburg district furnishes the largest supply of soft coal of any in this country. Professor Lesley calculated that 2,000 miles would scarcely cover the zig-zag outcrop of this coal, and this immense bed lies mainly above drainage level. From this bed along the Monongahela and Youghiogheny Rivers the best-known gas coal and the famous steam, domestic and industrial coal and the coal that produces the noted Connellsville coke is largely found. This coal, it may be stated, extends along the whole length of the Monongahela River as far as it is navigable. There are four counties in Pennsylvania and two in West Virginia, all of which are adjacent to each other, which contain practically all of the coal in the great Monongahela Valley. They are Allegheny, Washington, Westmoreland and Fayette, in Pennsylvania, and Monongahela and Marion in West Virginia."

Along the southern and western border of the territory underlaid by the Pittsburg seam it becomes thin and has suffered much from erosion. Here the lower coal measures rise up and approach so near

1. A condensation of a paper presented at the convention of the Association of Edison Illuminating Companies at Mount Washington, N. H., September 9-11, 1902. The author is chief operating engineer of the Chicago Edison Company.

the surface that they appear in the outcrop in the deep river valleys.

Along the Kanawha River there are a great many operations, producing the celebrated Kanawha splints and gas coals from the seams of the lower Allegheny series. Farther toward the head waters we come to the New River and Pocahontas operations which produce a semi-bituminous smokeless coal very free from moisture, ash and sulphur. This excellent coal is found principally in a limited district in the southern part of the state, and reaches south into Virginia. These seams outcrop north of Pittsburg and in Northern and Western Ohio, where they are known as Mercer, Sharon and Jackson County, but they do not have the thickness nor qualities which they possess farther south. It is doubtful if they are continuous throughout the whole basin. The anthracite of Eastern Pennsylvania is found in the same formation.

Dr. I. C. White, state geologist of West Virginia, says of the Pocahontas and New River coals: "These coals appear to have accumulated in commercial thickness only around the eastern rim of the Appalachian basin, since as their horizons dip under the high measures to the west, the coals thin away and disappear. Conversely they thicken eastward, since the Pocahontas bed had a thickness of eight feet to nine feet, where it escapes into the air from Flat Top Mountain on the border of Virginia."

The counties of Somerset, Cambria, Clearfield and Jefferson, all within 50 miles of Pittsburg, each produces from 5,000,000 to 8,000,000 tons a year, which is greater than the output of four-fifths of the coal-producing states. This coal is semi-bituminous, from the same measures as the Kanawha coal of West Virginia and the Hocking coal of Ohio. It has a heating power of about 15,600 B. T. U. per pound of combustion.

The Cumberland coal field, which is a wedge-shaped basin between the mountain ranges, runs from Eastern West Virginia through Maryland into Pennsylvania. This isolated coal basin, which was probably detached from the larger field to the west by erosion, contains the entire series of coals of the Pittsburg field. The principal operations are in the Pittsburg seam, which here does not resemble the gassy coals of the Youghiogheny and the Monongahela, but have the nature and appearance of Pocahontas. The Georges Creek coal, which comes from this vein, constitutes the entire coal production of Maryland.

The mining operations of Pennsylvania and Ohio and West Virginia are, for the most part, in mountainous or hilly localities, where the seams and rivers have cut down into the coal measures so that the seams are exposed on the sides of the valleys. Through these valleys run the railroads and navigable streams. To start a mine in this district is, therefore, a simple and inexpensive matter. The result is that a great deal of the coal, especially in Ohio and West Virginia, is produced from small and poorly equipped operations. But when these fields are properly developed their control of the western markets will be a question of freight rates only.

The central coal field comprises most of the state of Illinois, a wedge-shaped piece in the southwestern part of Indiana and about an equal area in the state of Kentucky.

In this field the principal operations are in the western part of Indiana and up through the western and central part of Illinois. These localities mentioned form a continuous line along what was once a seashore, and where the richest deposits were laid down. There are several deposits above these which are broader in extent, specially to the northwest, but the veins are thin and uncertain and are worked only in small operations.

From the standpoint of West Virginia, Ohio and the bituminous portion of Pennsylvania, the central basin is a locality of deep mining, nearly all of the coal for shipment coming from shaft mines, most of which are several hundred feet deep. The basin is from 1,200 to 1,400 feet deep in the center and has 16 seams of coal in all. These coals are for the most part gassy splints, which burn with a long flame and produce a great deal of smoke.

The northern part of the Indiana field produces a very hard, coking block coal, which is esteemed very highly for steam purposes because of its free burning qualities and its small amount of ash.

The best coal of the district comes from the second and seventh veins in Southern Illinois. The most productive district is four counties between Springfield and St. Louis, where the mining is carried on in the fifth and sixth veins, which are here from five to eight feet in thickness. The deepest mine in this district is at Assumption, where a very good quality of coal is taken from vein No. 1 at a depth of 1,060 feet.

Of the coal of the western coal district, little can be said except that it is very high in moisture, ash and volatile matter and lies in thin pockets and veins of limited extent. The entire output of the western field in 1902 was 14,000,000 tons.

The Michigan coal field is quite unimportant, the coal being in thin and uncertain veins and of about the same quality as that in the western district.

The scattered coal fields among the Rocky Mountains contain coal of every variety from lignite to anthracite. Many of these deposits have not yet been explored, but some of them, especially in Colorado and Utah, are known to be quite extensive and of very good quality.

A most casual comparison with coal fields of other countries is convincing that of the many natural advantages with which this land is blessed our vast deposits of coal are among the richest, and are sufficient to guarantee the commercial supremacy of the United States for all time.

Street-railway Standards.

On Friday of last week (October 10th) Colonel N. H. Heft submitted to the American Street Railway Association a report from the committee on standards. Following is an abstract:

It is unnecessary to suggest that because of the great changes and vast improvements being made in the type, design and construction of motors, it is difficult to make any definite recommendation upon this point, as we feel that the next year or two may radically change the ideas of the manufacturers as well as the operating departments of the several roads with relation to the matter of motors.

With regard to the matter of rails and trucks, we present more definite conclusions for your consideration.

Division of the Work.

At the first meeting of the committee the subjects to be considered by the committee were divided and assigned to the members, as follows:

N. H. Heft (Meriden, Conn.)—Wheels, axles, axle brasses, journals, journal boxes, brake heads, brake shoes, etc.

John I. Beggs (Milwaukee, Wis.)—Rails.

E. A. Newman (Portland, Maine)—Motors.

E. G. Connette (Syracuse, N. Y.)—Trucks.

R. T. Laffin (Worcester, Mass.)—Painting.

Will Christy (Akron, Ohio)—Car bodies for city and suburban service, including ventilation; also the question of the oval roof.

C. F. Holmes (Kansas City, Mo.)—Standard overhead construction for high-speed city and suburban roads, including trolley wheels.

Rails.

The committee having carefully considered this subject, and having consulted with various experts on the subject, recommends that this association adopt as a standard either a "T" or girder rail, the height of the rails to be governed by the character of the pavement required in the municipalities and the weight of the rail to be not less than 70 pounds for the "T" rail and not less than 90 pounds for the girder rail, per yard.

The head of the rail is made to conform to the angle of the tread of the car wheels for the following reasons: First, to increase the contact area, thus increasing the tractive force; and, second, causing a more uniform wear across the head of the rail and tread of the wheel.

The width of this head should be not less than three inches. With a rail head of this description, a car wheel having a three-inch tread and flange of 1⅛ inches in depth (which should be used on all suburban cars), can be operated without interfering with pavements, with safety at a high rate of speed on suburban and interurban roads, and with less cost for maintenance than the present form, due to the increased surface contact between the wheel and rail, and decreased wear on flange.

The committee is of the opinion that the "T" rail is the most desirable and practicable rail for all purposes, and advises its use wherever the consent of the municipality can be obtained, and an earnest and persistent effort should be made on the part of all electric railways to obtain such consent.

In all places where a "T" rail cannot be used, your committee recommends a grooved girder rail. This form of rail, owing to the bearing being placed directly over the center line of web, gives a rail of great stiffness, with a head of three inches in width, as well as a deep and wide groove, and can be paved in the same manner as with other girder rails.

In view of the rapid construction of suburban and interurban lines, which enter the cities over the tracks of city lines, the committee deems it advisable to recommend, in the renewal of special work where suburban or interurban cars are operated, and in all special work for new construction, that particular attention be given to the depth and width of the groove, applicable to special work in connection with "T" or grooved girder rails.

Motors.

Street-railway motors are subjected to such varying conditions and uses as to render it almost impossible to outline what might be considered a standard motor. Neither would it be practicable to standardize certain horsepower motors for certain weights of cars, as the conditions of operation are so varied that what might be perfectly satisfactory in one case would be unsatisfactory in another. Generally speaking, for city service motors of between 35 and 40 horsepower are most practicable. For ordinary suburban service motors of this capacity, with four-motor equipments, would meet nearly all ordinary conditions and requirements. For high-speed service on long suburban and interurban roads, motors of greater capacity are desirable, and should be selected with special reference to the specific duty to be performed.

As there is a possibility of alternating-current motors being developed, the committee feels, in view of the experiments now being made both in this country and abroad, with various types of motors, that it is advisable to await the outcome of these experiments before any recommendation on this subject is made.

Trucks.

Your committee is of the opinion that the time is inopportune for recommending any particular design of trucks for motor-car service, especially for single-truck cars, except such parts of trucks as wheels, axles, bearings and journal boxes.

For interurban service the committee recommends that the standard dimensions as given in this report for wheels, axles, bearings and journal boxes be followed, and also that the M. C. B. practice in the construction of trucks for double-truck cars be adhered to as closely as possible.

Axles, Axle Brasses, Journals, Journal Boxes, etc.

In view of the great demand on the part of the traveling public for a more frequent and rapid service, not only in large centers of population, but in suburban and interurban service, and in view of the increased weights of the equipment required to perform this service safely, your committee recommends the standard axle adopted by the Master Car Builders' Association, which is the result of developments and improvements covering a period of 50 years. These standard axles can be applied to all electric railroads, which are now performing practically the same service as steam railroads. We recommend, also, the Master Car Builders' standard journal brasses, journal boxes, dust guards and key seats.

Car Wheels for Suburban and Interurban Service.

Your committee has taken up with operating managers the subject of car wheels for suburban and interurban service to centers of population over public streets, and find their views in accord with those of your committee. We recommend for adoption as standard a steel-tired wheel and a cast chilled wheel. With a view to safety and economy, we recommend for motor cars used in suburban and interurban service steel-tired wheels, as follows:

For use with a car weighing 15 tons or less at full load, a wheel to weigh 640 pounds; for use with a car weighing up to 20 tons, a wheel to weigh 695 pounds; for use with a car weighing up to 25 tons, a wheel to weigh 740 pounds; for use with a car weighing up to 30 tons, a wheel to weigh 790 pounds; for use with a car weighing up to 40 tons, a wheel to weigh 840 pounds.

In the case of cast chilled wheels we recommend for use with a car weighing 15 tons or less at full load, a wheel to weigh 440 pounds; for use with a car weighing up to 20 tons, a wheel to weigh 490 pounds; for use with a car weighing up to 25 tons, a wheel to weigh 540 pounds; for use with a car weighing up to 30 tons, a wheel to weigh 590 pounds; for use with a car weighing up to 40 tons, a wheel to weigh 640 pounds.

Car wheels of the above weights conform to the Master Car Builders' standards.

Painting.

As a standard method of painting cars, your committee would recommend the following: All grease and rust should be removed from the iron work and the car body rubbed down to a smooth surface, after which thoroughly paint the iron work with pure red lead and raw linseed oil. Then the outside of car body to be painted as follows: First, pure lead and oil priming thoroughly rubbed in; second, one coat of flat lead egg-shell gloss; third, white lead putty; fourth, three coats of flat lead; fifth, two coats of rough stuff; sixth, scour to smooth surface; seventh, two coats of ground color. eighth, special color to cover; ninth, ornament on flat color; tenth, two coats of best finishing varnish.

No coat to be applied until the preceding coat is thoroughly dried. Roof canvas to have three coats of lead and oil; no glue size or patent filler should be allowed on the roof. As to the inside or standing finish, we recommend that one coat of lead and oil and one coat of Prince's metallic be put on back of same before finish is put in place. All standing or inside finish, if of open-grain wood, such as ash, oak or mahogany, should be thoroughly filled with Silex filler. If the wood is of more open-grain nature, such as cherry, maple or birch, we recommend a good oil stain instead of the filler. Then thoroughly sandpaper, after which apply two thin coats of absolutely pure-grain alcohol shellac, either bleached or orange, according to the wood. Then sandpaper and apply two coats of varnish. All inside work should be rubbed to a dead finish and all outside or exposed work should be left in the gloss.

The under or lining floor of car floors should have one good coat of oil before the upper or corrugated floor, which has received a coat of oil, is

laid. When finished it should receive one coat of bleached shellac and one coat of good floor varnish.

RETURN CIRCUIT.

The committee believes that one of the most important factors in the construction and operation of an electric railway is to provide for a standard return circuit in such manner as to give the least resistance and largest and most reliable carrying capacity, thus avoiding loss of power and increased cost of maintenance. We recommend a supplementary return, in addition to the usual practice at the present time, in all congested sections, crossing all special work, and in the vicinity of the power plants.

CONCLUSION.

We earnestly recommend that the incoming officers of the association be authorized and directed to appoint successors to the committee to carry on the work for which they were appointed, as we feel that the above recommendations are only preliminary to much work that can be done in this direction.

The Motorman.

[From the Scientific American.]

Considerations of public safety demand a thorough investigation of the whole subject of the selection and training of motormen; and in considering this question it is necessary to realize at the very outset that the responsibilities of the task assigned to the motorman have been greatly underrated. We venture to assert, without fear of contradiction, that the driving of a motor car at a moderate speed in a crowded city, or at the higher speeds that obtain in suburban service, calls for closer watchfulness and quicker judgment than the driving of a fast passenger locomotive on a steam railroad. A few considerations will show this. In the first place, the steam locomotive runs on a fenced-in right-of-way, and has the exclusive use of its own pair of steel rails; its movements are controlled by an elaborate system of signals, which is so arranged that the engineer, except in cases of extraordinary emergency, finds every provision made to assist him in controlling his train and maintaining it in its proper position relative to other trains; there are no cross streets at every 200 to 300 feet, through which other trains may come unheralded to cross his track; nor is there a mass of vehicular or pedestrian traffic that may quickly gather and surge over the track in front of him, necessitating exquisite judgment as to pace and distance if he would avoid continual arrest on the charge of culpable homicide.

The motorman, on the other hand, runs his car on a public thoroughfare; he has no signals to warn him of obstruction; no carefully marked-off distances; no home and distance signals; no clearly painted signboards giving him the pitch of the hills, or even in some cases the curvature of the line; he has to depend on his own judgment as to speed and distance; and at any time, when he is speeding his car in the effort to keep up with the company's schedule, he is liable to find the track ahead of him obstructed by a lumbering wagon or some unsuspecting or bewildered pedestrian. We venture to repeat that of the two men the motorman holds the more difficult and responsible position; and yet we find that while in the case of the steam railroad, engineers are subjected to an apprenticeship of many years before they graduate to the throttle, and by that time are a highly intelligent and well-paid body of men, the average trolley-car motorman, on the other hand, is rushed into his job with absurdly inadequate preparation; that his pay is barely half as much as that of the locomotive engineer; and that in point of intelligence, training and reliability, he does not compare with the men who, as a matter of fact, have the less difficult and exacting work to do.

This is all wrong, and we are paying the penalty for it in the ghastly list of tragedies which, during the last summer months, has been growing frightfully in length and in the shocking nature of its fatalities. The fact of the matter is that while the motorman had a comparatively easy task when electric trolleys were first introduced, when cars were small and speeds were low, the motorman of to-day is in a vastly different position, handling, as he does, a car which is two or three times as heavy and travels at nearly two or three times the speed of the car of 15 years ago. The great peril through which our president has recently passed will not have been without its due effect, if it leads to a thorough investigation and some stringent laws on the selection and training of trolley-car motormen.

W. S. Stacey, a farmer living near Marshalltown, Iowa, has been experimenting this season with electrically treated corn, with excellent results. The corn was treated in the following manner: A barrel was filled with water and a piece of zinc placed at the bottom and another on top of the water. Then the seed corn was placed in the water and a current of 500 volts run through the barrel for 20 minutes. The corn was then thoroughly dried, and planted with a drill. Thirteen acres were planted with this corn on May 17th. The land had been planted with corn for nine consecutive years. The corn averages eight feet in height, and it is said, will yield 75 bushels to the acre—nearly double the yield of the fields immediately surrounding it.

CORRESPONDENCE.

New York Notes.

New York, October 11.—Mayor Low, having discovered his mistake in delaying the Pennsylvania tunnel franchise by reopening debate on it, has returned the franchise in its original condition (without labor clauses) to the Rapid Transit Commission. This body unanimously readopted it, and the agreement will now go to the aldermen for action. The mayor recognized the impossibility of getting the railroad company to accept the franchise with the obnoxious clauses in it and, rather than hold up such a public benefit, he agreed to accept it without the clauses, and again gave it to the Rapid Transit Commission. Public sentiment seems to be in favor of immediate action by the aldermen, and the Merchants' Association has sent out 60,000 blank forms for taxpayers to sign, protesting against any further delay.

Work on the rapid-transit tunnel is progressing rapidly, and, according to Chief Engineer William Barclay Parsons, the end of the construction work is in sight. Track laying will be begun in December, and by January 1st the motors and cars will begin to arrive. Mr. Parsons believes that the main sections of the tunnel will be open to traffic by October 1, 1903, some 15 months ahead of the time limit.

The two-year fight in the courts carried on by the residents of the East New York section of Brooklyn to compel the Brooklyn Rapid Transit Company to abandon the elevated-railroad loop at Manhattan Junction has been won by the railway company. The Court of Appeals has just handed down a decision affirming that of the Appellate Division in Brooklyn, allowing the railroad company to continue to operate the loop. The loop was built in April, 1900, to connect the Broadway and Fulton Street elevated lines. Trains then were operated around this loop instead of being sent through to the terminals of the elevated lines in East New York. During the greater part of the day East New Yorkers were compelled to travel by trolley car to Manhattan Junction to make connection with the elevated trains. The loop excited great indignation in East New York. Finally Edward F. Linton, a prominent resident of the district, began the litigation just decided.

The United States Electric Light and Power Company of 55 Duane Street is planning to erect a power house at 523-525 West One-hundred-and-forty-fifth Street, to cost $8,000.

Policeman Christopher Stanton of Hoboken had an exciting experience one day last week. He was at home eating supper when his son entered and told him two men were stealing telegraph wires from the poles at the head of Eighth Street. When Stanton reached the place he saw a man jump from behind a telegraph pole and run away. Looking up he saw another man at the top of the pole cutting the wires. He called on the man to descend, but he refused. Stanton then drew his revolver and fired two shots, hoping to frighten the fellow, but the ruse did not work. "I am a policeman," said Stanton, "and I want you to come down." "If you are a policeman, come up and get me," was the answer. "I will," said Stanton. He started up the pole and reached the crosstrees. Then his prospective prisoner undertook to slide down the pole on the opposite side, but Stanton seized and held him. The result of the struggle was that the two men slid to the ground together. There Detective Grinan, who had heard the pistol shots, awaited them, and he and Stanton, after a struggle in which they were compelled to use their clubs, finally reduced the prisoner to subjection. O.

New England News.

Boston, Mass., October 10.—The Edison Electric Illuminating Company of Boston will hold its annual meeting next Tuesday. The company's fiscal year closed June 30th and its report for the year ended that date, shows the following: Income from sales of light and power, $1,840,291; total expenses, $1,245,599; net income, $594,692; surplus, $45,843. These figures include the operations of the Boston Electric Light Company for the five months and the Suburban Electric Light Company for the seven months ended June 30th.

The Bennington and Hoosick Valley Railway Company has completed a survey for extensions of its electric railway from North Hoosick to Troy, N. Y.; from Hoosick Falls, N. Y., to Williamstown, Mass., and from Eagle Bridge to Greenwich, N. Y., via Cambridge. Its present railway runs from Bennington, Vt., to Hoosick Falls, N. Y. When these extensions are completed the company's lines will serve 34 cities and villages with a population of 350,000 people.

The Auburn, Mechanics Falls and Norway Street Railway Company has been organized for the purpose of building an electric or compressed-air railway between Auburn and Norway, Maine, via Minot, Poland, Mechanic Falls and Oxford, a distance of 24 miles. The capital is $700,000, and the following are the directors: E. Burton Hart, Jr., of New York, A. H. Shaw, Samuel R. Percy and Frank E. Southard of Bath, Maine, and Frederick H. Wilson of Brunswick, Maine.

The Boston Elevated Railway Company has ordered some 8,000 tons of coal, to be sold, at cost, to its employes. This will benefit about 7,500 families. The company has also offered 10,000 tons, at cost, to the Boston municipal relief committee, and 1,000 tons of English Admiralty coal to the city of Cambridge, Mass., for its poor, at $5.50 per ton. President Bancroft of the company, who lives in Cambridge, has subscribed $500 to a fund to be used in purchasing coal for the Cambridge poor. The Old Colony Street Railway Company will also supply its employes with coal, at cost, until the price falls. The Consolidated Street Railway Company of Worcester, Mass., has offered 9,000 tons of Welsh coal, at cost, to the citizens' fuel committee of that city.

In the presence of the State Board of Conciliation and Arbitration, the New England Electrical Contractors' Association and Electrical Workers' Union No. 103 signed an agreement which ends the strike of men employed on the New England Conservatory of Music and the Majestic Theater in Boston, where the men went out August 10th. The agreement provides that, all things being equal, contractors shall give preference to union help; eight hours are to constitute a day's work; one and one-half the regular rate is to be paid for extra work, with double pay for work on Sundays and holidays; journeymen to receive a minimum of $3 per day and helpers to receive $2 per day.

The Massachusetts railroad commissioners have granted the Old Colony Street Railway Company's petition for permission to issue additional stock amounting to $948,700. Of the proceeds, $456,900 will be used in paying floating indebtedness, $301,600 will be used in buying additional rolling stock and electrical equipment, $116,300 will be used for additional power-plant equipment, and the remainder will be used for an extension of the road and requisite car houses in Quincy, Mass. The board has also approved an increase of $1,797,300 in the capitalization of the Boston and Northern Street Railway Company, the proceeds to be used in paying floating indebtedness, power stations in Lowell and Woburn, Mass., car houses in Danvers and Lawrence, Mass., and extensions of the company's lines.

The Boston Elevated Railway Company has procured sufficient foreign coal to protect it from the expected coal famine.

The Lynn (Mass.) employes of the General Electric Company are considering the advisability of buying a cargo of coal in Wales, to be distributed among themselves at cost.

The Boston Society of Arts will hold its first meeting for this season on the evening of October 10th. Dr. Louis Duncan, the new head of the Institute of Technology electrical department, will read a paper on "Long-distance Electrical Railroading."

The second automobile meet of the Rhode Island Automobile Club was held at Narragansett Park, Providence, last week, and was attended by many automobilists from New York, Boston and other places. A race of two miles for electrics brought together four Waverleys, a Buffalo and a Neftel, and was won by the latter, driven by Knight Neftel, and W. G. Titcomb's Waverley was second, and C. F. Peckham's Waverley was third. The time was four minutes and 23 seconds. The electrics' showing in track work was the best ever seen at any New England race meeting.

General Bancroft, president of the Boston Elevated Railway Company, has signed the contract for the proposed Washington Street subway, thereby accepting, for the company, the provisions of the act passed by the last Legislature. The people of Boston will have their say on the matter at the December municipal election.

Francis Peabody, Jr., master in the case of the electrical workers' strike, has filed his report with the clerk of the Superior Court. The plaintiffs in the case are the Lord Electric Company, Seth B. Wetherbee, the Seth W. Fuller Company, Edwin C. Lewis, et al., and the defendants are members of Local Union No. 103 of the International Brotherhood of Electrical Workers of America. The plaintiffs asked for an injunction restraining the defendants from interfering with plaintiffs' business. The master reports that he finds a few isolated instances of threats and the use of inelegant phrases to non-union men, on the part of some members of the union, and that three defendants had taken systematic action to compel the plaintiffs to accede to the union's demands.

The Pittsfield (Mass.) aldermen have adopted an ordinance providing that the speed of electric cars in that city shall not exceed 10 miles per hour on the main business streets and 12 miles per hour on other streets. The cars must come to a full stop before crossing certain streets. This ordinance is an outcome of the accident to President Roosevelt and party on September 3d. B.

Canadian Intelligence.

Toronto, Ont., October 11.—The Niagara, St. Catharines and Toronto Electric Railway Company, through the Dominion Securities Corporation, is offering for sale $150,000 five per cent. first-mortgage, 30-year bonds at 101 and interest. This company operates 34 miles of track and runs from Port Dalhousie to Niagara Falls, Ont., and Niagara Falls, N. Y. The company also controls the Niagara, St. Catharines and Toronto Navigation Company, which operates the steamers Garden City and Lakeside, which, dur-

ing navigating season, make four trips daily between Toronto and Port Dalhousie Wharf. The road and equipment of the company are in first-class condition. The company also does a large freight business, particularly in fruit and dairy products. The company has freight arrangements with the steam roads, with which it connects—viz., Grand Trunk, Michigan Central, Erie, New York Central, etc. This road, which has come to the front so rapidly, is an old steam road electrified and used to be called the Niagara Central Railway.

The Montreal Street Railway Company has commenced to use the power from the Richelieu River, which the Montreal Light, Heat and Power Company is under contract to supply. It involves about 4,250 horsepower, and Mr. Wanklyn, the general manager, states that it has given the street-railway company the greatest satisfaction.

The British Columbia Electric Railway Company of Victoria, B. C., has offered to extend its line around what is called the Gorge on condition that it receives as compensation one-half of the increase in value of the land on the line of the route of the proposed extension, the real estate to be appraised at its present value, and in case future sales were made at a higher figure than the valuation so made, half the difference to be paid to the street-railway company.

The Montreal Terminal Company has nearly finished the work on its line from Cadieux to Craig Streets, and is putting in a loop on City Hall Avenue, Craig and Cadieux. The line will be in operation in about a week. H.

Ottawa, Ont., October 11.—The power development of the High Falls on the Lievere River, Quebec, about 30 miles from the city of Ottawa, is being projected. There is a drop of 180 feet at the falls and further drops between the falls and the outlet in the Ottawa River. In all, at lowest water, the Lievere River, from its falls to its mouth, can probably produce 50,000 horsepower, which could be transmitted to Ottawa and other points, without difficulty. The character of the Ottawa Valley, in respect to abundance of waterpowers, is such, it is claimed, that the capital of the Dominion must eventually become the greatest manufacturing center in Canada. Electrical energy, produced by waterpower, costs in the Ottawa Valley, at present, about $15 per horsepower per year, while the same amount of power produced by steam costs upward of $50 per annum, but with the important difference in favor of water that the steam-produced power is only for the ordinary working day, while the water-produced power is for the whole 24 hours.

Alderman Askwith of Ottawa has been figuring on the possibility of warming the city by electric energy, generated at the Chats Falls, 35 miles distant from the city. He calculates that on the basis of last season's coal prices, the average cost of heating an ordinary dwelling would be $90 by electricity, as against $60 by coal for the winter season. But he also figures that, by a systematic utilization of the entire potential throughout the year, this cost might be much reduced. U.

From the Buckeye State.

Columbus, O., October 11.—It is stated that the Mandelbaum syndicate will erect a large power house at Dayton to furnish current for the roads that it is operating there. The amount to be spent in the building and equipment of the plant is placed at $2,000,000 and the structure is to occupy about one square in the city. It is also said that the offices which have been maintained in Cincinnati for the Cincinnati, Dayton and Toledo Traction Company will be moved to Dayton.

The stockholders of the Cincinnati, Milford and Loveland Traction Company have organized and the following-named officers have been elected: President, B. H. Kroger; vice-president, J. M. Wilson; secretary and treasurer, J. Nevin Roberts. Harry L. Gordon and Leo J. Van Lahr complete the board of directors. The first assessment on the stockholders has been made and the money has been paid into the Provident Savings Bank. Contracts have been awarded for rails and the construction work will be begun at an early date.

The Columbus, Delaware and Marion lines were partially tied up a few days last week because of shortage of coal, and were compelled to rely upon the electric-light plant for power. A supply was secured later in the week, however, and the power house at Stratford was again put in operation.

A company has been organized at Youngstown to manufacture iron trolley poles. The plant will be located near that of the Youngstown Iron, Sheet and Tube Company, but at this time it cannot be learned who are interested in it.

The Ohio Central Railway Company has applied for a franchise over East Long Street in Columbus. It is intended to enter the city in that way. The company proposes to sell tickets good in the city at the rate of 10 for 25 cents or 46 for $1. The road is competing with the Columbus, Newark and Eastern Traction Company for an entrance into the city over this route.

The Fisher Electric Company of Toledo was incorporated a few days ago with a capital stock of $10,000. The incorporators are H. O. Fisher, E. X. Schaffhaldt, J. M. Shunck, H. F. Shunck and Harry B. Thompson. The new company has absorbed the Fisher Electric Construction Company and secured large quarters near the News Building, where an extensive plant of retail and local work will be equipped.

The Village Council of New Martinsville, W. Va., has been asked to grant franchises to the New Martinsville-Sistersville Electric Railway Company and the New Martinsville Light, Heat and Power Company.

It is reported that the Appleyard syndicate is arranging to extend its line from Newark to Zanesville at once. A company was incorporated some time ago for this purpose.

It is reported from Dayton that contracts have been awarded for the construction of the lines of the Greenville and Union City and the Union City and Muncie electric lines. If these lines are built all the principal Ohio towns may be reached from Muncie and other points in Indiana with little difficulty by electric lines.

Stuart A. Allen has been appointed traffic manager of the Miami and Erie Transportation Company, with offices in the Union Trust Building, Cincinnati.

The Cincinnati and Eastern Traction Company now has four new passenger cars which are as complete as any coaches that have ever been purchased for an electric road in the state. They will seat 72 persons with comfort. The seats are upholstered in red plush and with plate-glass windows and mirrors between them, package racks, toilet rooms, smoking apartments make a very complete coach. The road has been practically completed between Richmond and California, and the power house has been tested and found perfect in operation. It is likely that that section will be put in operation within a very short time.

A franchise has been granted by the city of Mansfield to the Mansfield, Mt. Gilead and Delaware Traction Company, and it is believed that the work of constructing the line will be begun at once. The idea has been advanced that there will be traffic connections formed between this line and the Columbus, Delaware and Marion, for the purpose of forming a through line between Columbus and Cleveland, but this remains to be seen.

The Toledo and Indiana Railway Company has applied for a franchise to cross the highways at 21 points in Lucas County.

The Urbana, Bellefontaine and Northern Railway Company has increased its capital stock from $50 to $500,000. which would indicate that it will proceed to the construction of its lines at once.

The Rapid Railway Company of Cincinnati is making rapid strides in the construction of its road and expects to connect with the Cincinnati Traction lines by the middle of this month.

The Electric Storage Battery Company, a New Jersey incorporation, with a capital stock of $18,000,000, has been admitted to this state to do business. The Ohio office is located in Cleveland.

The Mansfield and Ashland Electric Railway Company has applied to the city of Mansfield for a franchise to operate lines on its streets. The application has been referred to the committee on streets for action.

The Columbus, Marion, Tiffin and Toledo Railway Company has secured an injunction against the Columbus, Delaware and Marion Railway Company to prevent it from building a branch line to Prospect and Richwood.

The Toledo and Indiana Railway Company will complete its lines as far as Wauseon, Ohio, this fall, if possible.

The report of the auditor of the Cincinnati, Dayton and Toledo Traction Company for the month of September shows total gross earnings of $44,090.12, operating expenses of $23,050.16 and net earnings $21,039.96, the net income being $4,788.49. For the four months ended September 30, the net earnings were $93,295.70 and the net income $28,054.69. O. M. C.

Information from Indiana.

Indianapolis, October 13.—The New Albany and French Lick Valley Traction Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are Crawford Fairbanks, Thomas Taggart, L. F. Dickson of Chicago; B. J. Jeup and Thomas B. Buskirk. The road will start at New Albany and will extend to French Lick, passing through Mooresville, Greenville, Galena, Palmyra, Fredericksburg, Hardinsburg, Rego, Chambersburg, Paoli and West Baden. The company has asked for a franchise to enter New Albany. The New Albany Street Railway Company is building a line out the Paoli pike to the city limits, and the question of the new company entering over this line or over an independent line is involved. The Southern Indiana Interurban Railway Company, which is composed of the same syndicate of Chicago capitalists that owns the New Albany Street Railway system, has a large force at work on the interurban line to connect New Albany and Jeffersonville.

The Evansville, Booneville and Rockport Railroad Company was incorporated on October 9th with $30,000 capital, but providing for an increase. The road will run from Evansville, through Vanderburg County, to Newburg and Booneville, in Warrick County, and to Rockport in Spencer County. The company has a plan to purchase and lease street-railway systems to complete its interurban system. The directors are William Trekeld, Charles E. Maley, Claude Maley, Daniel Wertz and E. C. Hemming.

The Union Traction Company has been granted a franchise to extend its system from Daleville to Middletown, and another franchise to extend its system from Muncie to Alexandria. Five miles of the latter road is graded and the road will be constructed at once. The right-of-way through Delaware County for the Muncie and Portland Traction line has also been entirely secured. This line is supposed to be a part of the Union Traction system.

The Wabash-Logansport Traction Company, operating the Peru interurban, has accepted a franchise by the terms of which it is to build a city system in Wabash. This system, when completed, will connect the Wabash-Logansport interurban on the south with the Fort Wayne and Southwestern Traction line on the north, thus joining the two systems for through service, if desired.

The Muncie, Newcastle and Alexandria Traction Company has abandoned its projected electric line from Muncie to Newcastle, although it had obtained nearly all its right-of-way, because its rival, the Union Traction Company, stole a march on it by beginning the construction of tracks between Muncie and Alexandria.

The Indianapolis and Northern Traction Company, which has secured a franchise to enter Kokomo, has now applied for a franchise for an electric-lighting and heating plant. There is a strong sentiment in favor of granting the franchise. Mr. Marrott has a five years' contract to light the city, and this could not be secured by the new company at present.

Wabash and Marion are within a few months to be joined by an interurban line. Eastern capitalists have agreed to finance the line, and engineers are now surveying the route. It is proposed to buy outright the right-of-way, no highways to be used.

Judge Gamble of Logansport has rendered his decision in the condemnation proceedings of the Fort Wayne, Logansport and Lafayette Traction Company against the heirs of the Wabash and Erie Canal towpath, announcing that he would appoint appraisers on the 13th. This is the beginning of what promises to be a hard-fought legal battle, extending through Cass, Miami, Carroll and Tippecanoe Counties. In addition to the heirs, the Wabash Valley and the Wabash-Logansport Traction Companies are among the defendants. The latter has already secured possession of a strip of the towpath between Logansport and Peru, and has nearly completed its line upon it.

Bids were opened on the 11th inst. for the contract of installing the mechanical and electrical equipments of the new postoffice building at Indianapolis. There were 10 bidders, the bids ranging from $111,028 to $149,700. Joseph McWilliams & Co. of Louisville submitted the lowest bid. The contract will be awarded some time this week.

The electrical display or illumination of the streets, business houses and the grounds and arena of the Indianapolis Fall Festival and Horse Show, being held this week, is as immense as it is brilliant. The great improvement and progress made in electric decoration is amazing to the people and greatly admired by all. The display is abundantly successful. F.

Old Mexico.

Austin, Texas, October 8.—There are some big electric-railway projects on foot in Mexico, and if the plans now being matured are carried out, that country will soon have a number of long interurban electric lines. It is stated that liberal subsidies have been offered by the federal government and the state governments of Jailsco and Aguas Calientes as an inducement for the building of an electric line between the cities of Guadalajara and Aguas Calientes, a distance of about 120 miles. The country through which the proposed line would pass is comparatively even ground, although there are some rough stretches which would require heavy construction work. The matter of building this road is now being considered by a syndicate of New York capitalists, who have sent an expert to Mexico to investigate and make a report upon the feasibility and probable success of the project.

Manuel Siquieros and a number of other wealthy mining men of the city of Chihuahua and Jesus Maria, in that state, propose to build an electric railway to connect the town of Minaca, the terminus of the Chihuahua and Pacific Railroad, with the Jesus Maria mining camp. The proposed road will be devoted principally to carrying ore and other freight shipments between the two places. The country is too rough for a steam road, and the proposed electric system is to have a number of branches running to the different mines of that district. It is proposed to utilize the power of the wonderful waterfalls of Passaunchic, situated in that immediate section, for generating electrical energy to be used in the motive power for the railway and in the mines throughout the district. The water of these falls drops a sheer 1,500 feet over a precipice.

A project is underway looking to the consolidation under one management of a number of electric-

light plants in Northern Mexico. The plants involved are located at Tampico, San Luis Potosi, Victoria and Linares. It is also the intention of the Americans who are promoting this combination to build elctric-light plants at Montemorelos, Matamoros and several other thriving towns in Mexico. In addition to the plant at San Luis Potosi, which may be embraced in this merger, another American company represented by George Waddill, has been granted a franchise by the Municipal Council of that city for the installation of a large electric plant which shall furnish power, light and heat for local industries and for private houses. The new company has a paid-up capital of $300,000 gold, and preparations for the construction of the plant are now in progress.

Emilio Dysterud, general manager of the Monterey Electric Light and Power Company of Monterey, Mexico, has been making an extended tour of the United States, during which he visited Chicago, St. Louis and a number of eastern cities. He made some large purchases of machinery for his plant during his trip, it being the intention of the company to increase the capacity of the plant from 800 horsepower to 2,000 horsepower.

It is announced that good progress is being made in the work of laying the cable between the ports of Vera Cruz, Frontera and Campeche, Mexico. The steamer Idum has the cable on board. The expedition is in charge of Dr. A. E. Kenelly, an electrical engineer. W. D. H.

Northwestern Notations.

Minneapolis, Minn., October 11.—The mayor of New Hampton, Iowa, has reported to the council of the city a recommendation for municipal ownership of the electric-light plant and the installation of new dynamo, engine and boiler.

The Burlington Railway Company has completed its electric line between Deadwood, S. D., and Lead and has put it in operation. The company found the grade so steep that steam locomotives were unable to make the trip without throwing a mass of soot and cinders at all times. This made it unpleasant traveling. The electric line will give better and quicker service.

The Madison and Northeastern Railroad Company has been incorporated at Madison, Wis., to build an electric road northeast to Fond du Lac and Oshkosh, via Sun Prairie, Columbus, Beaver Dam and Waupun. The line will be 130 miles long. Henry Knox of Chicago is said to be back of the enterprise.

Lincoln, Neb., will vote on November 4th on $55,000 bonds for the purchase of a municipal electric-light plant.

The Interurban Railway Company of Des Moines is pushing its tracks beyond Altoona, Iowa, as rapidly as possible, and will soon be beyond Mitchellville, when complete service will be established to that point.

The St. Anthony Hill Electric Company has been incorporated in St. Paul with $50,000 capital stock to furnish light for St. Anthony Hill. The new company will be on friendly terms with the present company, from which it will secure its power.

Browerville, Minn., has defeated a proposition to establish an electric-light plant.

The Winnipeg, West Selkirk and Lake Winnipeg Railway Company has begun work on an electric line from Winnipeg to Selkirk, Man., which it proposes to have in operation by July 1st next. When the road is completed, it will connect with the Winnipeg Street Railway Company. The road is to be extended to Lake Winnipeg next year.

Citizens of Mount Ayr, Iowa, contemplate arranging to connect with Creston by an electric-railway line.

The St. Paul Gas Light Company has appealed to the council for an extension of time in which to complete the work of placing its wires in subways in the underground district. The committee of the Board of Aldermen has therefore voted to extend the time from 30 to 60 days. This will require the resolution to return to the Assembly before it can become effective.

The Creston Electric Light, Heat and Power Company has awarded the contract to J. H. Collins & Co. of Chicago to build and equip an electric railroad from Creston to Winterset, Iowa. About 11 miles of the road has been graded, and it is expected to build 20 more this fall. The stockholders of the company have also formed the Des Moines, Mount Ayr and Southern Electric Railway Company and propose to build from Creston to Mount Ayr. The capital stock of the company is $600,000. Three routes are in view, and the company expects to start work in the spring.

L. P. Palmer has resigned as manager of the Waterloo (Iowa) Gas and Electric Company.

The Waterloo and Cedar Falls Rapid Transit Company of Waterloo, Iowa, has doubled its capital stock, making the total $1,200,000. The increased capital will be used in the extension of the lines, the construction of car shops, building new cars and new equipment generally.

The Crowley Electric Company of Duluth has been awarded the contract for a village electric-light plant for Verndale, Minn., at $6,511. The plant is to be in operation by December 15th.

Townsend, Reed & Co. have been awarded the contract for the construction of the interurban line between Davenport and Clinton, Iowa, for the Iowa and Illinois Electric Railway Company. The contracts run about $21,000 a mile, including equipment, giving a total of about $800,000.

John Costin, Jr., has been granted a franchise at Chisholm, Minn., for a local electric-lighting plant.

The Chippewa Valley Electric Railway Company, which has an interurban line between Chippewa Falls and Eau Claire, Wis., contemplates the construction of a line from Eau Claire to Menominee, Mich. A line from Eau Claire to Mondovi, Wis., is also projected. R.

Among the Rockies.

Salt Lake City, Utah, October 8.—On October 2, 1901, ground was broken at Colorado City, Colo., for the erection of the Telluride Reduction Company's plant for the treatment of ores. October 2d of this year was celebrated as the first anniversary of that occasion by breaking ground for an immense addition to the plant, which will more than double the capacity. The new addition will enable the company to treat 200 tons of ore per day more than it has heretofore handled, making the daily capacity of the plant 500 tons. The contract for the machinery for the addition was let two weeks ago to the Allis-Chalmers Company of Chicago, which furnished the present equipment. The General Electric Company of Schenectady, N. Y., will supply the electrical portion of the equipment. The entire mill will be in full operation March 1st next.

The Federal and Gold Copper Company is the title of the corporation formed of Wisconsin capitalists, operating the Como Eureka mine at Como District. The company will install a power plant at the cost of $10,000, from which electric power will be transmitted to Como to operate and light the company's mill and hoist plant.

In the matter of the application of the American Falls Water Power Company for an injunction restraining the city of Pocatello, Idaho, from interfering with the operation of its steam-electric plant under its waterpower franchise, Judge Beatty, in the Federal Court, states that the company had no legal right to operate a steam plant, but he granted the injunction until December 17th, at which time the company's franchise will expire unless its conditions are complied with. The case reduced in a contest between the American Falls Power, Light and Water Company and the American Falls Water Power Company, locally known as the Brady Company. Both companies were granted identical franchises, the conditions being that the power be generated and transmitted from American Falls and that a stated sum be expended, the power to be delivered by December 17th. Brady constructed his plant and had the power in Pocatello on August 1st. The other company erected a steam plant, the operations of which were forcibly stopped by the police under the direction of the mayor and council. By the decision the city is restrained from further interference of the operation of the steam plant until after December 17th.

The Electric Light Company of Provo, Utah, has offered to sell the city its franchise and interests for $25,000.

Colonel Stout of Boise, Idaho, president of the Electric Light and Gas Company, which is now installing a 2,700-horsepower electric power plant on the Payette River, 20 miles above Boise, states that the new plant will be completed by December 1st. The plant is modern in every particular and will cost when completed $400,000. It is the intention of the company to light Boise and furnish power for a number of mines in the locality, and later on the business of the company will be extended to other towns where light and power are needed.

There is under consideration the establishment of a wire-rope tram line covering a distance of nearly 10 miles from the old-time Vulture group of gold mines to Wickenburg, Ariz., by prospective purchasers of the famous mines. It is intended, in the event of the reopening of these rich claims, to utilize electricity for every possible purpose, including the equipment of machinery, trams, lighting and heating, operating of mill, and for every purpose where it can be used. G.

PERSONAL.

A. P. Munning of the New York office of the Cutler-Hammer Manufacturing Company called on several of his Chicago friends last week.

J. L. McCreary has been appointed superintendent of electric and motive power of the Federal District Street Railway Company of the City of Mexico, succeeding E. C. Littlewood, resigned.

Harrington DeWitt Leamard, an electrical engineer with the Seth W. Fuller Company, and Miss Grace Adele Tucker were married at the home of the bride's parents, in Boston, on October 7th.

Andrew Creelman, a telegraph and electrical engineer, died in Los Angeles, Cal., on October 13th of heart failure. Mr. Creelman went to California from Chicago a few months ago and was employed by the Western Union Telegraph Company.

Albert Crane, formerly first assistant chief engineer of the Lake Superior Power Company at Sault Ste. Marie, has accepted a position as one of the assistant chief engineers of the Chicago Sanitary District. He is an expert in hydraulic engineering, and will be placed in charge of the waterpower development on the Drainage Canal at Lockport and Joliet, Ill.

William C. Clarke, president of the Sea View Electrical Railway Company, died at his home in South Kingstown, R. I., October 8th, aged 62 years. Death resulted from a nervous collapse. He was largely instrumental in installing the town's electric-lighting and water plants.

A. M. Patitz, a well-known mechanical and electrical engineer of Milwaukee, Wis., died at his home, 508 Galena Street, Milwaukee, on the morning of October 5th, at the age of 33 years. He came to the United States from Germany in 1885. He is survived by a wife and two children.

James P. Gilbert, who has been general superintendent of the New York and Ohio Company, Warren, Ohio, manufacturer of Packard lamps and transformers, has resigned his position and will take the general management of the Standard Electrical Manufacturing Company at Niles, Ohio, manufacturer of the Standard incandescent lamp.

Reginald A. Fessenden, until recently with the government as an expert in wireless telegraphy, has resigned and will locate at Norfolk, Va., to conduct experiments with his wireless-telegraph appliances. Experiment stations will be established in the neighborhood of Norfolk, and Mr. Fessenden's purposes to develop a purely American system of space telegraphy.

Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, was married, on October 1st, to Mrs. Katherine A. Durant of Great Barrington, Mass., at Ocean Grove, N. J. The ceremony was performed by the Rev. Mr. Longley, rector of Trinity Church, Asbury Park. Mr. Pope has been secretary of the Institute for about 16 years, and is very popular with members of that society and other friends, who are extending their congratulations.

ELECTRIC LIGHTING.

The Taylorville (Ill.) council has passed an ordinance providing for the construction of an electric-light plant. Bonds to the extent of $20,000 will be issued for that purpose.

The American Light and Heating Company, Marion, Ind., is preparing to erect a modern power plant. It will be designed to supply light for a city of 50,000 people, if necessary.

The Chicago Edison Company is placing foundation in an annex to its Harrison Street power station for a new generating unit, consisting of a 2,000-kilowatt, three-phase, 25-cycle, 9,000-volt, General Electric alternator, direct-connected to a 3,400-horsepower, vertical, cross-compound Allis-Corliss engine.

It is said that E. E. Rines, an Indianapolis (Ind.) electrician, has invented an incandescent lamp of which the light can be varied through two, four, six, eight and 16 candlepower. The lamp employs two filaments, and the different voltages are obtained by turning the lamp in the socket. Mr. Rines was in Thomas A. Edison's laboratories for 12 years.

Judge Chytraus of Chicago has authorized Receiver Theodore K. Jackson of the Evanston Yaryan Company to borrow $30,000 to make improvements in the plant. The petition filed by the receiver states that he finds that the heating apparatus is in poor condition to furnish heat, and that in order to operate the plant economically he will have to make extensive improvements.

The United States Electric Lighting Company of Washington, D. C., has transferred to the Potomac Electric Power Company of the same place all of its property, deeds, assets and franchises for the consideration of an amount of the Potomac company's stock equivalent to the value of the property. This means that the United States company has ceased to exist. The Potomac company assumes all indebtedness.

For some years there has been a fight between the New Omaha (Neb.) Thomson-Houston Electric Light Company and the different electrical workers' unions. The fight has been over the question of recognition. Recently the light company signed an agreement recognizing the unions and thus putting an end to the warfare. During the fight the unions have done everything to hamper the business of the company and have succeeded to some extent. No change in the scale of wages will be made.

ELECTRIC RAILWAYS.

The Lake Shore Electric Railway Company of Cleveland, Ohio, one of the Everett-Moore properties, has decided to issue $4,000,000 bonds to take up its entire existing debt.

The Joliet (Ill.) and Western Railway Company on October 10th filed a trust deed for $10,000,000 in favor of the Royal Trust Company, to secure 50-year five per cent. gold bonds. The proceeds secured by the sale of the bonds are to be used in

the construction of an electric railway to extend from Joliet westward to Morris and DeKalb, all in Illinois.

The Zanesville (Ohio) Railway, Light and Power Company has been incorporated with a capital of $1,000,000. The incorporators are G. H. Warrington, J. Ross, G. M. Finch and E. E. Guenther.

The Washington, Baltimore and Annapolis Railway, to which considerable interest attaches on account of its proposed use of B. G. Lamme's single-phase railway system, is to be built by the Cleveland Construction Company of Cleveland, Ohio.

The report of the Aurora, Elgin and Southern Railway Company for the nine months ended September 30th shows total gross earnings of $308,241.13, operating expenses of $179,123.89 and net earnings of $129,117.24, the net income being $54,117.24.

The Bullshead (N. Y.) and Annadale Beach Railroad Company has been incorporated with a capital of $250,000 to operate an electric railway eight miles long, from Bullshead to Annadale Beach. The directors include James W. Hughes, Harcourt Bull and others.

The London, Aylmar and North Shore Electric Railroad Company has been incorporated with a capital of $500,000, to construct and operate an electric railway with terminals in London and Barwell, Ont., Canada, and passing through Middlesex and Essex Counties.

It is said that the Northeastern Railway Company in England has made final arrangements and let the contracts for the electric equipment of 41 miles of its (steam) road. This report, if true, marks the first practical step taken by any of the great English railroad companies to supersede steam locomotion.

The DeKalb-Sycamore Electric Company is rebuilding its central power plant at DeKalb, Ill., to provide for its increasing business, and to furnish power for the interurban electric line now being constructed between DeKalb and Sycamore, Ill. The Arnold Electric Power Station Company of Chicago is acting as consulting engineer.

The directors of the Metropolitan West Side Elevated Railway Company of Chicago have called a meeting of the stockholders for November 5th, for the purpose of submitting the question of enlarging the objects of the corporation, so that it may build a downtown terminal and independent spur track for which ground was purchased last year between Market Street and Fifth Avenue and Jackson Boulevard and Van Buren Street. The object of the new terminal is to relieve the Union Loop of some of the traffic that now congests it at certain hours of the day.

Boise, Idaho, although having one street-railway system in operation, is considering applications for franchises for two more. One of these companies is known as the Inter-mountain Electric Railway Company. It is said to be backed by a Mr. Costigan of St. Paul, Minn. The other company's name is not given out, but it is said that the people concerned in the enterprise are from Denver, Colo. Franchises have been granted to neither company as yet, and what the council will do in the matter cannot be foretold.

The New Orleans car strike was ended last Sunday, and the men went to work on the following Monday. The negotiations for the settlement began Saturday night and lasted until Sunday morning at seven o'clock. The basis of the settlement is that the men go back to work at 20 cents an hour for a 10-hour day, a minimum day to be 7½ hours long. No discrimination is to be made against any of the men and as many are to be taken back as are needed for the operation of the company's lines. This, practically speaking, is a complete victory for the strikers.

An ordinance granting a 20-year franchise to the Chicago, Milwaukee and Inland Lakes Traction Company for an electric line in Milwaukee Avenue from Lawrence Avenue north to the city limits, was introduced in the Chicago City Council on October 6th. This company proposes to have its city terminus at Lawrence and Milwaukee Avenues. It has already applied for a franchise for the county. The only compensation offered is to pave the street from curb to curb with cedar blocks. The company wants to carry freight in bulk between 11 p. m. and 6 a. m. The measure was referred to the committee on local transportation.

Speaking of the extension of the Hawks-Angus road from Jackson to Lansing, Mich., James McNamara, attorney for the road, said recently: "There are many reasons why the road was not built this season, too many to attempt a detailed explanation; but the principal cause was our inability to get material. Why, we have had to borrow rails from the Michigan Central within the last month to repair our tracks between Ypsilanti and Ann Arbor, because we could not purchase them. Railroad-construction material has been practically out of the market. Now we have got our orders placed where we will get the necessary rails and other material. It is too late now, however, to do much this fall, but early next spring the road will be built, and it will be built early in the year, too."

TELEGRAPH.

Manager Tracey of the Western Union telegraph office at Wheeling, W. Va., has decided to employ girls to do the messenger work instead of boys. He is unable to engage enough boys for the work.

The War Department has arranged to transfer the telegraph system of the Philippines from the military to the civil authorities. First-lieutenant Charles W. Wallace of the Signal Corps has been detailed to organize a civil telegraph bureau there. This change will, it is said, be of mutual advantage to both the army and the civil authorities in the islands.

The Northwestern Telegraph and Stock Company of Troy, N. Y., has been incorporated to operate lines of telegraph and telephone between New York, Chicago, Philadelphia, St. Louis, San Francisco, Montreal and other cities. The company has a capital of $40,000, and its directors are Michael J. Duffy, Peter Curley and Thomas Hendrickson of Troy.

On October 10th the messenger boys of the Postal Telegraph-cable Company in St. Louis, Mo., went on a strike. They were out but two hours when the trouble was smoothed over and everything going on as before the outbreak. The cause of the trouble was a newspaper report to the effect that the company was making plans to supersede the boys with girls. The report was proved false and so the boys resumed their work.

Postmaster-general H. C. Payne has issued the following order to the officials under him: "Owing to the meager appropriation provided the Postoffice Department for telegraph service, it is necessary that official telegraphing be limited to the actual necessities of the service. Those officials whose duty it is to prepare and sign official telegrams will govern themselves accordingly, resorting to the use of telegraph lines only when it is absolutely necessary."

The cable steamer Colonia, laying the all-British Pacific cable, which sailed from Bamfield Creek, Vancouver Island, on September 18th, arrived at Fanning Island on the morning of October 6th. The steamer is credited with having broken all cable-laying records, having maintained an average of eight miles an hour, thereby completing the entire journey in 17 days 21½ hours. She will now proceed to lay the Manila-Hawaiian cable, for which she has contracted.

AUTOMOBILES.

The American Motor Carriage Company of Cleveland, Ohio, has been incorporated with a capital of $500,000 to manufacture motor carriages propelled by electricity and compressed air.

PUBLICATIONS.

The Buffalo Forge Company of Buffalo, N. Y., has issued a tasteful booklet which describes its down-draft stationary and heating forges for industrial work.

Recent publications of the Fort Wayne (Ind.) Electric Works include an instruction book on Wood measuring instruments, a folder on the Wood type-A oil transformers, an October calendar card and bulletins on the firm's enclosed, direct-current, power-circuit and 110-volt arc lamps and standard small-motor panels. All are well illustrated.

The Smith & Hemenway Company of 296 Broadway, New York city, has issued the fourth edition of its "Green Book of Hardware Specialties." This book is considerably larger than the last one. It contains 144 pages of highly interesting matter and is illustrated throughout by a number of half-tones. The book contains illustrations of all articles manufactured by the Smith & Hemenway and Utica Drop Forge and Tool Companies. It is printed on green paper and each page has an attractive border in orange around it.

The Westinghouse Companies' publishing department has recently distributed a handsome catalogue of electric locomotives for surface haulage, as manufactured by the Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company. The book is well illustrated with diagrams and views of electric locomotives used in steel work, by electric-railway companies, in coal and metal mines, in factories and on plantations. Detail pictures of parts are used to illustrate the description, and the catalogue closes with specifications and blank data sheet.

POWER TRANSMISSION.

On October 22, 1902, the plant and properties of the San Joaquin Electric Company will be sold at the courthouse at Madera, Cal., under order of the United States court. No bid will be accepted by the master in chancery, Wynn Helm, for less than $350,000. The property to be sold consists of the Fresno Water Company's stock, held by the company, all franchises in Fresno, Madera and Kings Counties, besides the material for distributing systems in the city of Fresno, and on the Hanford extension. This includes many miles of copper wire with the poles and insulators, all the material at the operating station, transformers, generators, etc., the motor for driving the Fresno waterworks, the water-wheel machinery and real estate in Madera and Fresno Counties.

MISCELLANEOUS.

The Consolidated Electric Light and Power Company of Gowonda, N. Y., has been incorporated with a capital of $50,000. The directors are E. C. Fisher, C. S. Phelps and G. I. Lincoln.

Houghton, Mich., has sent to Chicago for an electrical expert who is familiar with the Gamewell fire-alarm system. The Houghton system is out of order, and local electricians have been unable to do anything with it.

Architect A. E. Bowd of Lansing, Mich., is preparing plans for a large brick power house to supply heat, light and power to several buildings of the State Agricultural College at Lansing. The estimated cost is $125,000.

A recently issued report by A. A. Vosey, electrical engineer of the city of London, England, upon the central-station output of that city during 1901 states that about 11,500,000 kilowatt-hours were sold by the companies at the rate of nine cents a kilowatt-hour. The price of this unit has dropped, since 1895, from 15 cents to the figure mentioned.

The United States Construction Company of Toledo, Ohio, has been incorporated with a capital of $1,000. The incorporation is formed for the purpose of constructing railroads, electrical plants, telegraph and telephone lines, etc. The incorporators are L. H. Gould, J. P. Degnan, Charles Komrofoky, Sherman Bond and John L. Haley.

An odd spectacle was seen recently on a bridge (Pont Sully) over the Seine River in France. Men, women and children who happened to be on the bridge suddenly began to dance a wild highland fling which was exceptionally amusing to on-lookers. The cause of the demonstration was a defective trolley wire, which became grounded through the bridge, thereby charging it and shocking everyone who was unlucky enough to be crossing the river at that time.

An announcement has been made that work on the extension to the local Denver and Rio Grande Railroad shops in Salt Lake City, Utah, will commence at once and not stop until the improvements are completed. Manager Herbert has ordered R. F. Hayward, electrical engineer, to take up at once the matter of the large electrical power plant; contracts for its construction will be let immediately. The buildings will be located west of Sixth West Street and will combine all the latest improvements for such a plant. The power house is the most important part of the contemplated improvements and will be built at once. A main shop building will also be provided, with a large extension, adding a roundhouse, machine shops, paint shop and new car shop. The new shops will be equipped with new and expensive tools, capable of turning out the very heaviest locomotives. Each tool will be equipped with its own motor, thus doing away with the old system of belts and wheels. The power house will be a large brick building with factory windows.

TRADE NEWS.

Sayre Bros. of Newport News, Va., want three induction motors, one each of two, 10 and 15 horsepower, 220-volt, three-phase, 60-cycle machines.

The Lubbock (Texas) Electric Company has been incorporated with a capital of $2,500. The incorporators are C. E. Spath, M. G. Abernathy and H. S. Graham.

The Piedmont Electric Company of Asheville, N. C., has been incorporated with a capital of $25,000. The incorporators are William Farr, George L. Hackney and J. H. Weaver.

It is said that the General Electric Company has expended so far this year more than $1,000,000 upon its plants and has already planned for an expenditure of $1,500,000 in 1903 in expanding its manufacturing capacity. The above extraordinary expenditures are all charged against the profit of the business, which may account in a large measure for the fact that while the General Electric people say that the company is safely showing net profits of $1,000,000 per month, official published reports have as yet failed to show such large returns.

BUSINESS.

The Jeffrey Manufacturing Company of Columbus, Ohio, announces that its catalogue of elevating and conveying machinery is now ready for distribution and that it will be glad to supply all interested parties with a copy.

The Whitehead Machinery Company of Davenport, Iowa, announces that it has ready for immediate shipment 10 72-inch by 18-foot tubular boilers (125 pounds pressure), with all accessories. The

boilers are located in the Lindell Railway Company's power house in St. Louis, Mo.

Charles H. Besly & Co. report the month of September as one of the largest in the amount of sales that they have ever enjoyed. They are making many shipments of their Gardner grinders to various parts of the country, and are closing many contracts with agricultural people for their celebrated Helmet oil and Badger and Bonanza cups. They are receiving numerous orders for complete shop equipments, and for tools and supplies for repairs and replenishing.

To meet the demands of the trade, and at the request of its customers, the Mica Insulator Company of New York and Chicago is now manufacturing its new-process Empire oiled cloths in the form of a tape under the registered name of Linotape. It is made in any width from one-fourth inch to 36 inches, and samples will be furnished on application. The company states that the tape seems to be meeting with universal satisfaction and that there is a growing demand for it. The company has issued a little booklet describing the merits of the tape and enclosing a sample of it.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) October 7, 1902.

710,414. Controlling Device for Electric Generators. John H. Bickford, Salem, Mass. Application filed March 19, 1900.

An electric circuit contains one or a number of translating devices, a dynamo and means for connecting it with the circuit, two storage batteries and means for connecting them in series with the circuit, exclusively of the dynamo. Means are also provided for connecting the storage batteries in parallel with the dynamo and a resistance is adapted to be introduced when the storage batteries are thus connected in parallel with the dynamo.

710,425. Frame for Dynamo-electric Machines. Alexander J. Churchward, Brooklyn, N. Y. Application filed September 12, 1896.

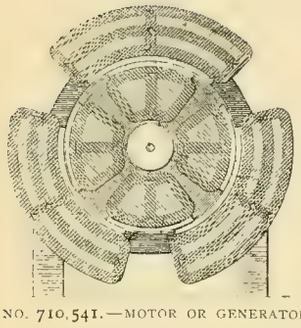
The inventor describes a dynamo-electric machine, combining with an armature a field-magnet frame therefor, and cores of metal of low permeability provided for the field-magnet frame, the pole pieces of the cores being of less area in cross-section than the cores, whereby the pole pieces become magnetically saturated in advance of the cores. The widths of the pole pieces opposed to the armature vary in lateral extent longitudinally of the armature.

710,532. Rail Bond. Charles Sprague, Boston, Mass. Application filed February 24, 1902.

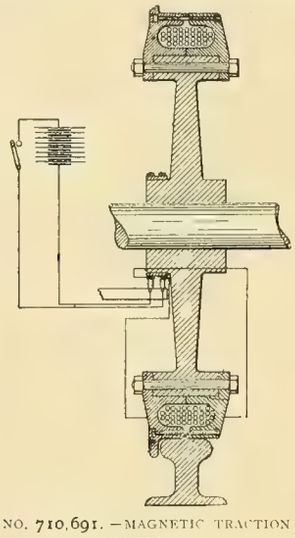
The bond is composed of a laminated strip having flat feet and an intermediate extensible portion, the layers composing the flat feet being soldered together. A sheath incases each flat foot and incloses the end thereof. This sheath is made up of a metallic strip bent or folded to present a top layer, a bottom layer, and an end portion. A thick strip of sheet solder is attached at one end of the sheath.

710,541. Electric Motor or Generator. John A. Titzel, Sr., Franklin, Pa., assignor of one-third to James C. Titzel, Glenshaw, Pa. Application filed December 13, 1900.

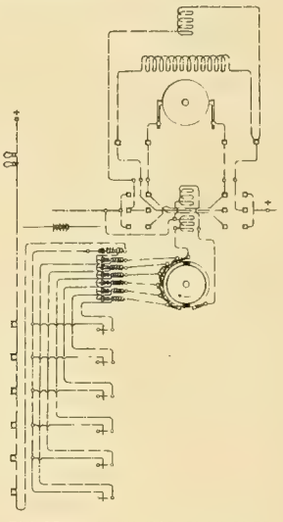
One claim reads: An electric motor or generator, having stationary or field magnets, and rotary or armature magnets, each magnet comprising a number of cores, and coils consisting of an individual winding for each core, and an outer winding for all the cores, connections whereby a current flowing through the windings will have a like magnetizing effect on all the cores of the magnet, a commutator and brushes controlling the connection of the armature coils with the field coils, and connections for supplying current to the motor.



NO. 710,541.—MOTOR OR GENERATOR.



NO. 710,691.—MAGNETIC TRACTION WHEEL.



NO. 710,914.—ELEVATOR PUSH BUTTON SYSTEM.

710,429. Electric Body Appliance. Patrick J. Collins and Christopher G. Boland, Scranton, Pa. Application filed January 22, 1902.

An electric body appliance to be used for medicinal purposes is described.

710,448. Apparatus for Perforating Tape for Automatic Telegraph Instruments. John Gell, Wellington, New Zealand. Application filed November 26, 1901.

Combined with a group of punches to cut marking holes and also a series of feed holes is a differential tape-feed mechanism having means to engage the series of feed-holes.

710,455. Electric Switch. George H. Hill, Glenridge, N. J., assignor to the Sprague Electric Company, New York, N. Y. Application filed August 10, 1901.

The electric switch is made up of a shaft, a body of insulation on the shaft, and contact supports embedded in the insulating body and each having a skin or film of suitable insulating material separate and distinct from, and wholly separating the supports themselves from the insulating body.

710,469. Trolley. John F. Kerr, Paterson, N. J. Application filed August 8, 1901.

The trolley head described has a vertical tubular body portion and a lug integral therewith and a shank also integral therewith for securing to the pole. In combination with this is a swivel head adapted to turn in the tubular portion of the trolley head, and having a rearwardly and upwardly extending fork and a forwardly extending clevis both integral therewith. A trolley wheel is mounted to rotate in the fork at a point back of the center of the swivel head, and a spring is arranged the lower end of which is secured to the lug on the trolley head.

710,473. Electric-light Switch. Harry W. Lawrence, Denver, Colo., assignor to the New England Electric Company, Denver, Colo. Application filed December 28, 1901.

A push-button of the rocking-lever type is described.

710,488. Bushing for Electrical Conduits. Mathias Mauer and William J. Billings, New York, N. Y. Application filed February 17, 1902.

A concentrically formed bushing having an eccentrically formed opening to be used in the outlet box of electric conduit systems is described.

710,516. Ice Cleaner for Trolley Wires. Fred N. Root, Kalamazoo, Mich. Application filed January 23, 1902.

A trolley-wire cleaner is described which is attached to the ordinary trolley head, swinging pivotally on the same so as to be capable of being put to one side when not in use. The cleaner makes use of two fluted wheels, one running alongside of the wire and the other underneath it.

710,581. Elevator. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed January 2, 1902.

An elevator combines a motor and motor-controlling means so connected as to reduce the speed of the same before stopping and to vary such reduction of speed in accordance with the load.

710,625. Electric Elevator. Rudolph C. Smith, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed July 10, 1899.

A cage, a counterweight, two electric motors and two parallel driving wheels rotating about the same axis are combined in an elevator with a continuous rope engaging both wheels and pulleys on the cage, the counterweight being engaged by loops of the rope.

710,659. Gas Cap for Arc Lamps. Edward H. Belden, Dayton, Ohio. Application filed October 7, 1901.

A gas cap for the arc-chamber of an arc-lamp is described.

710,667. Device for Automatically Unrolling the Paper Ribbon in Morse Apparatus. Luigi Cerebotani, Munich, Germany, assignor of one-half to Joh. Friedr. Wallmann & Co., Berlin, Germany. Application filed November 27, 1901.

The inventor describes a device for automatically unrolling the paper ribbon used in connection with a Morse telegraph receiver. The mechanism is actuated by an electromagnet having its armature joined to a spring-actuated pawl.

710,682. Locking Device for Motor Controllers. George G. Guenther and Arthur G. Guenther, Los Angeles, Cal. Application filed December 4, 1900.

The locking device employs a perforated plate fixed to the controller shaft, and means for engaging the openings in the plate to prevent movement of the controller lever. An electromagnet operates the locking apparatus.

710,691. Magnetic Traction Wheel. Barton B. Hill, St. Petersburg, Russia. Application filed January 28, 1902.

A vehicle wheel is provided with a sectional hollow removable rim, a magnetizing coil mounted in the rim, a non-magnetic metallic bridge mounted between the polar surfaces of the rim, and tie-bolts passing through the polar surfaces. (See cut.)

710,716. Electric Motor. George H. Reynolds, New York, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed December 5, 1900.

The inventor describes an electric motor which has its armature and field capable of opposite rotation. A driving pulley is provided for both the armature and the field. Individual electromagnetic generators are connected to the field and to the armature to vary their speed rates.

710,771. Sparking Device for Explosive Engines. Theodore S. Glover, East Norwalk, Conn., assignor of one-half to Cyrus E. Crabbe, Stamford, Conn. Application filed April 15, 1901. Renewed April 16, 1902.

A sparking device for explosive engines comprises two movable contact points or electrodes, one adapted to make sliding contact with the other. The speed of the wiping contact is under control.

710,794. Rail Bond. Elmer P. Morris, East Orange, N. J., assignor to the Morris Electric Company, New York, N. Y. Application filed July 9, 1901.

A rail bond is described which has a flexible body portion with terminals attached to its ends, these terminals being made up of a head and shank. An opening is provided through the head and shank and through this the body portion passes.

710,802. Electric Gas Lighter. Arthur Radiguet, Paris, France, assignor to Henri de Thiersant and Hans Jacob Norballe, London, England. Application filed February 28, 1902.

A sparking device capable of connection with a gas burner and to be used in lighting the same is described.

710,819. Manufacture of Filaments from Cellulose Solutions. Edmund Thiele, Barmen, Germany. Application filed April 1, 1902.

A process is described for the manufacture of filaments from cellulose solutions wherein an aqueous cellulose solution issues through comparatively large orifices into a precipitating medium that acts only slowly upon the aqueous cellulose solution, the issuing solution being drawn out to fine filaments in such medium. (See cut.)

710,829. Electric Clock. William F. Winslow, Winsted, Conn. Application filed October 19, 1901.

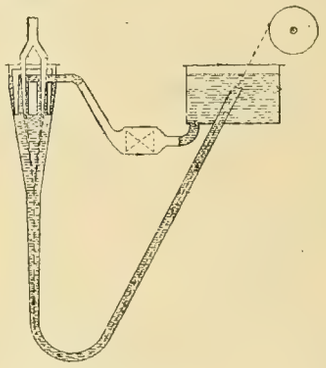
The inventor describes an electric clock which employs a circuit-closing device comprising a notched rotatable disk, an arm, a pin thereon adapted to enter the notch, a cam carried by the arm, pendulum-actuating mechanism, and means actuated thereby to engage the cam and effect the closing of the circuit and to disengage the pin from the notch.

710,892. Starting Device for Electric Motors. Thomas M. Pusey, Kennett Square, Pa. Application filed January 8, 1902.

A starting device for an electric motor comprises a rheostat, a train of gearing, a driving device for the gearing, a governor for placing the gearing in operative connection with the driving device, a drum having clutch connection with a shaft of the gearing, a cord extended from the drum to the rheostat arm, and means for moving the arm to normal position.

710,914. Electric Operation of Elevators by Single Push-button System. John D. Ihlder, Yonkers, N. Y. Application filed December 6, 1897.

An apparatus for controlling elevators is described in which a floor controller for each floor is installed, these controllers being operated by push-buttons located at the several floors.



NO. 710,819.—MANUFACTURE OF FILAMENTS.

710,927. Electric Alarm Clock. Andrew V. Strait, Sidney, N. Y., assignor to Nehemiah H. Brown, Norwich, N. Y. Application filed October 29, 1901.

One claim reads: In an alarm clock, the combination with a spring-finger traveled by the clock and forming one terminal of an electric circuit, of a metallic ring connected in the circuit, a circuit including an alarm and a source of electrical energy, an annular series of push-buttons extending through and in electrical contact with the ring, an auxiliary push-button, also electrically connected to the ring, a shunt including a terminal for contact by the auxiliary push-button to permit the manual closing of the circuit at any time, and an annular series of permanently fixed contact pins arranged in the path of travel of the spring-finger, each of the pins having a portion projected into alignment with one of the annular series of push-buttons.

710,933. Bathing Tub for Dipolar Galvanic Baths. Josef Zwiebel, New Ulm, Germany. Application filed December 12, 1901.

Combined with a bath-tub of non-conducting material are metal rods supported within the tub, electrodes carried by the rods, and suitable electric conductors.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, OCTOBER 25, 1902. No. 17

Large Electric Furnaces near Penn Yan, N. Y.

By William Hoskins.

The rapid development in the application of electricity to the manufacture of chemical products is manifested in very striking manner at Niagara Falls. Though permission for the inspection of the plants of most of the establishments is difficult to obtain, their magnitude and the possibilities of future development are soon appreciated by the visiting electrician or chemist.

Perhaps the meeting of the electrochemists recently held at Niagara will do more than anything else to attract attention to these industries, and will, no doubt, greatly stimulate investigation.

But it is not only at Niagara that this work is going on. At Sault Ste. Marie, on the St. Lawrence, and in numerous places at home and abroad, where waterpower is available, investigation and actual manufacture are now being carried on.

It is at one of the less-known places that the writer found one of the most interesting applications of electrochemistry. This is in the manufacture of bisulphide of carbon by the Taylor Chemical Company, near Penn Yan, N. Y., some distance from Niagara.

The feature of this plant, which is illustrated herewith, is the electric furnace used, developed and invented by Edward R. Taylor, formerly of Cleveland, Ohio. Bisulphide of carbon has heretofore been made by passing the sulphur vapor through charcoal or other available form of carbon heated to a high temperature, when the sulphur and carbon combine, forming a heavy, highly refractive liquid. This process has, of course, necessitated the heating of both the sulphur and carbon in retorts from the outside, and it will be seen, owing to the nature of the material used and the high temperature required, deterioration is rapid and uniform heating of the materials throughout well-nigh impossible.

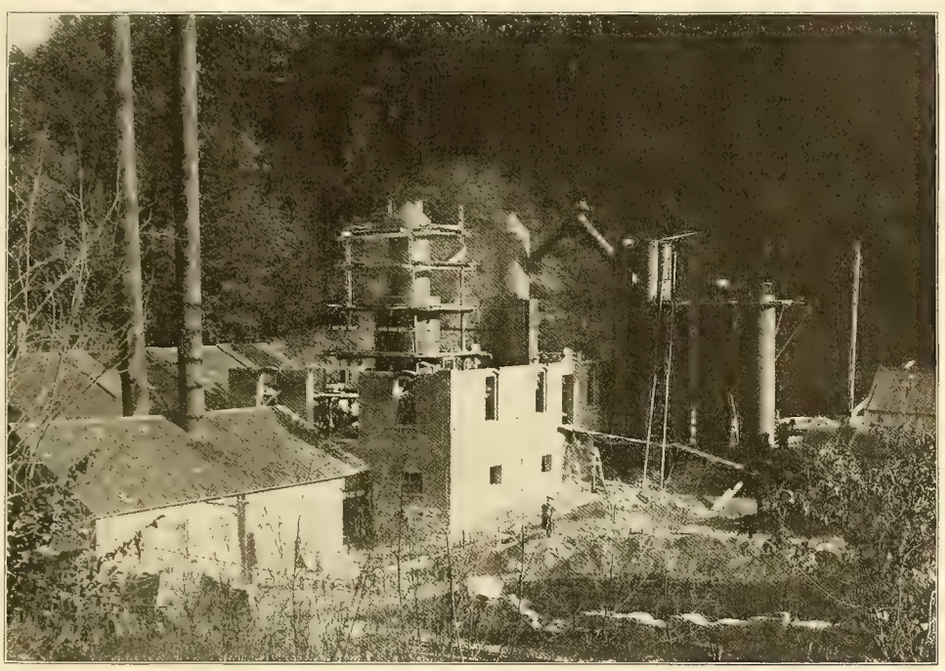


Fig. 1. Furnaces and Enclosing Building During Construction.

Fig. 2. General View of Plant.

Fig. 3. Dam and Power House.

LARGE ELECTRIC FURNACES NEAR PENN YAN, N. Y.

Mr. Taylor's application of electricity and the design of his furnace seem completely to have solved the problem of simply and economically producing this substance. The furnaces in operation at Penn Yan are 41 feet high and 16 feet in diameter, and rather stagger anyone with preconceived notions as to the possible size of electric furnaces.

There are certain novel features in this furnace (see Fig. 4, next page) upon which depend its success. The walls are hollow and so constructed that the spaces may be kept filled with sulphur. The heat which would otherwise be lost by radiation is thus absorbed in melting the sulphur, which, when melted, flows into the furnace.

The bases of the electrodes are also prevented from getting excessively heated by an arrangement which allows sulphur, on its way to the interior of the furnace, to take up the heat which would otherwise be wasted.

The circuit through the furnace is closed through fragments of coke, or other form of carbon, which is fed into the furnace through ports made for the purpose, so the wear of the electrodes proper is reduced to a minimum, and the resistance is under quick control by causing more or less sulphur to cover these fragments of carbon, or to take their place, or by increasing or diminishing the supply of carbon. The advantage of such an arrangement is apparent.

Stationary conduits of sufficient surface to conduct large amounts of current to such broken material are arranged so comparatively little electricity is converted into heat before reaching the active part of the furnace, the pieces of carbon taking the brunt of the battle, as it were, and are renewed as required, thus making a practically continuous operation.

The fact that one of these furnaces has a record of a continuous campaign of 17 months suggests the possibilities as experience and improvements are attained.

The shaft of this furnace is kept filled with charcoal to supply the carbon to combine with the sulphur, but there seems no reason why any smelting operation may not be carried out in such a furnace, as provision may easily be made to tap out slags or other material periodically or continuously. The availability of electricity for such a purpose is dependent simply upon sufficiently cheap water or other power, and upon other economic conditions.

At first sight it might be imagined that furnaces of this size would be difficult to manage. On the contrary, when once started they require scarcely any attention, except to keep them supplied with material. The total absence of noise of any kind is particularly striking.

The buildings shown in the illustrations are substantial and of fireproof construction. In Fig. 1 are shown the furnaces surrounded by building partially completed. In Fig. 2 the upright condensers for condensing the bisulphide vapors may be seen. In the foreground is the refining plant. Fig. 3 gives a view of the dam and power station. Some 400 horsepower of the waterpower is used, though 1,000 horsepower may easily be developed. The company has also a steam-engine reserve and auxiliary. Two-phase alternating current is used, generated in Stanley machines. The furnace takes about 4,000 amperes of current at 60 volts. While the use of bisulphide of carbon is increasing, one furnace at present supplies the demand, 8,000 pounds daily, though more than twice this amount could be produced by increasing the power. The capacity of a single furnace approaches some 20,000 pounds daily.

Fig. 4 (on the next page) shows the furnace now employed. The improved type (Fig. 5), which was briefly described in the Western Electrician of August 16th last, shows a better arrangement, although the principle remains the same. At Niagara Falls, N. Y., on September 17th, Mr. Taylor read a paper entitled "Some Advances in the Closed and Continuous-working Electric Furnace." I shall conclude this brief account of Mr. Taylor's interesting furnace by subjoining this paper, a better understanding of which may be had by referring to Figs. 4 and 5. The paper reads as follows:

"In continuity for most chemical manufactures there is great gain, and for some it is almost an absolute necessity. Movable electrodes in a closed electric furnace present serious difficulties and make such continuity of operation practically impossible;

the continual wearing out of their terminal ends must be provided for in some other way, and their replacement in some manner becomes a necessity.

"In such a furnace, if continuous work is to be done, a movable electrode through a stuffing box for the manufacture of such a body as bisulphide of carbon, for example, is practically out of the question. The use of pieces of conductive material that can settle down upon each other from above and properly arrange themselves and feed down by gravity early commended itself to my thought; but a suitable and proper arrangement, to meet all the required conditions did not immediately appear. A conduit of sufficient surface to conduct large amounts of current to such broken material without offering such resistance as to determine the conversion of large portions of electricity into heat, before reaching the active part of the furnace, afforded also a large surface for insulation against the passage of electricity into the shell of the furnace. I therefore reached the solution of the difficulty by a compound method, i. e., by carrying the current into the furnace by the use of a stationary conductor of moderate size, and separately arranging the moving portions inside the furnace itself.

"Noticing the construction illustrated (Fig. 4), in connection with the paper that I had the honor to read before this body at the Philadelphia meeting, it will be seen that there is presented a plan of prolonging the life of the electrodes by regularly feeding upon them and at their ends, by gravity, broken conductive material, whereas in the plan illustrated by this paper (Fig. 5) we may properly leave out the word prolonging and say that we have for all practical purposes made a live electrode; or, in other words, we have a self-renewing electrode in a closed

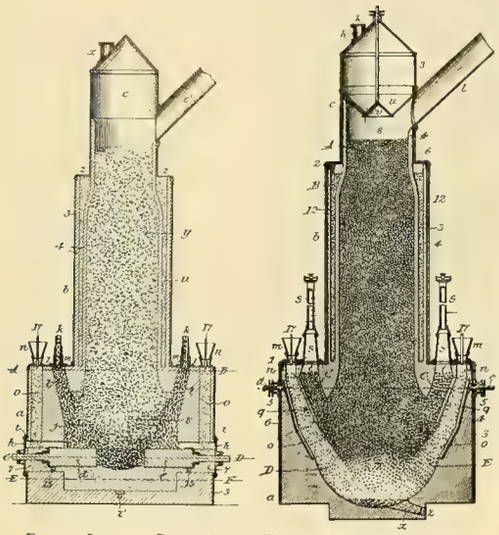


Fig. 4. In use at Present. Fig. 5. Improved Form.

LARGE ELECTRIC FURNACES NEAR PENN YAN, N. Y.

furnace—a continuously reproducing electrode, the broken and moving portions of which in their continual descent, themselves constituting the electrode. New material constantly descends and takes the place of that exhausted at the ends of points of wear.

"The conduits through which these broken pieces are fed are suitably connected by an insulated conductor through the shell of the furnace to the source of electricity. Suitable hoppers are made above the conduits and outside of the furnace, through which the broken conducted material can be fed into and ultimately through the several conduits, at the bottom of which the broken fragments are free to arrange themselves by gravity, so that the weakest part of the circuit will be determined where the pieces come together at the bottom of the furnace. As fast as the lower ones are exhausted others feed down from above and take their place, and thus the continuity of the electrodes is maintained.

"A second requisite for an electric furnace that shall be capable of continuous and prolonged use, without stopping to clean out, is that either a non-volatile product or residue may be removed from the furnace, either continuously or at intervals, in a fused or molten state. This provision is clearly shown in the illustration (Fig. 5). I will say that, with this construction of the furnace and an adequate source of electricity at my command, it would take less nerve on my part, with my present experience, to construct an electric furnace that would dwarf the largest blast furnaces in existence to-day, than it took to build the furnaces now in use, which are 16 feet in diameter and 41 feet high.

"To prevent the passage of electricity through the furnace at a higher level than desired, a wall made of suitable non-conductive material constitutes the front side of the conduit. Provision is also made to increase or reduce the resistance of the furnace at will by feeding conductive or non-conductive material through openings provided in front of the conduits, down upon the working ends of the electrode. In this manner comparatively quick changes can be made in the resistance of the working furnace, permitting its increase or diminution as may be required for the best results in utilizing the current and the best production of goods.

"If at any time piers should form in the furnace tending to hold up the charge, they can easily be reduced by changing the path of the electricity through the furnace. There is therefore nothing that can interfere with the regular descent of the furnace charge and the regular continuity of the work."

Responsibility for Pittsfield Accident.

Justice Charles E. Hibbard has rendered his decision in the case of the street-railway accident which occurred in Pittsfield, Mass., on September 3d, and by which President Roosevelt was injured and William Craig of the Secret Service killed. The justice finds that "the unlawful act of James T. Kelly, conductor, and Euclid Madden, motorman, contributed to the death of William Craig." There seems to have been a misunderstanding on the part of the street-car companies of the city as to what thoroughfares were to be closed to traffic during the president's visit. The particular car which collided with the president's carriage was running, according to evidence, at an unusual rate of speed and was allowed to maintain that speed even though approaching the presidential party and the crossing at which it was the custom for carriages to pass over the tracks.

Death of Sidney H. Short.

Just as this issue of the Western Electrician is going to press a dispatch from a staff correspondent in Cleveland conveys the sad intelligence that Professor Sidney H. Short has just died in London. Professor Short was prominently identified with the development of the electric railway in the United States, and had to his credit a long list of valuable inventions. Of late years he had devoted his time, with signal success, to opening up the promising field of electrical manufacture in England. A biographical sketch of Professor Short will appear in the next issue of the Western Electrician.

New Power Plant of Twin City Rapid Transit Company.

The Twin City Rapid Transit Company of Minneapolis and St. Paul, Minn., has under construction a large power plant which, when completed, will be one of the best equipped railway plants in the country, thoroughly up-to-date in every particular. The location chosen for the building is the north bank of the Mississippi River, near the lower dam of St. Anthony's Falls, Minneapolis. This new plant, together with the present waterpower station, will supply the power for the entire railway system of the company, with two distributing sub-stations, one in Minneapolis and one in St. Paul. The now existing waterpower station will be run in conjunction with the new plant, always supplying power to its capacity depending on the rise and fall of the river. The new station will cost, machinery and all, something over $1,000,000. Each sub-station is contracted for at an additional cost of $300,000, making the total amount to be laid out in the neighborhood of $1,600,000.

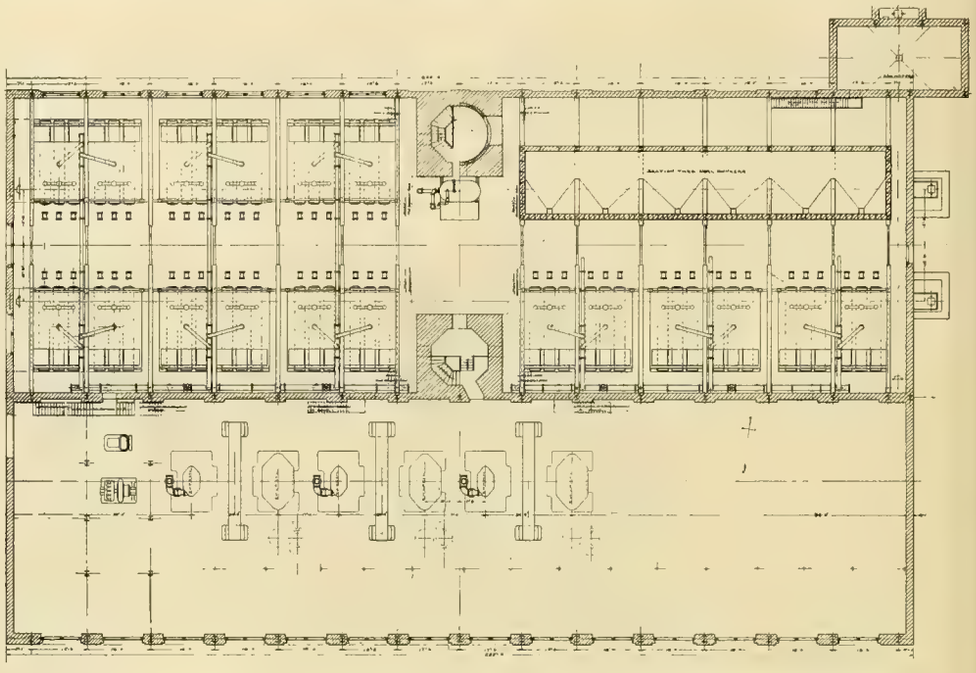


FIG. 1. NEW POWER PLANT OF TWIN CITY RAPID TRANSIT COMPANY.—PLAN OF MAIN GENERATING STATION.

Steel, Kettle River sandstone, pressed brick and terra cotta will enter into the construction of the main station. The basement walls will be built of stone, and the upper portion of the building of brick and terra cotta. The idea of the engineers is to make the structure as nearly fireproof as modern building materials will allow. The site for the building is sloping, part of the basement being built into the hill, while the river side is open to the light. The ground dimensions of the power house are 156 by 255 feet. The height of the building on the river side is 86 feet. The engine room is located on the river side of the station, the boiler room being back of it, as shown in the plan (Fig. 1). The basement floor under the engine room is 10

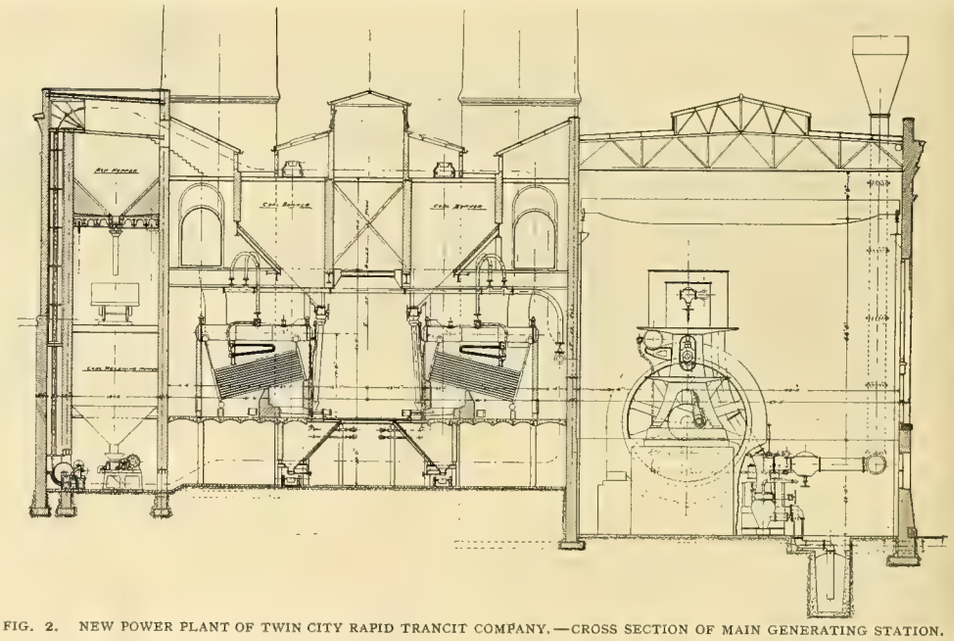


FIG. 2. NEW POWER PLANT OF TWIN CITY RAPID TRANCIT COMPANY.—CROSS SECTION OF MAIN GENERATING STATION.

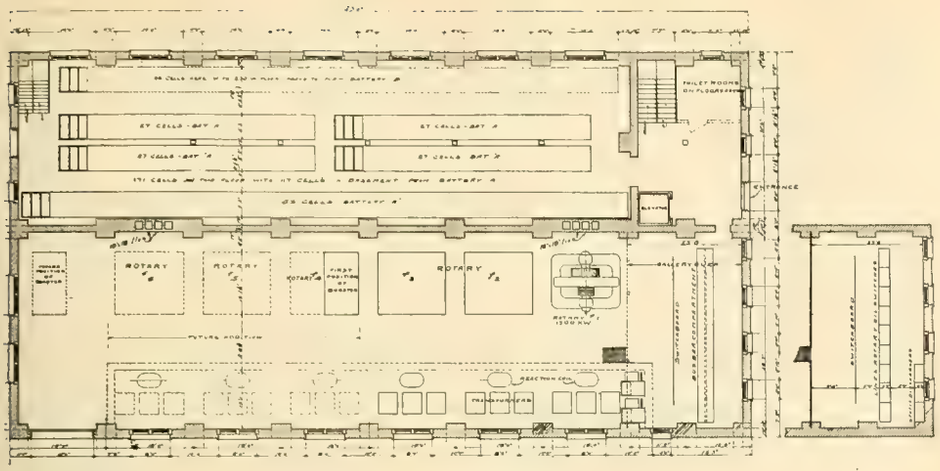


FIG. 3. NEW POWER PLANT OF TWIN CITY RAPID TRANSIT COMPANY.—GROUND-FLOOR PLAN OF SUB STATIONS.

feet lower than that under the boiler room, while the main floor of the engine room is four feet below that of the boiler room, leaving a basement 20 feet deep under the former and 14 feet deep under the latter. A good idea of the relative positions of the two rooms may be obtained from the sectional drawing (Fig. 2). The floors throughout the entire plant will be of cement composition. The walls of the engine room will be wainscoted with enamel brick to a height of seven feet, the upper portions being of sand-faced brick.

The boilers, 18 in number, are being built by the Babcock & Wilcox Company, and are each 23 feet three inches long and three feet in diameter. Each boiler contains 273 water tubes, four inches in diameter and 18 feet long. These tubes are built into the boiler in sections, of which there are 21, each section containing 13 tubes. These boilers will each have a heating surface of 5,560 square feet, will work on a steam pressure of 175 pounds and will have a rated horsepower of 556. They will also be fitted with Babcock & Wilcox superheaters and automatic stokers built and erected by the Underfeed Stoker Company of America. The location of the coal bunkers, one for each boiler, and the coal and ash-conveying apparatus can be seen in Fig. 2. The coal conveyors are now being built and will be installed by the John A. Mead Manufacturing Company. There will be two longitudinal conveyors and one cross conveyor. The cross conveyor passes directly under the coal crusher, also shown in Fig. 2, which is placed directly under the track for the coal cars. This cross conveyor, as shown by the dotted line in Fig. 2, delivers coal to the longitudinal conveyors, which in their turn dump it into the coal bunkers located above each row of boilers.

From the bunkers, the coal, which has been reduced to three-inch lump by the crusher, passes through chutes to the stokers, which feed it into the grates. The ash, dropping through the grates, is picked up by the before-mentioned longitudinal conveyors which, as is seen in the elevation, pass underneath the grates. It is dumped into the cross conveyor which empties into the ash hopper.

Feed water for the boilers is taken from a feed-water heater built by the Stilwell-Bierce & Smith-Vaile Company. This heater uses the exhaust steam from the boiler-feed pumps, of which there are four, built by Dean Brothers of Indianapolis. These pumps are of the simplex type. Besides these pumps, there will be two low-pressure service pumps installed in the basement of the engine room to supply condensing water. This condensing water is to be drawn from a tunnel which will connect with the river and pass the entire length of the engine room.

On each side of the boiler room and centrally located as to the boilers (see Fig. 1) a chimney is to be built. The two stacks will each be 16 feet in internal diameter and 225 feet high, measuring from the boiler-room floor to the top. They are to be built of brick by the Alphons Custodis Chimney Construction Company. The boiler room will be 85½ feet wide and 255 feet long and will have a clear height of 50 feet. Space will be provided for increasing the 18 boilers now going in to 24.

The engine room (Figs 1 and 2) will have ground dimensions 68 by 255 feet and will have a height in the clear of 56 feet. It will be provided with an overhead traveling crane of large size. Space is to be allowed for five direct-connected units, but only three will be installed at first. These units will each be made up of a vertical cross-compound Allis-Corliss condensing engine, built without a fly-wheel, and a General Electric alternator of the fly-wheel type. These engines will have 46 by 94-inch cylinders and a 60-inch stroke, and will run at a speed of 75 revolutions per minute. They will operate on 175 pounds steam pressure and 75° F. superheat, and will have a continuous working indicated horsepower of 6,000, with a maximum capacity of 9,000 horsepower. They are guaranteed to have an economy of 11½ pounds of steam per indicated-horsepower-hour. They run condensing, being supplied with Blake jet condensers. The alternators will be three-phase, 13,200-volt, 3,500-kilowatt machines, designed for a frequency of 34⅔ cycles. This unusual frequency was necessary in order that the new plant might be run in parallel with the present waterpower station. The exciters for these alternators are to be built by the General Electric Company, which company is building all the electrical apparatus for the entire installation except storage batteries. There will be two of these machines, one 50-kilowatt, direct-connected to its own engine, and one of 200 kilowatts, run by an induction motor, which is to be used in regular operation.

The controlling apparatus for the main-station output will be located on two galleries built in the west end of the engine room and reached by an iron stairway. On the first gallery will be installed the instrument transformers with space for future feeder, oil switches and engineers' office. The second gallery will contain the operating board and the oil switches for the high-tension service. Each machine in the main station can be controlled from this operating board.

The two sub-stations are exact duplicates. A ground-floor plan is shown in Fig. 3. In general the sub-stations will follow the main station in style of construction. The ground dimensions of sub-stations will be 155 feet by 80 feet, the buildings being three stories in height, with a basement. Each sub-station will be divided into two parts, one part, 80 feet wide, for rotary converters and booster, and the remainder of building for batteries and offices. The switchboards in the sub-stations will be placed on a gallery, with direct-current feeder panel on main floor, at one end of the room.

Each of the two sub-stations will be built to allow the final installation of six 1,500-kilowatt, six-phase rotary converters. Three will be installed under the first contract in each sub-station. Besides the rotary converters each sub-station will be equipped with a 1,000-kilowatt storage battery, built and installed by the Electric Storage Battery Company of Philadelphia. Cells of these batteries will be installed in the basement and one-half of the first floor, the other half and the third floor being reserved for a duplicate battery. A booster will also be provided in each station for the charging of these batteries.

General wiring connections of the new main station, the two new sub-stations and of the new panels to go in the present waterpower station are shown in Fig. 4. The current from the three units in the main station and that from the waterpower plant having reached the main bus-bars through the ordinary instruments, etc., is conducted over three-conductor, paper-insulated, lead-covered cables, run through underground conduits to the two sub-stations, where it passes through three banks of three 550-kilowatt, 13,200-440-volt air-blast, six-phase transformers. This six-phase, 440-volt, alternating current then passes into the rotary converters from which the final 600-volt, direct current for the distribution lines is taken.

When completed, this plant will be one of the

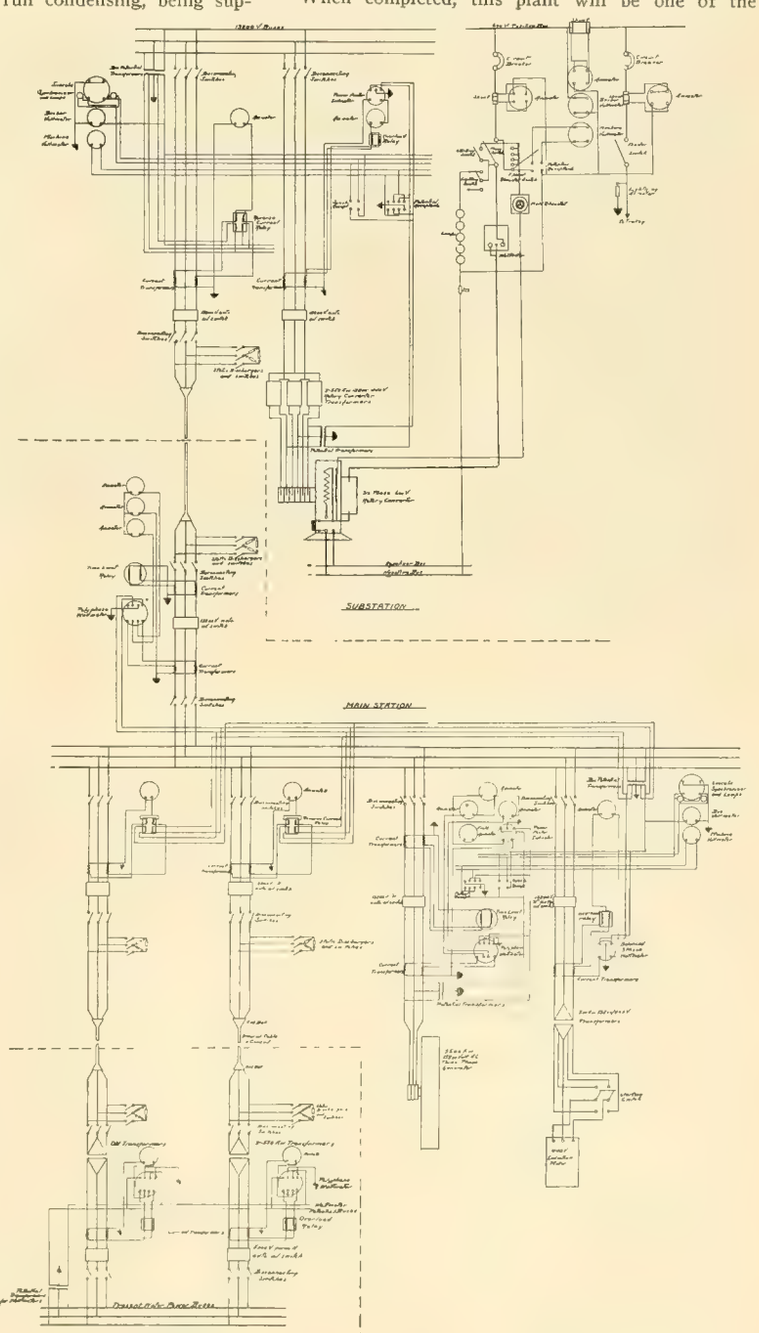


FIG. 4. NEW POWER PLANT OF TWIN CITY RAPID TRANSIT COMPANY.—GENERAL PLAN OF WIRING OF NEW MAIN STATION, NEW SUB STATIONS AND EXISTING WATERPOWER STATION.

best of its kind in the country. The entire engineering work is in the hands of Sargent & Lundy of Chicago. The architects for the plant are E. C. & R. M. Shankland, also of Chicago. The principal officers of the Twin City Rapid Transit Company are: President, Thomas Lowry; vice-president, secretary and treasurer, C. G. Goodrich; general manager, W. J. Hield; chief engineer and master mechanic, R. C. Taylor; electrical engineer, E. H. Scofield.

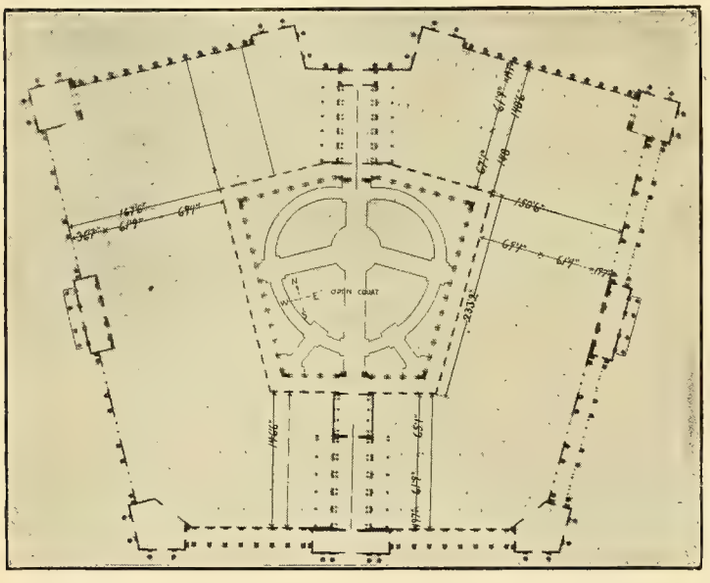
Electricity at the St. Louis Exposition.

Construction work on the Electricity Building at the Universal Exposition (which seems to be the latest official title) in St. Louis in 1904 is now well advanced. This building was illustrated in the Western Electrician of May 10th last, and a ground plan of it is herewith presented. As to the general outlook for electricity at the exposition, Chief Goldsborough, in his most recent circular, presents the following facts:

The Electricity Building of the Universal Exposition, to be held in St. Louis in 1904, is a structure of more than ordinary beauty, and is made, by the position which it occupies on the grounds, one of the leading and ornamental features of the exposition picture.

The electrical interests have been particularly favored in the apportionment to their uses of this very desirable location right into the heart of the exposition grounds, and immediately adjoining the area which will contain the chief works of art and the most magnificent display effects to be inaugurated.

As the building will be between the Art Palace, the illuminated cascades and the Grand Basin on the one hand, and the main entrance of the exposition on the other, it is sure to be the pathway at one time or another of every person visiting the exposition, and the demonstrations of the scientific, industrial, household and commercial applications of electricity exploited within the building will be developed along lines possessing so great intrinsic merit as to compel attention.



GROUND PLAN OF ELECTRICITY BUILDING AT ST. LOUIS EXPOSITION.

Exhibit space in the Electricity Building will also be of especial value, on account of the fact that the whole population is interested in what pertains to electricity, and, to a degree not approached by any other department of human endeavor, is absorbed and held by the fascinating problems so brilliantly conceived, achieved and perfected through the medium of this latest and best form of energy.

The Electricity Building has an extreme width of 700 feet and an extreme depth of 600 feet. It has four imposing entrances on its four sides, four handsome entrances at its four corners, and numerous minor entrances dispersed along all four of its sides. Through the medium of large windows and an abundant skylight area, the building will be particularly free of objectionable shaded areas during the day. It will be airy and well ventilated at all times and most artistically and grandly illuminated at night.

The center of the building is given over to a large open court, which the architects have made most attractive by a beautiful colonnade and the lavish use of sculptural decoration. This court will be made cool and attractive by fountains and the artificial circulation of air. Palms and flowers will augment its beauty, and everything will combine to make it a spot of restful retirement from the busy whirl of the exposition as a whole, and a most convenient and well-appointed meeting place.

Since within the limits of this building (the contract price for which is $400,000) there will be a space equal to that of four ordinary city blocks, it will be at once apparent that the exposition authorities have provided most amply for the presentation of electricity.

The benefits to be derived from the exploitation of electrical manufactures are given to exhibitors with a free hand. No charge will be made for space, and it will be impossible to buy space. More than this, those exhibits possessing special merit will receive special recognition, and facilities such as have never been equaled at any previous international exposition will be offered free to promote perfection in exhibits and to reduce the expense of exhibiting.

Manufacturers are not asked to show only the product of their factories. It is in the processes of manufacture and the direct applications of the manufactured product where lies the power to interest and attract the attention of the student, the teacher, the scientist, the operator, the investor, and the general public.

Under the classification of the Louisiana Purchase Exposition complete electric-light installations, the electric transmission of power, the application of electricity to transportation, electrochemistry and telephony, etc., are all accredited to the Department of Electricity. The department classification is therefore broad and comprehensive. It includes the following groups:

Group 67. Machines for generating and using electricity
Group 68. Electrochemistry.
Group 69. Electric lighting.
Group 70. Telegraphy and telephony.
Group 71. Various applications of electricity.

It is the desire of the department to secure the immediate and active interest and co-operation of the manufacturers who intend to exhibit, in order that the best results may be obtained and the highest class of exhibits secured.

Possible Power Transmission from the "Soo" to Detroit.

F. H. Clergue, in an interview while in Detroit, Mich., recently, is said to have made the statement that all plans had been arranged for the building of an electrical power-transmission line from his plant, now nearing completion at Sault Ste. Marie, to Detroit, a distance of nearly 300 miles. The plan as outlined by Mr. Clergue is to convey the electrical current by means of overhead cables, carried on steel towers 60 feet high and stationed 1,000 feet apart. The route which will be followed includes Cheboygan, Bay City, Saginaw, Port Huron and Mt. Clemens, Mich., besides numerous smaller places, all of which will be supplied with whatever electrical power they may require. The system will be extended as far west as Jackson as a starter, the ultimate aim of Mr. Clergue being nothing less than to furnish the entire state of Michigan with power.

"There is nothing impracticable about the plan," said Mr. Clergue. "The distance between the Soo and Detroit is a trifle less than 300 miles, and it has been demonstrated that electricity can be transmitted that distance successfully. We propose furnishing Detroit with 20,000 horsepower to begin with. As the line loss at 80,000 volts would be about 20 per cent. through transmission, it will require 25,000 horsepower at the starting point. That will make no perceptible difference in our plant there, however, as, when completed, we will have 200,000 horsepower available."

A line voltage of 80,000 will be used, and the transforming stations will be located at the various cities along the line to reduce this to a serviceable voltage. "We will not go into the retail field at all," said Mr. Clergue, "at least not in Detroit, as we do not desire to compete with local enterprises. The power will be furnished the street-railway and electric-light companies in the desired quantities, and they will act as distributing agents, our sole aim being to furnish them with electricity cheaper than they can generate it themselves by the use of coal. We have inexhaustible power, with comparatively little attendant expense, and this should result beneficially for both retailers and consumers." The proposed transmission line may be built next year.

The Springfield (Ill.) and Central Illinois Railway Company, recently incorporated, will soon assume control of the Springfield Consolidated Railway Company and will increase the capital stock to $1,500,000 and float $2,500,000 in bonds. From the proceeds of the bond sale the company will purchase the Consolidated railway property for $556,000 and will expend $600,000 on improvements of the roadbed, new equipment and interurban extensions. It will hold $750,000 in trust to retire the bonds of the old company.

New Rotary-converter Distribution System.

Charles P. Steinmetz and William L. R. Emmet of Schenectady, N. Y., have invented a system of electrical distribution, covered in letters patent No. 710,081, dated September 30th, that has interesting features. The invention relates to alternating-current systems of distribution and more especially to an arrangement in which a neutral conductor is brought out from a point of neutral potential on an alternating-current supply system and is led forward and co-operates with direct-current mains of a converter to form a multiple-conductor direct-current system of distribution. Where a system of transformers is used for feeding the converter, the invention is particularly valuable, in that it permits a reduction in the number of transformers, which has heretofore been found necessary for feeding a converter of any given number of phases.

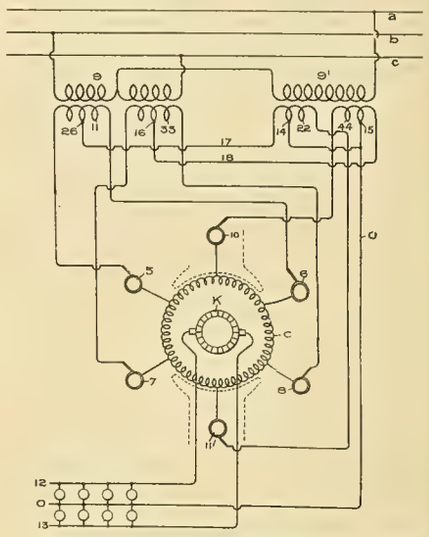


FIG. 1. NEW ROTARY-CONVERTER DISTRIBUTION SYSTEM.

In the embodiment selected for the purpose of illustrating the invention the alternating current from the source is passed through a system of phase-changing transformers, the currents from the secondaries of which are suitably proportioned, and passed to the armature of the converter, by which they are changed into direct current.

One of the features of the invention consists in supplying a rotary converter having a number of phases represented by a multiple of three by currents which are the resultants of currents displaced from each other in phase by 90 degrees. In the instance shown a six-phase rotary converter is fed by means of two overlapping T-connected three-phase systems, the nature of which will be best understood by reference in detail to the drawings. Fig. 1 represents such a system, and Fig. 2 denotes the relation of electromotive forces operating therein.

Referring first to Fig. 2, the dotted circle represents the locus of the ends of vector electromotive forces combined to produce a six-phase system. The particular relation of electromotive forces chosen consists of two sets of quarter-phase electromotive forces, each set consisting of an electromotive force of given value operating in conjunction with another electromotive force having a ratio thereto of $\sqrt{\frac{3}{2}}$, the electromotive forces being so combined that the resultant electromotive forces represented by connecting the ends of the vectors will be equal. Thus the line (1) may represent one of these electromotive forces or vectors, and the line (2) the other displaced from the first by 90 degrees and combined with the first electromotive force (1), so that the end of the vector (2) is connected to the middle point in the length of the vector (1). With the proportions indicated, the resultant vector formed by connecting either end of the vector (1) with the free end of the vector (2) is equal to the vector (1). Such a system of electromotive forces is produced in practice by the use of two transformer or other windings carrying current in quarter-phase relation to each other and connected so that the end of one winding joins the

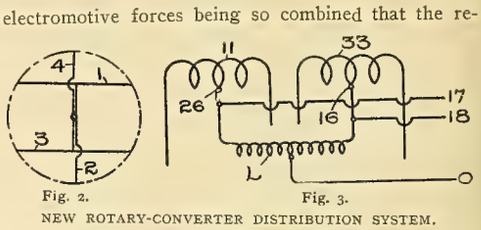


Fig. 2. Fig. 3.

NEW ROTARY-CONVERTER DISTRIBUTION SYSTEM.

middle point in the other winding, the electromotive forces of the windings being suitably proportioned, as before referred to.

A second system of electromotive forces is indicated in Fig. 2 by the lines (3) (4); but these electromotive forces operate in a reverse relation with respect to the first set, as will be seen. The inscribing circle is thus divided into six equal parts by means of the intersections of the lines (1) to (4), these intersections representing the points of connections of windings carrying electromotive forces related to each other and arranged in the proportions indicated. The physical embodiment of such a system is diagrammatically shown in Fig. 1, in which the winding (11) represents a winding generating an electromotive force corresponding to the line (1) of Fig. 2, while the winding (22), connected at one end to the middle of the winding (11), represents the line (2), similarly connected to line (1). In a similar manner the winding (33) corresponds to the line or electromotive force (3), (shown in Fig. 2), while the winding (44) corresponds to the line (4), connected to the middle point of the line (3). It is to be noted that while the lower end of the line (4) is connected to the middle point of the line (3), the upper end of the line (2), on the contrary, is similarly connected to the middle point of the line (1). The connections of these lines being reversed, the connection of the winding (44) is accordingly reversely connected with the winding (33), in order to reproduce the arrangement of electromotive forces indicated in Fig. 2. This is shown in the drawings by connecting the left-hand end of the winding (22) to winding (11), while on the contrary, the right-hand end of the winding (44) is connected to the winding (33). If the terminals of these windings be connected to equally spaced points in a closed-armature winding, according to the scheme of connections represented in Fig. 2, then resultant six-phase currents will flow in the armature winding.

At (C) is indicated the armature winding of a rotary converter, from which taps are brought out at six equally spaced points and connected to suitable collector rings. These rings are connected to the supply system as shown. The arrangement corresponds to a bipolar field, so that if the field is multipolar, the connections are to be made accordingly. With the system of connections described the quarter-phase electromotive forces circulating in the windings of the supply system are so combined when they reach the converter armature as to produce therein six-phase currents, which latter are changed into direct current in the ordinary manner. At (K) is indicated the commutator of the converter, to which direct-current mains (12) and (13) are connected.

In cases where it is desired to operate translating devices on the three-wire system from the direct-current side of a rotary converter, the system for supplying the converter is particularly desirable, since while permitting the use of a smaller number of transformers than has hitherto been found necessary, it at the same time affords an easy means for obtaining a point of neutral potential to which a neutral conductor from the three-wire system may be connected in a well-understood manner.

In some cases there may be considerable practical difficulty in connecting intermediate points in the transformer windings in order to secure a neutral, particularly so where the transformers are not specially constructed or their coils easily accessible. In such cases the inventors make use of the following device. The tapping-in points (16) and (26) of the T-connected windings are joined by means of a compensator to the middle point in the length of which the neutral conductor is connected. In Fig. 3 so much of the system in Fig. 1 is shown as is necessary to understand the connections of the compensator.

Electrical Apparatus in English Coal Mines.

The coal mines of England, the primary source and the essential element of the industrial strength of that country, have now been worked extensively for more than a century. Until a few years ago England mined more coal than any other country in the world. However, this is no longer the case. American production exceeds the English, which is now almost stationary from year to year, by a rapidly increasing percentage; American coal competes with English coal on the continent of Europe, and the possibility of some day "carrying coals to Newcastle" is by no means indefinitely remote. It has been estimated that 500 years will see the end of England's coal supply, and long before that time the mining of coal must become so difficult and costly, and the price of coal so high, that English manufacturers will be seriously handicapped or compelled to seek other locations where cheap fuel is to be found. This is beginning to be felt even now. The price of coal in England is steadily rising, shafts are being carried deeper and deeper, and, the richer veins having been exhausted, the thinner veins, containing often poorer grades of coal, must now be developed. These things have put the British operator upon his mettle, and he has taken up the latest and most improved methods of coal mining even more rapidly than his American competitor. Moreover, he has stepped out boldly and adopted for power transmission alternating currents and induction motors, which, for mining work and especially coal mining, have many advantages over direct-current machinery. The foregoing facts are well illustrated in the following brief description of electrical plants recently installed at a number of English coal mines.

The Sneyd Colliery, at Burlem, Staffordshire, has recently put in a complete alternating-current equipment. Current is generated by a Westinghouse three-phase alternator, and induction motors aggregating about 1,000 horsepower and of the same make as the alternator, are used for driving "main-and-tail" and "endless" rope-hauling engines, for pumps and for several other auxiliary purposes. The hauling gears, with their electric-motor equipment, are shown in the accompanying photographs. These mines are gaseous, and the use in them of direct-current machinery would have been dangerous. The induction motor, however, on account of the fact that it has no moving contacts to spark or flash, is entirely adapted for use in such locations.

The Clapwell Colliery of Chesterfield has recently installed two three-phase alternators, one of 225 kilowatts capacity and the other of 20 kilowatts, together with a 6-kilowatt direct-current exciter. The British Westinghouse Company also furnished 10 induction motors, aggregating 280 horsepower.

The Oxcroft Colliery of Chesterfield has installed two three-phase alternators, each of 200 kilowatts capacity and operating at 440 volts, 30 cycles per second and 100 revolutions per minute. The equipment includes two exciters, each of 11¼ kilowatts capacity, and a small generator of 1½ kilowatts capacity; also 13 induction motors, with an aggregate capacity of 300 horsepower and a complete switchboard outfit for the entire plant.

About 4,000 horsepower of Westinghouse electrical apparatus is about to be installed in the several collieries owned by the Stavely Coal and Iron Company of Chesterfield.

The Sherwood Colliery of Mansfield has purchased two three-phase alternators, each of 50 kilowatts capacity and operating at 440 volts, 60 cycles per second and 900 revolutions per minute; also three direct-current, multipolar generators of about 12 kilowatts aggregate capacity.

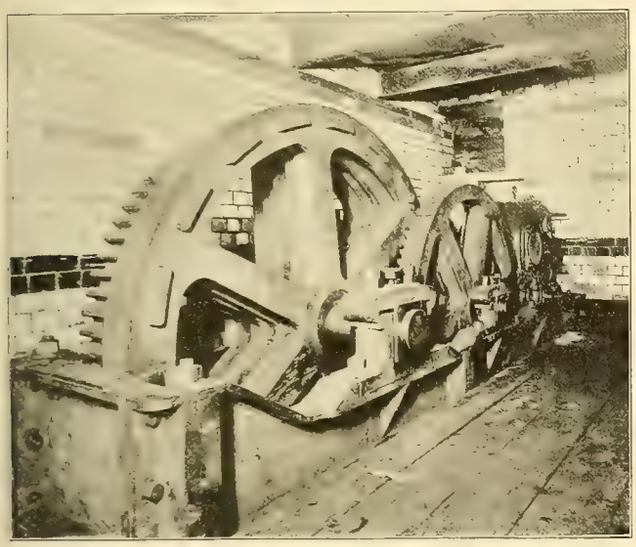
At the Tredegar Iron and Coal Company's collieries in Monmouth a complete power equipment is being installed, comprising two 150-kilowatt three-phase alternators, two exciters, each of 7½ kilowatts capacity, and 10 induction motors ranging in size from 50 to five horsepower and aggregating 220 horsepower.

The Bolsover Colliery Company of Chesterfield has decided to adopt electric driving to a considerable extent, and has placed a large order with the British Westinghouse Company, including a 180-kilowatt, three-phase alternator, together with exciter, a 200-horsepower induction motor, complete switchboards, etc.

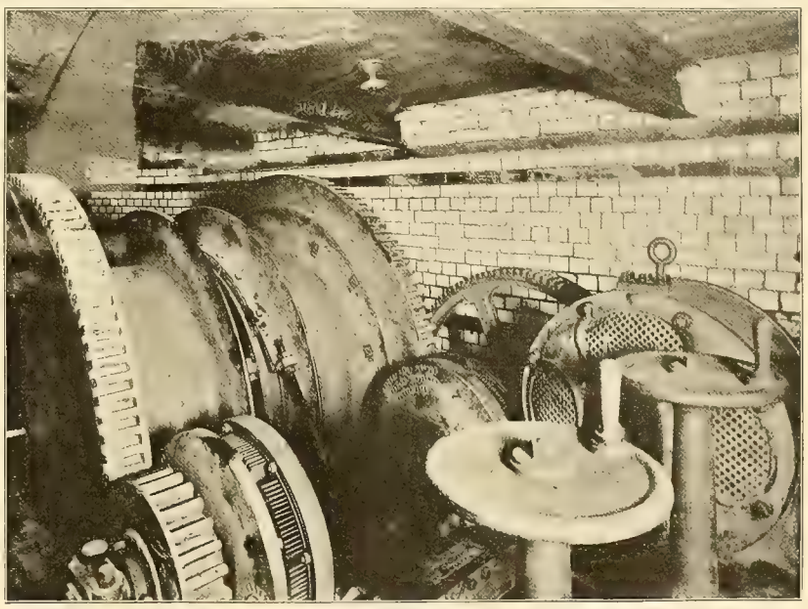
The Stanton Iron Works Company of Pleasley will equip its collieries with electrical apparatus, including about 150 kilowatts in generating capacity and 100 horsepower in motors.

The Tyrdail Collieries of Carmarthen have contracted for an electric-power installation consisting of a 60-kilowatt, three-phase alternator, exciter, switchboard, and about 50 horsepower of induction motors. The New Cross Hands Colliery of Lanelly has purchased an electrical-power equipment consisting of a 125-kilowatt, direct-current generator, with switchboards, etc., complete, and several Westinghouse direct-current motors.

From the above examples it will be apparent that the British manufacturers are by no means slow to see the economies of electric driving, and when their mines have been thoroughly equipped they may yet for a long time give the Americans a stiff fight for European markets.



Induction Motor Operating Endless Haulage in Sneyd Colliery.



Induction Motor Operating Main-and-Tail Haulage in Sneyd Colliery.

ELECTRICAL APPARATUS IN ENGLISH COAL MINES.

Volney W. Foster of Chicago is said to have taken up the building of the "missing link" in the electric-railway lines betwen Chicago and Milwaukee. The agents of Mr. Foster have been busy during the last week securing the right-of-way from Kenosha to Waukegan along the North Shore, and have secured the old right-of-way from Waukegan through Zion City, which was obtained before Zion City was incorporated, up to the state line. The surveyors say the building of the line will begin as soon as the frost is out of the ground in the spring and rushed through to completion.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Large Electric Furnaces Near Penn Yan, N. Y. Illustrated 287, 288
Responsibility for Pittsfield Accident 288
Death of Sidney H. Short 288
New Power Plant of Twin City Rapid Transit Company. Illustrated 288, 289, 290
Electricity at the St. Louis Exposition. Illustrated 290
Possible Power Transmission from the "Soo" to Detroit 290
New Rotary-converter Distribution System. Illustrated 290, 291
Electrical Apparatus in English Coal Mines. Illustrated 291
Editorial 292
Ohio Electric Light Association. (Convention at Columbus, October 14-16, 1902.) 293, 294
Sleeping Cars for Electric-railway Service 294
Methods of Increasing Central-station Business and Improving Load Curves. (Ohio Electric Light Association.) 294, 295
Chicago Electrical Association 295
Marine Electric Signaling System 295
Development of the Telephone Field. Illustrated 296, 297, 298
Indiana Mutual Telephone Association 296
Southeastern Iowa Telephone Association 296
Hutchinson Telephone Transmitter for the Deaf. Illustrated 296
Bell Extensions in New York and Pennsylvania 296
Telephone Men 296
Ohio Telephone Notes 297
Telephone News from the Northwest 297
Southern Telephone Developments 297
Indiana Telephone Items 297
Central Intercommunicating Telephones. Illustrated 297, 298
Co-operative Farmers' Telephone System in Indiana 298
Anglo-Belgian Telephone Service 298
A San Francisco Application 298
Stromberg-Carlson Farewell Party 298
New Exchange for Cheyenne 298
Peerless Automatic Smokeless Stoker. Illustrated 298
The Old and the New in Appleton 299
Battery Plates and Dinner Plates 299
Possible Power Developments on the Colorado River 299
Electric Elevator of Great Magnitude Proposed 299
Extensive Interurban System in Texas 299
Drainage-canal Power Litigation 299
Consolidation in Dallas 299
New Developments in X-ray Work 300
Central Electric Catalogue 300
Storage-battery Trade Abroad 300

DEPARTMENTS.

Correspondence 300, 301
New York Notes 300
New England News 300
From the Buckeye State 300, 301
Information from Indiana 301
Southern Developments 301
Northwestern Notations 301
Among the Rockies 301
On the Pacific Slope 301
Personal 302
Electric Lighting 302
Electric Railways 302
Automobiles 302
Power Transmission 302
Space Telegraphy 302
Publications 302, 303
Telegraph 303
Miscellaneous 303
Trade News 303
Business 303
Illustrated Electrical Patent Record 303, 304

CONVENTIONS AND EXPOSITIONS.

Kentucky Independent Telephone Association, Louisville, Ky., October 28th and 29th.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

DISINFECTION of telephone transmitters is not a new proposal by any means, although we are not aware than any actual communication of disease has been traced to the telephone mouthpiece. Heretofore it has been thought that if any slight danger did exist it could be averted by an occasional cleansing of the transmitter with a cloth dampened in a weak solution of some disinfectant like carbolic acid. And, as a matter of fact, even this precaution is rarely adopted in the actual everyday use of the telephone. But it appears that reform is the order of the day in New York in the use of the telephone, if not in some other things. An Associated Press dispatch states that "in order to make certain that disease shall not be transmitted by means of telephones," Commissioner Folks of the Charities Department of New York city has issued an order that all the telephones used by employes must be disinfected every week. "The mouthpiece is to be unscrewed and scrubbed clean, then immersed for a few moments in an antiseptic bath," says the account. This drastic order applies only to one department of the city government, of course, but it will be of some interest to see whether it is carried out, and if so, whether it has a beneficial effect on the health of the community.

ONE of the most useful of the smaller electrical associations is the Ohio Electric Light Association, which held its eighth annual convention in Columbus last week. The attendance was not large, but this fact was partly due to the difficulty experienced by central-station men in getting away from their offices at this season of the year and partly to the recent large gathering in Detroit, which had already made a large inroad into the available time of electrical men in Ohio and adjoining states. However, the quality of the attendance was excellent in this as in previous conventions of this association. Earnest, level-headed electric-light men gathered to discuss practical problems arising in their business, and it seems safe to say that not a man was present who did not derive benefit from the meeting. The topics discussed were practical and of to-day—steam turbines, the increase and betterment of the load on the station, the meter department, central-station heating, alternating-current series arc lighting, and the like. Something of value was said on each of these subjects, either as the result of the experience of operating men or else from the expert knowledge of members of the staffs of the great engineering and manufacturing companies. No announcement of startling novelty was made, but the whole level of the discussions was earnest and thoughtful and of distinct value. A full report of the meeting is given in this issue of the Western Electrician, a few of the papers being reserved for future presentation. Central-station men generally will find the discussion of the topic, "On What Lines Shall We Reach New Business to Improve Our Load Curve and Increase Our Net Earnings" of particular interest.

GAS ENGINES as the prime movers in electrical generating plants have been somewhat obscured for the last year or so by the increasing attention paid to steam turbines. Nevertheless, as the ultimate fields of usefulness of the turbine steam engine and the explosion engine promise to be quite distinct, it is likely that the interest in the gas engine, after a temporary lull in this country and England, will be renewed. In Germany, it seems, the gas engine is making steady, although slow, progress in central-station employment. There are two public electric-lighting plants in that country—one at Presburg and the other in Erlangen—in which these engines are used. It is true the units are small—125-horsepower—but the gas engines and dynamos (direct current) are direct-coupled, and some interesting tests have been made by F. Ross. Mr. Ross found that the quantity of coal which was consumed in the gas producer brought the figures for the kilowatt-hour to 4,500-5,500 calories, while the corresponding amount for steam averaged 9,220. This shows a decided advantage in favor of gas. The coal consumption figured 3.14 pounds to the kilowatt-hour. Comparing a station outfit using gas engines with steam engines, it was found that the gas plant, while it takes up about the same space as the other, is cheaper in general, one point being the absence of the chimney and the boiler masonry. The cost of combustible has been found to be less in a number of different cases, among which may be cited the Klausthal plant in Germany, where a gas engine and dynamo set of 70 horsepower is working. The annual production is 164,315 kilowatt-hours. The figure for combustible in this plant is as low as 2.38 pounds of coke and anthracite per kilowatt-hour. At Oerlikon, which has a 125-horsepower plant, the fuel consumption figures 2.05 pounds per kilowatt-hour. The Weimar station, with a 100-horsepower engine, consumes 2.40 pounds. One of the largest plants is that of Brünn, which has a 300-horsepower gas engine, and this takes 3.36 pounds per kilowatt-hour. The figures, apparently, show that the gas plant can compete with steam, both as to first cost and fuel consumption, although the difference in cost of combustible needed for gas production and steam raising must, of course, be taken into account.

OZONE is commonly produced by the action of electrical discharges in the atmosphere, but the installation of suitable apparatus on shipboard as a regular part of the vessel's equipment is a recent and novel idea. A Canadian correspondent informs us that on the Elder-Dempster steamship Lake Simcoe a device of this character is in use to "clarify" the air. It is stated that during a recent voyage from Liverpool to Montreal the quarters of the steerage passengers, containing some 500 persons, were by this means kept refreshed and odorless. The apparatus is the invention of Colonel Josiah Harris, F. R. G. S., and is compactly disposed in three boxes, which can be placed on an ordinary dining table. Direct current is taken from a lamp socket connected with the generating plant of the ship. This is converted into alternating current by a small rotary or motor-generator in the first box. A transformer in the second box raises the current to a high potential. The ozonizer proper is contained in the third receptacle. This is described as a box-like cabinet, about 18 inches each way, containing at one end a revolving fan, and at the other end two screens, one positive and the other negative, made of copper netting, covered on one side with many little spikes or points. The screens are so arranged that these points lie just opposite one another, and it is between them that the electricity passes, setting up a succession of discharges. The air is forced through these screens by the fan, and, in passing, the ozone is generated. There seems to be no question of the entire practicability of the device, and as the cost is trifling, there may be a real field for its operation on shipboard, especially in steerage quarters in unfavorable weather.

Another recent application of ozone, on a much more ambitious scale, is reported by the eminent electrochemist, Professor Van't Hoff of Berlin, in a paper presented to the German Bunsen Society, describing the Vosmaer-Lebret system of sterilizing water on a large scale by means of ozone. The system has been in use commercially at Schiedam for about six months for 11 hours a day without interruption. Alternating current of 100 periods and 10,000 volts is used. The ozone is formed by means of dark discharge, without any solid dielectrics. Through the ozonizer the dried air is driven at a speed of about 40 liters a minute. A concentration of 3.5 milligrammes to five milligrammes of ozone per liter is obtained. For sterilization purposes a concentration of three milligrammes to 3.5 milligrammes has been found to be sufficient. The ozonized air is then pumped into the sterilizer, entering at the bottom and leaving at the top. The coarse impurities of the water are filtered off by means of a quick filter, before the water is sterilized by the ozone. The sterilizing result is said to be good. The cost of ozonization is said to be from one-sixteenth to one-eighth cent per cubic meter. It is proposed to introduce ozonization at the waterworks in Rotterdam. It is interesting to observe that in Chicago, with its average consumption of over 300,000,000 gallons of water daily, the cost given would work out, roughly, at $1,500 to $3,000 a day. Taking the mean, $2,250, the annual cost would be $821,250, which, capitalized at five per cent., would be $16,425,000. This is a large sum, but as Chicago has already spent over $38,000 000 on its Drainage Canal, it may be regarded as not too large a price to pay for insuring a pure water supply.

OHIO ELECTRIC LIGHT ASSOCIATION.

The eighth annual meeting of the Ohio Electric Light Association was held on October 14th 15th and 16th at the Chittenden Hotel, Columbus. In the absence of President W. F. White of Cincinnati it was called to order by Vice-president E. H. McKnight of Middletown, who presided over its deliberations and contributed materially to the success and interest of the meeting. Mr. McKnight being at the head of two electric-light plants in Middletown and Bowling Green, respectively, and president of an electric-railway line, is in a position to know whereof he speaks. His address at the opening of the convention recalled some interesting reminiscences of the formation of the Ohio association. While fully alive to the interests of the capitalization of his companies and keen to perceive and adopt every suggestion looking to increased efficiency of operation and economy of cost, Mr. McKnight believes that the way to make the people your friends is to treat them as if they were, and this policy he endeavors to carry it out. He urged that without being subjected to unnecessary annoyances, electric-lighting companies be encouraged to give the very best possible service at the least cost to consumers, and that they be made secure in a reasonable return for their capital invested and risk assumed.

Attendance.

The following-named gentlemen (names in alphabetical order) were in attendance from central stations:

E. J. Bechtel, Toledo Railways and Light Company; E. H. Beil, Youngstown Consolidated Gas and Electric Company; E. A. Beckstein, Sandusky Gas and Electric Company; Albert Charles Blinn, Sandusky Gas and Electric Company; M. S. Browne, Columbus Edison Company; Joseph Brooks, Columbus Edison Company; Frank Espy, Kenton Gas and Electric Company; A. W. Field, Columbus Edison Company; D. L. Gaskill, Greenville Electric Light and Power Company; E. F. Gwynn, Delaware Electric Light, Heat and Power Company; George Hayler, Jr., Van Wert Gas, Electric Light and Power Company; W. F. Hubbell, Wauseon Electric Light Plant; M. C. Hull, Columbus Edison Company; Walter Jaynes, Columbus Edison Company; David S. Kohler, Columbus Edison Company; C. R. Lutz, Citizens' Electric Light Company, Logan; R. H. McCoy, Kenton Gas and Electric Company; E. H. McKnight, Citizens' Light, Heat and Power Company, Bowling Green, and Middletown Electric Light and Power Company; George Matt, Lancaster Electric Light Company; John Miller, Springfield Light and Power Company; Joseph P. Myers, Chillicothe Electric Railroad, Light and Power Company; J. H. Perkins, Youngstown Consolidated Gas and Electric Company; J. M. Plaisted, Columbus Edison Company; W. F. Raber, Citizens' Electric Railway, Light and Power Company, Mansfield; O. W. Rhoads, Columbus Edison Company; A. C. Robeson, Greenville Electric Light and Power Company; S. M. Rust, Piqua Electric Company; T. J. Smith, New Lexington Electric Light and Power Company; W. D. Somers, Columbus Edison Company; Frank E. Valentine, Urbana Electric Light and Power Company; L. G. White, electrical department, Columbus Edison Company; John Whiteley, Greenville Electric Light and Power Company; H. C. Dye, municipal electric-light plant, Galion; Lehman B. Hoit, Cleveland.

The following-named representatives from supply houses were present:

W. W. Affleck, John A. Roebling's Sons Company, Cleveland, Ohio; F. J. Alderson, Stanley Instrument Company, Great Barrington, Mass.; Perry R. Boole, Electric Appliance Company, Chicago; Frederick Bissell, F. Bissell Company, Toledo, Ohio; W. Gibson Carey, General Electric Company, Schenectady, N. Y.; F. H. Carpenter, Nernst Lamp Company, Pittsburg, Pa.; Charles W. Cobb, Western Electric Company, Cleveland, Ohio; F. C. Colwell, Cincinnati, Ohio; Frank Conrad, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; H. P. Davis, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; H. J. Douds, General Electric Company, Cincinnati, Ohio; James R. Downs, Westinghouse Electric and Manufacturing Company, Cleveland; G. B. Fairbanks, Electric Appliance Company, Chicago; W. J. Hanley, General Electric Company, Cincinnati, Ohio; W. A. Hopkins, Erner-Hopkins Company, Columbus; W. F. Howe, Jr., General Electric Company, Schenectady, N. Y.; R. E. Hull, Erner-Hopkins Company, Columbus, Ohio; Wesley P. Jend, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; F. M. Knierim, F. Bissell Company, Toledo, Ohio; E. Kuhlman, Kuhlman Electric Company, Elkhart, Ind.; Charles S. Kuntz, Post-Glover Electric Company, Cincinnati, Ohio; Waldo Arnold Layman, Wagner Electric Manufacturing Company, St. Louis, Mo.; C. R. McKay, General Electric Company, Cincinnati, Ohio; J. W. Mason, Central Electric Company, Chicago; Charles D. Meyers, Helios-Upton Company, Philadelphia, Pa.; W. D. Packard, New York and Ohio Company, Warren, Ohio; Nathaniel Paige, Jr., Westinghouse Electric and Manufacturing Company, Pittsburg (Columbus); E. J. Paradis, W. G. Nagel Electric Company, Toledo, Ohio; Allen S. Pearl, Central Electric Company, Chicago; M. A. Pixley, Erner-Hopkins Company, Columbus, Ohio; Thomas J. Ryan, Fort Wayne Electric Works, Cincinnati office; George S. Searing, Hart & Hegeman Manufacturing Company, Hartford, Conn.; H. T. Stewart, General Electric Company, Cincinnati, Ohio; Charles J. Wells, Fostoria Incandescent Lamp Company, Fostoria, Ohio; W. H. Whiteside, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; Albert H. Wright, Otis Elevator Company, Cleveland, Ohio; Edwin Yawger, Westinghouse, Church, Kerr & Co., Pittsburg, Pa.; C. R. McKay, General Electric Company, Lynn, Mass.; L. T. Levy, sales agent for L. E. Frorup, New York city.

The Steam Turbine.

Edward Yawger of Westinghouse, Church, Kerr & Co., Pittsburg, read a paper on "The Present Development of the Steam Turbine," accompanying it with blue prints illustrating a number of tests made on a 400-kilowatt turbine. The paper elicited considerable discussion. In answer to a query by Mr. McKnight, the author stated that he thought the comparative cost of a 400-kilowatt turbine and that of an engine of high grade and same capacity would be very nearly equal, although the less cost of foundations and building required would tend to bring down the cost below that of a reciprocating-engine plant. The tendency would be toward a cheaper installation all along the line in the case of the turbine.

Reaching Out for Business.

The topic following was: "On What Lines Shall We Reach New Business to Improve Our Load Curve and Increase Our Net Earnings?" Papers on this question were submitted by Messrs. E. J. Bechtel, superintendent of lighting, Toledo Railways and Lighting Company, George Hayler, Jr., manager Van Wert Gas, Electric Light and Power Company, and L. G. White, superintendent electrical department, Columbus Edison Company. All of these papers are printed in full on succeeding pages. In the discussion Mr. Colwell wished to know if anyone had an appreciable load from electric cooking, and if that would ever amount to anything. Mr. McKnight stated that he had cooked flapjacks against his wife, she using a coal stove and he an electric one, and he had had his on his plate some minutes ahead. He was asked if he had made any estimate of comparative cost, and replied that he had not treated the matter that seriously. A gentleman present reported that in Traverse City, Mich., the current had been purchased to some extent for a fad of chafing dishes, etc., bills that had been $2.50 running up to $5 and $6 a month. During some months of the year this might be a profitable branch. Mr. McKnight again called attention to the value of introduction of current for any other purpose as valuable in stimulating its use for lighting, as if it was on the premises, its great ease of use would tend to its use for light. He had in Middletown a number of electric sadirons taking current, and heard no complaint on the score of cost. Mr. Bechtel reported curling irons employed in Toledo to some extent current; also warming tables and sadirons. It was very handy to heat water in a sick-room, etc. Mr. Raber of Mansfield gave a special rate for electric automobiles, provided they were not run during the peak, and had found this profitable business. Mr. Bechtel agreed with this, his rate being three cents. Mr. McKnight several years ago adopted the idea of furnishing lamps, but now thought it bad policy. He now held it better to charge for all supplies. It was objected by some that if the consumer bought his own lamps he might buy a poor article and indirectly reflect upon the quality of light furnished, but Mr. McKnight in such a case felt his own conscience was clear. Mr. Perkins instanced a case where a certain manufacturer who had a good many renewals, thought he could buy his lamps cheaper and he did so, but the lamp used so much more current that it proved a losing speculation, and the manufacturer was glad to purchase thereafter of the company. Mr. Raber reported that they had had trouble with excessive lamp renewals, and had kept track of their renewals for a considerable period and after ascertaining the percentage increased the price of current sufficient to cover that item, and it was now no longer a matter that concerned them. They sold their lamps at cost in some cases; in others furnished them free on renewals. Mr. McKnight saw no objection that could reasonably be urged to making a fair charge for all material supplied consumers; otherwise the station would lose.

Theater Party.

Tuesday evening was passed at the Empire Theater, an entire section of boxes being reserved for the members and their ladies, with compliments of the Columbus Edison and the Erner-Hopkins Companies.

Meters.

On Wednesday morning the first subject for discussion was electric meters. Papers were presented and read by F. G. Vaughan of the General Electric Company, Lynn, Mass., H. P. Davis of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and F. J. Alderson of the Stanley Instrument Company, Great Barrington, Mass. On the part of the central station, E. H. Beil of the Youngstown Consolidated Gas and Electric Company presented a paper. The discussion on this subject was long and showed a variation in practice among station managers, some holding that meters should remain permanently in adjustment without necessity for frequent inspection. Mr. Field considered that this was as unreasonable as if a man were to expect his watch to remain a good timekeeper without being given a periodical cleaning and oiling. Mr. Perkins said that at his station a card index was kept of meters, and if variations in bills occurred which could not be accounted for otherwise, the meter was at once examined and inspected, without waiting for the customer to complain; so far as possible complaints were anticipated and their cause inquired into in advance. Many of his customers were in the habit of sending notice to the office if an extra amount of light would be required for an especial occasion. By keeping track of this it was often possible later on to reconcile the increased bill satisfactorily to the consumer.

E. H. Beil of Youngstown, in his paper, stated that inefficient meters are a constant source of dissatisfaction and loss of custom. Meter cases should be well made, stiff and dustproof, and should require the minimum amount of skill in installing. Terminals do not receive sufficient attention from manufacturers, and should be made heavy and have at least two good screws for securing the wire in same. Meters should be so set that the heat generated by a poor contact will not destroy the entire meter. Means of adjustment should be provided, so that the meter may be easily calibrated; the moving element to be light as possible, and sliding contacts minimized. In Youngstown a test room has been established, with both alternating-current and direct-current instruments for testing. The stop-watch method is used, and a running test sometimes made to determine whether the recording dial is all right. All meters are tested when received from manufacturer, and thereafter as may be found necessary by occurrence of variance in consumers' bills, etc. No regular inspection is made. Twelve hundred meters are installed. Of 800 Westinghouse meters in use, some 50 required repairs to shafting or jewels, etc. Of a lot of Stanley meters received about 18 months ago, none has required any repairs. Thirty Thomson meters have caused the most trouble. However, a comparison of the last-named as used on a 500-volt circuit would probably be invidious, as they are then operating under altogether different conditions; but the experience with them at this station has not been satisfactory.

Visit to University.

Professor F. C. Caldwell, at the head of the electrical engineering department of the College of Engineering of the Ohio State University, being in attendance, invited the association to visit his department Wednesday evening and view the apparatus installed, and also witness the operation of the new Nernst lamps. A vote of thanks was returned, and the invitation was availed of very generally, special trolley cars being provided for the conveyance of the party. The members were received at the university by Professor Caldwell and addressed by Professor Edward Orton, dean. Professor Embury Asbury Hitchcock, M. E., professor of experimental engineering, and William T. Magruder, M. E., professor of mechanical engineering, also assisted in receiving and entertaining the visiting body.

Legislation.

On Wednesday afternoon the convention was addressed upon legislative matters, referring to the proposed municipal code and the proposed repeal of the arc-light bill heretofore passed at the instance of the railroad companies, by D. L. Gaskill, chairman of the advisory committee.

Hot-water Heating.

This was followed by papers and discussions upon hot-water heating as an adjunct to electric-lighting plants—a topic to many of the station managers of growing importance and in which they were greatly interested. A brief report of this discussion will be given in a later issue of the Western Electrician.

Series Arc Lighting.

Thursday morning, at request of Vice-president McKnight, D. L. Gaskill of Greenville took the chair and conducted the remainder of the meeting. C. R. McKay of the General Electric Company, Lynn, Mass., presented a paper on the topic, "What is the Reliability, Regulation, Power Factor and Efficiency of Present Forms of Alternating-current Series Arc-lighting Apparatus?" with reference to constant-current transformer systems.

Thomas Spencer of the Helios-Upton Company, Philadelphia, was unable to be present. His paper on the same general subject, with especial reference to the inductive regulator and step-up transformer system, was read by the secretary. W. A. Layman of the Wagner Electric Manufacturing Company, St. Louis, presented a paper on variable secondary step-up transformer systems.

Mr. Bechtel of Toledo reported very good results with three 100-light transformers in operation for one to two years and a half; service reliable and no repairs. This experience had taught them it was better to burn up lightning arresters in the station than cable outside that could not be so easily repaired. Three hundred alternating-current lamps, besides 75 direct-current enclosed, were taken care of by one trimmer with a wagon equipment. In the winter trim once every five days; in fall and spring once every six days; in summer once every seven days. He desired to know of the supply men what impedance is absolutely necessary in a circuit to insure steadiness of light. Mr. McKay replied that when an underground cable had been in use for some time it is rather hard to tell just what may be happening to it. There might have been a weak spot in the cable to cause the unsteadiness complained of; but it is not likely that the unsteadiness was due to the carbon resistance being in circuit.

Mr. Layman said that in relation to amount of self-induction necessary to keep the lamps nicely balanced, Mr. Spencer had recommended 75 per cent., but he thought a lamp circuit could be burned with excellent results with a power factor of 85 per cent.—84 or 85 per cent. Mr. Perkins thought about 81 per cent. Mr. Layman thought this depends on the construction of a particular lamp. Mr. Perkins referred to the matter of arrangement of circuits, and said he had had occasion to rearrange the Youngstown circuits, using the station as the center

of distribution, running the different circuits out radially, like the spokes of a wheel. Circuits should be laid out originally with an average of 40 lamps, leaving leeway for additions. A better power factor should be sought for on lower loads. Mr. Bechtel believed it was necessary to be careful not to lay out too many circuits, so as to avoid increasing the fixed charges for copper investment and for extra transformers. The fixed-charge expense will almost offset the expense of rearrangement complained of by Mr. Perkins. Circuits when laid out should be so laid out that they can easily be changed.

Mr. Doud stated that his company did not now recommend the use of single circuits of 100 lights, but rather to limit to 75 lights.

Mr. Gaskill stated that his company had lately installed for street lighting series alternating-current, 7½-ampere lamps, using two 50-light tub transformers, and although at first some opposition was experienced, he doubted if now the people would go back to the former system. Their plant was of the size usual in towns of 5,000 to 7,000 inhabitants; present installation, 300 kilowatts' capacity. Had formerly been using the open-arc system. Originally it had operated very satisfactorily, but of late years the cost of repairs was excessive and depreciation rapidly increasing. They had contracted with the city some 7½ years ago for a 10-year term at $84.50 a lamp. They had been able, by the present change in system, to offer a lower rate and to secure a renewal of their contract for another 10 years, while reducing their operating expense materially. Their present contract called for $78 a lamp (7.5 amperes), with a guaranteed delivery of 450 watts at the lamp terminals. Under the Ohio law the council cannot make a contract that does not go into full force during their term of office, and therefore could not consider a bid from other parties if offered, but by the present company making the offer at a reduced rate before the expiration of existing contract an arrangement was consummated satisfactory to all parties. The suggestion was offered for others.

Mr. Beckstein of the Sandusky Gas and Electric Company had been using the transformer system for past five or six months. He referred to great saving in operating expense secured thereby. Mr. Bechtel confirmed this observation.

Closing Business.

Columbus was adopted as next place of meeting, the time to be fixed according to the provisions of the constitution. It was considered by some members that the month of October is too late and too far into the busy season, and August was favorably spoken of as a suitable time. The report of the secretary-treasurer was read and approved, and a special vote of thanks returned to Secretary Perkins and Vice-president McKnight for their labors during the year and in preparing programmes for this convention. On motion of Mr. McKnight a vote of thanks was tendered to the various essayists.

The following-named officers were elected for the ensuing year:

President—A. W. Field, Columbus.
Vice-president—S. M. Rust, Piqua.
Secretary-treasurer—J. H. Perkins, Youngstown.
Advisory committee—D. L. Gaskill, Greenville; E. J. Bechtel, Toledo; Samuel Scovil, Cleveland.
Executive committee—E. H. McKnight, Middletown; George Matt, Lancaster; F. E. Valentine, Urbana; W. F. Hubbell, Wauseon; A. C. Blinn, Sandusky.
Finance committee—George Hayler, Jr., Van Wert; W. F. Raber, Mansfield; John Miller, Springfield.

Mrs. A. W. Field and other ladies of Columbus were assiduous in their attentions to the visiting ladies, entertainment for whom was especially provided in the shape of an electric-automobile drive through the city, theater party, and lunch at the Country Club. The only regret was that not more of the members were accompanied by ladies.

Sleeping Cars for Electric-railway Service.

A company in Cleveland, Ohio, has received an order for five sleeping cars to be used in interurban electric-railway service between Detroit, Mich., and Cleveland. This is the first order that has been placed with any car company for sleepers to be used on electric-railway lines. The cars will resemble the Pullman sleeper in general plan, but will not be as long or as heavy, being built to accommodate but 15 sleeping passengers. The berths will be arranged in tiers, two to a tier. The cars will be used on the night service between the two above-mentioned cities, which are 173 miles apart. The time of the run will be about 10 hours, as the proposed schedule provides for a train to leave Detroit at nine o'clock in the evening and reach Cleveland at or near seven o'clock the next morning. The average speed will be about 25 miles an hour, the usual stops being made along the line.

According to press dispatches, a successful test of the electrograph—the Palmer-Mills picture-telegraphing machine—was made on a 1,000-mile circuit in New York a few days ago.

Methods of Increasing Central-station Business and Improving Load Curves.

One of the features of the convention of the Ohio Electric Light Association in Columbus last week was a discussion on the topic "On What Lines Shall We Reach New Business to Improve Our Load Curve and Increase Our Net Earnings?" Some of the contributions to this very practical discussion are here given.

L. G. White, Columbus: Of all the methods of securing new business which have been tried in the past the most successful, in my opinion, is that of personal soliciting of the business on the part of the company. Many of the larger companies maintain an elaborately equipped soliciting department, and by that means secure a great deal of very desirable business which they would not have secured had it not been eagerly sought after by experienced men.

The lighting companies located in the smaller towns cannot, as a rule, afford to keep a man for the sole purpose of soliciting; however, I think it would be possible, and in a great many cases desirable, to select some one man who might devote a portion of his time to this class of work. The solicitor should, of course, be a man of good address, but, of more importance still, he should be thoroughly informed on the cost of both installation and operation of all devices likely to be required by his prospective customers. He should advise the customer as to the most satisfactory manner of installation and the most economical way of operating the devices in question; in fact, he should help the prospective customer in every way possible. A little attention shown in this way is usually appreciated, and is frequently the direct means of securing the business.

An intelligent solicitor cannot fail to have a beneficial effect on the load curve of the station. Of course the most desirable load for the daylight hours is the motor load, and here is where the solicitor can get in his good work upon the small power user, showing him the many advantages of electric power, without forgetting to call his attention to the obvious disadvantages of the power which he is using. The electric elevators are good business and not difficult to secure, because where electric power is sold at reasonable rates it is almost invariably cheaper than hydraulic power.

There are many small shops in manufacturing districts in which there is at present no power used at all, but which could and would use electric motors if all the facts were put before the owners. For instance, not long ago there was not a single blacksmith shop connected to the lines in this city, and then one blacksmith put in a small motor to blow his forge; he found the power very satisfactory and not nearly so expensive as he thought it would be, and then the wires were right in the shop, so he tried a little electric light, just for night work, you know. The bills were still reasonable, so he began using light on dark days, and now is using both light and power, and most of his work is done during the light-load period of the station. A number of blacksmiths have followed the example set by this first man.

Another way in which the load curve can be materially improved is by the substitution of the enclosed-arc lamp in place of the incandescent lighting. The effect of the arc lamp upon the load curve is more than one would suppose, until the matter has been looked into carefully. The reason of this is that probably a customer will have, say, from 10 to 12 incandescent lights hung in a line through his store, and ordinarily will burn but two or three until the time of maximum load, when he will turn them all on. If the arc lamp is hung in place of the incandescents the arc lamp will be turned on when light is first needed and will be continued until he is through with light, which is practically the equivalent of running the whole 10 or 12 lamps throughout the whole period. Thus you see his maximum load is no greater with the arc lamp than with the incandescent, but his average load is considerably greater. In any one case this probably would not amount to very much, but, taken in the aggregate, it has a very beneficial effect upon the load curve of the station.

We have found that the addition of residence lighting to the same mains upon which our business lighting is connected has had the effect of broadening our peak to some extent. This is probably due to the fact that the small peak of residence lighting comes in after the peak of the business lighting, and has the effect of broadening out the peak, which, of course, serves to give a better load factor.

E. J. Bechtel, Toledo: Local conditions have so much influence on this question that it can only be discussed in a general way, or with certain defined conditions. There are a number of items which have direct relation to the subject, as efficiency and reliability of service, proper system of charging, systematic contracting department, intelligent credit system, courteous and satisfactory treatment to all complaints and misunderstandings, maintenance of meters to a proper efficiency, etc.

First of all we must face the proposition squarely and admit that under most conditions gas is a cheaper illuminant than electricity. We must make our service so convenient, so reliable, and satisfy our customers' wants so thoroughly that it will be looked upon as an offset or consideration for the somewhat larger cost. Every care should be taken, both in the power house and on the lines, to give an efficiency and reliability of service which cannot be questioned and which will demand consideration. If we can prove to our customers that they can rely absolutely on our service, many of them will use no other illuminant. If, however, an emergency connection to the gas plant is made, the consumer is apt to use it on different occasions for purposes other than that for which it was installed, such as burning all-night lamps, etc., which takes from the electric company what may be called the cream of the business.

There is, however, an economical line beyond which it is not policy to go, as the fixed charges on the increased investment overbalance any benefits gained. In a station operating two or more different systems much benefit can be derived from an installation of the different classes of generators on the same engine shaft, or using rotary converters or motor-generator sets as a connecting link between the systems. This allows the minimum amount of surplus machinery, especially where the peaks of the different systems do not occur at the same time. Storage battery also has the effect of compensating for the variable load curve, and is advisable under a great many conditions. It not only equalizes the load of the power station, but also gives an insurance of reliability or continuity of service which is very desirable. Careful and diligent study of existing conditions is the only solution of this problem.

The much-discussed rate question also has its influence on both the station load curve and the net income. The system of charging must be one which is most nearly proportional to the cost curve and yet presentable and acceptable to the public. The rate as given out must be as simple as possible, so as not to confuse or mystify the consumer, and yet one which will appeal to his judgment as having an equitable and fair basis. The fixed expense, or that part of the expense which does not increase or decrease with the increase or decrease of the length of the time the current is used, is such a large proportion of the total expense that it confines the electric-lighting business to a class almost its own. The gas companies undoubtedly have similar conditions, but perhaps in such different proportions that it does not so materially affect the direction of the cost line in relation to the output line. This probably is their excuse for maintaining one fixed price to all classes of consumers.

A good representation of the variable results from the different methods of charging may be had by carefully examining the article under the heading "Central-station Rates" in one of the recent electrical journals. The results obtained by plotting the different charge curves on one chart are very interesting. With the exception of one or two, there are none of those explained in detail which are at all similar after leaving the 2½-hour line. One of the rates described gives a saw-tooth effect to the line, rising and dropping alternately, one condition being that a 3½-hour consumer pays about 0.2 of a cent a kilowatt-hour less than a five-hour user, which is the reverse of what should be. It is readily seen that the consumer using his capacity one hour a day cannot be supplied with the current as cheaply per kilowatt-hour as one using his capacity a number of hours a day, and occasioning only the same fixed expense, which, on account of being distributed among the greater number of units used by the long-hour consumer, is less per kilowatt-hour than if distributed among the small number of units used by the short-hour consumer.

In determining charges for a station operating different systems the load curves in the different systems should be considered separately rather than a station load curve as a whole. For instance, if 7 a. m. to 6 p. m. power is to be had in the residence district, rates should be made, after considering that the same lines, machinery, etc., would answer for both purposes. Or, if business can be had which is demanded only when the municipal arc lights are not burning, the same machinery could be used for both and rates made to encourage this new business which might not be possible otherwise.

A system of charging giving the proper encouragement to long-hour burning will not only get new consumers of that class which are impossible on a less variable rate, but teaches the short-hour consumer to use electricity for long-hour decorative and advertising effects, instead of for illumination only, and materially affects the station load curve for the better, giving greater efficiency of operation as well as increasing the gross income, thus doubly increasing the net income.

After the system of charging is decided upon, it remains for the contracting department to apply it, so as to get the best results. This is by no means the least important. In this department should be an accurate record of all consumers' conditions, giving their peculiarities of service, if any, and all information on estimates, visits, correspondence or dealings with them, so that any solicitor will be able to visit a consumer, strange to him, with

the information necessary for him to have the situation well in hand.

The record system just being started in Toledo consists of a system of folders, indexed with alphabetically arranged guides, having one folder for each consumer or prospective consumer. Reports by the solicitors of each visit or other information are dictated to a stenographer, who writes and distributes the reports to the proper folders. This system requires only a small amount of labor in comparison with the good accomplished.

The contracting department should be in the hands of courteous, gentlemanly, enthusiastic and businesslike men, who have the good of both the consumer and the company at heart. They should proceed with vigilant and close attention to the requirements, and be progressive enough to suggest new ideas for the use of current to suit conditions which benefit both company and consumer. They should gain the confidence of the consumer and prove to him that his interests are being cared for as well as the company's. Details, however small, should receive the attention they merit. Little details of loose management are as conspicuous as large one, inasmuch as they occur oftener and are just as annoying to those concerned. Close attention to details and intelligent contracting will give greater dollars and cents' efficiency to a plant than the installation of expensive and highly efficient apparatus in the power station. This department should also keep in close touch with architect clubs and individual architects. Information should also be available from which to recommend proper installation of motors, elevators, special apparatus, etc., should the consumer require it.

Advertising should also be followed intelligently. Blotters and novelties distributed, as well as attractive announcements made in a businesslike way, help to keep the public attention.

Solicitors and contracting agents should be capable of recommending the proper use of reflectors, distribution of lamps, etc. In some cases where this is done it is possible to get a consumer who otherwise would of necessity use a cheaper illuminant. All complaints from consumers should be given courteous and gentlemanly attention.

The credit department must also be handled with discretion and care. In Toledo these duties are under the care of the accounting department, but are in harmony with the contracting agents and solicitors; otherwise it would be very easy for an imprudent collector to lose a good consumer to the company, on whom the contracting department has spent hours of work. It is not desirable, however, to have the contracting department in any way connected with the collections.

Maintenance of the meter department also demands its share of attention, to get the best returns from the current output. Meters always kept in proper condition will save a great deal of annoyance from complaints as well as increasing the income.

Probably no one department or condition is more important than another in relation to the increasing of the net income, but it is the combination of all departments, well managed, that insures successful increase of net earnings and improvement in the load curve.

George Hayler, Jr., Van Wert, Ohio: The problem under discussion may be treated from several standpoints, but I shall simply aim to make a few suggestions along a line that seems to me to offer a solution in the case of many small lighting properties. I am speaking more especially from the standpoint of stations operating from dusk to daylight and supplying light only—a condition which prevails in a large number of the smaller towns.

It is a notorious fact that the returns from the operation of lighting machinery are small in comparison with the possible output; and the average lighting plant is operated at a maximum efficiency for an extremely small proportion of the time.

The average lighting plant, under the conditions of which I have just spoken, will be in operation about 5,000 out of a total of 8,760 hours a year, or an average of about 417 hours a month. During this period the street-lighting machinery will be in service (on a moonlight schedule) for an average of 188 hours a month; and I think that I am safe in saying that 75 per cent. of the earnings from other lighting will accrue within a period not exceeding 160 hours a month, on an average. In other words, the machinery of a lighting plant is practically idle, so far as earnings are concerned, for about 70 per cent. of the time, and even when in service it is probably earning but little, and perhaps operating at a loss during 30 to 50 per cent. of that period.

These conditions make it extremely difficult to show good earnings unless the prices received from lighting are remarkably good; and in these days of severe gas competition this is a hard problem to face.

If now we could so arrange as to operate our property, either in whole or in part, for longer hours and dispose of the output, we should be nearer a solution. But, so far as lighting strictly is concerned, there is just about so much business to be done, and no inducement will persuade people to use light when they do not need it. Further, it is practically impossible in a small town to develop a power load at prices that would make it profitable to operate a plant.

The only way out of the difficulty seems to be some means of operating the lighting plant in connection with some other business of such a nature that the electrical energy developed will be, in a measure, a by-product, and may be sold at a figure which will be attractive to customers who would, under ordinary circumstances, be entirely out of the question. A heating plant forms such an addition, and I shall endeavor to show you how it has worked out in our case.

If we examine into the operating expenses of a lighting concern, we shall find the costs divided pretty much into the following percentages: Fuel, 22 per cent.; labor, 27; water, three; oil and waste, three; carbons and lamps, four; miscellaneous expenses (insurance, repairs, maintenance, etc.), 11; fixed charges, 30.

The large items are fuel, labor and fixed charges; and I think that it will be readily admitted that all or part of the machinery of the plant could be kept in continuous operation at a slight additional expense, other than for fuel, and this item would not be increased in proportion to the added output.

The average lighting property, operating under the conditions mentioned, is supplying electrical energy for only about 57 per cent. of the time; but we must not infer that our expenses will be proportionately increased if we should decide to operate for the balance of the 24 hours. The labor item will be increased perhaps 15 per cent.; fuel will be more, but a comparatively small amount, while the fixed charges will be increased by an amount covering interest on the investment in the heating plant. Other items may be increased a little, but may be neglected, being counterbalanced by savings made through the operation of the heating plant.

Roughly, from what experience we have had in the past few months, on a heating load requiring about 100 horsepower, in freezing weather, the cost of fuel will be increased about 50 per cent.; labor 15 per cent., and fixed charges 30 per cent., a total increase of operating expense equal to about 24 1-3 per cent. of the whole.

We will assume, for the time, that if we can obtain, on an average, about $80 a year per engine horsepower developed, we can show good net earnings. This is an arbitrary quantity, and will vary according to conditions, and must not be taken as authoritative. Now if we can so arrange our business that we may dispose of an increased output at somewhere near this figure, we shall add very materially to our net income.

When we use steam in an engine, under the conditions prevailing pretty generally in this section of the country, we obtain from 10 to 15 per cent. of our heat energy in the form of power, the balance of 85 to 90 per cent. being wasted in the exhaust, with the exception of perhaps about 15 per cent., which may be absorbed in heating feed water. Now, if we can dispose of this waste, it is evident that we can supply the balance, represented by the amount of electric energy produced, at a figure equivalent to the difference between what we receive for the waste and the amount that we find it profitable to sell our electric output for under ordinary conditions.

We find that hot-water radiation will give off about 246 British thermal units per hour with water at 200 degrees F., which will be the temperature required in severe weather, or about 155 British thermal units with water at 160 degrees, which represents ordinary working conditions, and, allowing for losses, etc., one engine horsepower of exhaust steam will supply, approximately, 120 feet of radiation in extreme weather, or about 192 feet under ordinary working conditions. Now, at the figure received for heating in this section, the income from one engine horsepower will be $18 a year under extreme conditions and about $28.90 under ordinary working conditions.

We have seen that the cost of operating our steam plant will be increased about 25 per cent. In other words, we may obtain a load of 100 horsepower, bringing an income of $28.80 per year, at an output of about 25 per cent. of our total operating expense, and have the electric energy produced at the same time to sell at a figure equivalent to the difference between what we receive for the heat and what we ordinarily get. For example: If we have a heating load of 20,000 square feet of radiation, requiring, approximately, 100 horsepower under ordinary conditions, and bringing in an income of $3,000 a year, then, assuming that we are to receive the same rate for horsepower developed ($80 on the average), we can dispose of our electrical output at the rate of about $50 per horsepower per year, and at the same time increase our net earnings 100 per cent. on each 100 horsepower of our steam equipment.

Understand, I have assumed ordinary working conditions. It is true that in severe weather 100 horsepower of exhaust will not supply 20,000 feet of radiation, and we shall have to use live steam at a consequent increase of operating expenses; but the number of days that this condition will prevail is comparatively small.

It is evident, however, that at the figure quoted the income from heating alone is but a little more than the additional expense incurred in operating the plant during the entire year. If we simply furnish live steam in cold weather and do not operate our lighting plant, we shall still be making a profit, for the reason that during the winter months there is a supply of exhaust steam available for about two-thirds of the time. It is evident, however, that the solution of the problem is to operate the entire plant and increase the output of electric energy during the day, so that we may be deriving income from the two sources. What I mean is this: If we can sell our heat for $30 per horsepower per year, and utilize 85 per cent. of our heat energy, and make a profit, then we can certainly increase that profit very considerably by selling the balance of 15 per cent. of our heat energy in the form of electricity at the rate of, say, $50 per horsepower developed per year, or even less.

It may be argued that it will be difficult to dispose of the electric energy developed in a small town, but there is always some demand, and, with the proper inducement in the way of prices, which we are enabled to make under the circumstances, there is no reason why such a load should not be developed.

Assuming that we can deliver 60 per cent. of our engine output in the form of electrical energy to the customer, and make a profit at $80 per engine horsepower developed per year, then we can sell electric energy for about $30 per horsepower per year—an amount favorably comparable with the cost of steam power in a small plant.

Chicago Electrical Association.

At the meeting of the Chicago Electrical Association on Friday evening, October 17th, Harris C. Trow, instructor in electrical engineering at the American School at Armour Institute of Technology, read an interesting paper on "The Place of Correspondence Schools in Electrical Education." After summarizing the classes of men most benefited by a correspondence course, Mr. Trow described the methods of instruction pursued at the American School and briefly outlined the course in electrical engineering.

The discussion that followed the reading of Mr. Trow's paper was participated in by Messrs. Wiler, Grier, Scheible, Hale, Dimick, Blumenthal and others among the members, while Mr. Dewey of the American School and Mr. Lavers of the International Schools made brief remarks.

A resolution was then adopted to the effect that the Chicago Electrical Association desires to encourage the spread of correspondence instruction along electrical lines, and the tendency toward a higher plane in such instruction, and also to recommend the taking of correspondence courses by those not in a position to take similar residence instruction.

The following programme for future meetings has been arranged:

November 7th—"The Development of a Small Alternating-current Motor," by H. I. Finch, superintendent Emerson Electric Manufacturing Company of St. Louis.

November 21st—"The Electrical Features of the Aurora, Elgin and Chicago Railway," by Howard Brooks, assistant electrical engineer of the company operating the road.

December 5th—"The Early Development of European Incandescent Lamps," by Captain A. D. de Khotinsky, late managing director of incandescent-lamp factories at Paris (France), Rotterdam (Holland), Gelnhausen (Germany), and Marlboro (Mass).

January 16, 1903—"The Third-rail System of Electric Railways," by H. M. Brinkerhoff, general manager, Metropolitan West Side Elevated Railway Company.

Marine Electric Signaling System.

A novel system of marine electric signaling has been devised by Leo Daft, the well-known electric-railway inventor, and Alfred Williams of Wimbledon, England. The invention consists of four combinations: The first of these comprises an earthed plate, a distant wide-spread conductor sunk in the sea, a source of electricity and an induction coil. The second combination consists of a vibrating contact-breaker and a receptacle partially filled with mercury, adjustably fitted to the same. These two combinations together are adapted to generate and transmit electric impulses to considerable distances through the earth and water. In the third combination are two plates carried by a ship exposed to the contact of the sea water in positions as remote as possible from each other, the two plates being in electrical connection and having the fourth combination interposed in series between them. The fourth combination is a device for detecting minute electric impulses and consists of a pivoted coil suspended in a magnetic field and rigidly connected to a soft-iron arm controlled by an adjustable permanent magnet which is so wound in series with the pivoted coil that the passage of an electric impulse momentarily weakens its controlling influence. The invention is covered by a United States patent issued on October 14th.

DEVELOPMENT OF THE TELEPHONE FIELD.

Indiana Mutual Telephone Association.

The annual convention of the Indiana Mutual Telephone Association was held in the German House, Indianapolis, October 14th. The morning session was given up entirely to the routine business of the association, and when the afternoon session was called to order by President L. A. Frazee of Connersville, representatives from about 70 exchanges and a number of supply men were present.

In his annual address President Frazee said it was a matter for congratulation to see so many members and visitors present. Among other things, he said: "In Independent telephony we Hoosiers have much cause for state pride. The ups and downs and difficulties incidental to entering into a new business are, with us, the experience of the almost forgotten past. Struggles and uncertainties which we now hear of in other states, we experienced, it seems, years ago. Five years ago a fragment of our present membership met here and put forth its best efforts to induce some reliable company to install a plant in Indianapolis, thereby knitting our plants together with toll lines, giving us an entrance into our state capital, thus patching up the weak spots in our poorly developed field, and developing the unclaimed territory. The influence, impetus, strength, stability and reliability which the New Telephone Company of Indianapolis has given Independent telephony throughout Central Indiana and far beyond the borders of the state are incalculable. In Illinois the Bell company has her Chicago, in Michigan her Detroit, in Ohio her Cincinnati; but in the Hoosier State the Central Union is getting what Sherman called 'war all over the state.' Formerly the map maker included a few spots here and there as developed territory in Indiana, but the lines have multiplied so rapidly that it now requires far less labor to indicate the undeveloped territory.

"As a rule we have all had plenty to do at home to supply service to the large number of people who are clamoring for it. It is far more advisable for companies to develop their own fields rather than encroach upon others; and those who desire to enter the business should find new fields or buy good stock in some of the many prosperous companies that have long lists of people waiting for telephone service. A few of us take on a troubled look because some well-meaning farmers on the outer edge of the county are installing exchanges on their own account and running right toward our city exchanges. We should not be troubled on that account. If they can furnish that service better and cheaper than we can, all things considered, they are the ones to do it. Taking all things in consideration, if our service is better than theirs, and it should certainly be made so, their's will eventually give way to the improved or better service. We should not care how near our city exchanges, the farmers build their lines, but let it be forcibly understood that we cannot build and maintain our city exchanges in a cheap way, and that we will give connection with our exchanges only on terms that are fair and just to us."

The subject of needed legislation was discussed by Hugh Dougherty of Bluffton, J. W. Weik of Greencastle, and R. C. Stephenson of Rochester. Each shared the opinion that laws were needed defining the rights of the telephone companies and the rights of the people. It was contended that a telephone line established along a public highway was in no sense an additional servitude; that as a means of communication such use of the highway was among the developments of the age, contemplated in the matter of public highways. However, it was deemed advisable to ask the incoming Legislature to enact laws providing for franchise rights to be granted by county commissioners and providing for condemnation proceedings for telephone purposes. This discussion resulted in the appointment of a committee to draft necessary bills and attend the legislative sessions with a view of securing their passage and otherwise furthering the interests of Independent telephony.

The following resolutions were adopted:

Whereas, A number of Independent telephone companies in the state of Indiana have granted to certain other Independent companies connections with their exchanges without first entering into an explicit written contract governing such connection; and,

Whereas, In many cases such arrangements have led to much confusion and the violation of written contracts heretofore entered into by Independent telephone companies, and have occasioned litigation and encouraged attacks upon the doctrine of the right of Independent telephone companies to control their business by contract; therefore, be it

Resolved, That the Independent Telephone Association of Indiana condemns the practice of granting such connection other than by explicit written contract in which each company shall have the right to refuse business which shall tend to violate its existing contracts, and be it further

Resolved, That the association recommends that each Independent telephone company in this state shall refuse connection with such companies as have been organized and are operated in cities, towns and communities already supplied with Independent telephone service, and which, after such organization, attack the doctrine of the right to control the telephone business by contract.

Hugh Dougherty, speaking for the national association, made a report in regard to the litigation that has been successfully defended by that organization during the last few years. He said that it was of vital importance that the fight be continued until the victory is complete. He said such litigation required skilled and learned attorneys, and was in every way expensive, but that the outcome meant everything to the Independent telephone people. Up to the present time, he said, $37,000 had been expended and there was a deficit in the litigation fund of $12,000, of which $2,000 had been apportioned to Indiana.

In moving that a committee be appointed to raise this money, R. C. Stephenson said that "but for the interest and labor performed by such men as Mr. Dougherty and his colleagues the Independent telephone companies would not now be doing business in Indiana."

Officers for the ensuing year were chosen as follows: President, R. C. Stephenson, Rochester; vice-president, J. W. Weik, Greencastle; secretary-treasurer, Harry B. Gates, Indianapolis.

In point of attendance and character the convention was satisfactory. However, no report would be complete which did not credit the officers and managers of the New Telephone Company of Indianapolis, and the New Long-distance Telephone Company of Indiana, with a large share in making the convention a success. These companies were very hospitable to the visiting telephone men, entertaining them at a complimentary dinner in the evening.

Southeastern Iowa Telephone Association.

The Southeastern Iowa Independent Telephone Association held its annual meeting in the Hotel Lacy, Oskaloosa, Iowa, on October 14th and 15th. President C. B. Dobie of Sigourney was in the chair and Secretary and Treasurer C. M. McFatridge of Moravia performed the duties of his office. Others in attendance were W. D. Dinsmore and F. W. Kelley of Oskaloosa, G. W. Smith of Brighton, J. S. Bellamy of Knoxville, Dr. H. S. Herr and H. E. Pancost of Ottumwa, W. H. Fowler of Pella, C. B. Dobitz, O. C. Cochrane, C. D. Randell, W. E. Bryan, S. S. Lichty, G. M. Heiseman, J. S. Moon, Thomas Dupy, O. H. Seifert and N. B. Halloway.

President Dobie delivered his annual address and a committee consisting of Messrs. Heiseman, Fowler, Dinsmore and Bellamy was appointed to consider the subject of standardizing toll-line equipment and service. Later this committee recommended the election by the association of a committee of five whose duty it shall be to receive complaints about all matters relating to the Independent toll-line service in Southeastern Iowa, investigating and suggesting changes or improvements in apparatus or lines which will insure an efficient service. The report goes on: "Should the party neglect, after being advised, the evils necessary to correct or the improvements to be made, the committee shall have power to impose such penalty as they see fit, even the refusing of connections with the lines of the members of this association." This report was adopted.

Members then discussed the central-energy system versus the magneto system, and it was decided that central energy was preferable for all exchanges of 200 telephones or more.

On Wednesday, October 15th, these officers were elected: President, Dr. H. S. Herr, Ottumwa; vice-president, W. H. Fowler, Pella; secretary and treasurer, F. W. Kelley, Oskaloosa; executive committee, H. C. Raney of Fairfield, G. M. Heiseman of Albia and C. M. McFatridge of Moravia. The important "toll grievance and managing board" provided for by the committee's report was made up of W. D. Dinsmore, Thomas Dupy, J. S. Bellamy, H. E. Pancost and C. B. Dobie.

The executive committee was given power to call special meetings as well as name time and place for the annual meetings.

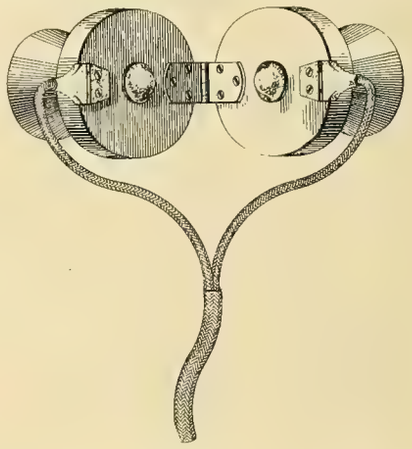
Papers were read as follows: "Flat Rates," C. M. McFatridge; "Time Limit on Toll Lines," C. B. Dobie. Messrs. Dinsmore and Pancost were appointed a committee to prepare a time-limit schedule for toll-line service. This committee reported, and the report was adopted, that the time limit for minimum-charge toll-line conversation be five minutes on and after January 1, 1903. For each minute in excess of the five-minute limitation one-fifth of the initial toll rate will be charged.

On Wednesday afternoon Dr. Herr read a paper on "Toll Lines." H. E. Pancost followed with a short talk on the same subject. He thought that nothing should be considered a toll line that allowed free use to subscribers or farmers or that allowed flat-rate privileges. After some further routine business adjournment was taken without date.

Manufacturers and dealers were represented at the convention as follows: Kellogg Switchboard and Supply Company, W. R. Hind; John A. Roebling's Sons Company, R. B. Abbott; Stromberg-Carlson Telephone Manufacturing Company, W. H. Bowen; Western Electrical Supply Company, J. W. Hardy.

Hutchinson Telephone Transmitter for the Deaf.

Miller R. Hutchinson, who is well known for his extensive work in aiding the deaf to hear by means of telephonic devices, has devised, as an addition to his already numerous inventions in that line, the telephone-transmitter arrangement shown in the accompanying illustration. The apparatus consists of a number (in this case two) of portable telephonic transmitters hinged together and adapted to be electrically connected to a single telephone circuit. It is so arranged that a person with impaired hearing can adjust the instruments at will to collect sounds approaching from various directions. Mr. Hutchinson's invention is covered by a patent, No. 710,979, issued last week and assigned to the Akouphone Manufacturing Company.



HUTCHINSON TELEPHONE TRANSMITTER FOR THE DEAF.

Bell Extensions in New York and Pennsylvania.

The New York and Pennsylvania Telephone and Telegraph Company (Bell) purposes to make a number of improvements in Southwestern New York and Northwestern Pennsylvania.

During the last year and a half the company officials state that the business of that section has increased with such rapidity that the long-distance lines of the company have become taxed to the full extent of their capacity. Likewise the local business, not only of Jamestown, N. Y., but of the other cities of the district, as well as the village service, has increased far beyond the anticipation of the managers.

A number of important moves were decided on at a recent conference in Jamestown. Buffalo, which is now connected with Jamestown by one circuit, will soon have three additional ones. The service to Warren, Pa., is to be increased, and Mayville, N. Y., is to have a complete and modern exchange, to be finished in two or three weeks. Jamestown is to have additional underground and overhead cables. Dunkirk, N. Y., also comes in for her share. A new and improved switchboard will be installed there and the exchange enlarged.

TELEPHONE MEN.

St. Andrew's University of Scotland recently conferred the degree of doctor of laws on Professor Alexander Graham Bell of Washington, D. C.

Frank L. Schuyler, who has been manager of the Iowa Telephone Company at Oskaloosa, Iowa, has been made manager of the company's office at Ottumwa, Iowa. Cloyd R. Potter of Oskaloosa succeeds him in charge of the Oskaloosa office.

Arthur I. Phippen, an inspector employed by the New England Telephone and Telegraph Company, died at his home in Charlestown, Mass., October 13th. He was 40 years old and a member of the Telephone Employes' Association, the Knights of Malta, and the Knights of Pythias.

Friends of Milo G. Kellogg, president of the Kellogg Switchboard and Supply Company of Chicago, are greatly pleased to see him back in Chicago after an extensive sojourn in California and Colorado for rest and recreation. Mr. Kellogg's health is much improved, and he is again giving his attention to the problems of the great business he has established.

A new telephone company has been chartered at Gastonia, N. C., by N. B. Kendrick and other stockholders. The capital stock will be $11,000.

Ohio Telephone Notes.

It is stated that the negotiations for the sale of the stock of the United States Telephone Company to the Barber syndicate have been declared off. The matter was not closed up at once, and it is now believed that the Everett-Moore syndicate concluded that the telephone business is still in a good way to make a success. With the lines already built and in operation, the United States company is in a position to connect a very large number of the Independent plants of Ohio with surrounding states. The financial affairs of the syndicate are so nearly cleared up that it will be able to retain the property of this company, it is believed, without trouble. In the event that it is kept by the syndicate, there will no doubt be a revival of interest in the Independent movement within the next few months.

In all the important points but one Judge Dempsey of Cincinnati decided against the John C. Rogers demurrer to the answer of the Cincinnati Telephone Company to his suit brought against it. Judge Dempsey sustained Rogers' claim that franchises are not perpetual, and are subject to the will of the Legislature and can be revoked by it. Rogers brought suit to restrain the telephone company from using the public streets and alleys in Cincinnati. The case will be tried upon its merits.

Murray E. Weymer of Rosewood, Champaign County, has purchased the lines of the United Telephone Company of Bellefontaine, which lie within the boundaries of Champaign County. There are about 13 miles of the lines, and it is said that this is probably the beginning of a combination of the lines in the county into one control. Mr. Weymer owns several other small lines in the county.

The Home Telephone Company of Toledo has issued its first directory, containing the names of the 5,000 subscribers who now have telephones in use.

The Columbia Telephone Manufacturing Company of Ottawa has been placed in the hands of a receiver and its property has been taken in charge by the United States court on claims of creditors. An application for bankruptcy has also been filed in the District Court by some of the creditors. Mathes & Rice, a local firm, have secured judgment against the company for $3,020, and the property had been levied upon by the sheriff. It is also said that the company had assigned more than $10,000 in valuable contracts to this firm to secure debts. The Security Trust Company has been appointed receiver. The concern moved from Chicago to Ottawa several months ago, and local men there became interested in it.

D. Bradfute and Oscar Bradfute have purchased the controlling interest in the stock of the Cedarville Telephone Company of Cedarville, which has been held since the organization by the Rankin brothers of South Charleston. They now own all but $900 of the stock, of which there is $15,000. This will be increased in order to build more lines and make improvements in the plant.

The Wood County Telephone Company has absorbed the Independent company at Bowling Green. J. B. Hoge of Cleveland is chairman of the board of directors and W. L. Carey, Jr., of Cleveland is secretary and treasurer of the company.

The Portsmouth Telephone Company, which is now in charge of Judge James M. Thomas, has ordered a $7,000 switchboard, and in all will expend about $20,000 in improvements on the plant. O. M. C.

Telephone News from the Northwest.

The Commercial Club is after the Northwestern Telephone Exchange Company of Minneapolis again, feeling that the company did not make the improvements as promised a year ago. A first-class system was what was promised then, but all that was done was to put in new instruments and make a few improvements.

The Cannon Valley Telephone Company of Waterville, Minn., elected Mr. Worland of Waterville as president, Dr. R. O. Craig of Janesville, vice-president, Mr. Kanne of Waterville secretary and treasurer, and C. A. Backman, manager.

The Minnesota Mutual Telephone Company has adjusted matters at Isanti, Minn., by acquiescing in the $1 rate for local instruments, as requested, by subscribers.

The Twin City Telephone Company (Independent) has asked a new trial in Minneapolis in the case brought by the Northwestern Telephone Exchange Company against it. The Northwestern sued to have the Twin City wires removed where they passed under its wires, asserting that it was entitled to the space on its poles for a space to within 20 feet of the ground, and that the Twin City's wires prevented the use of this space. They won in the District Court, and now the Twin City seeks a new trial.

The Twin City Telephone Company of Minneapolis and St. Paul has declared a quarterly dividend at the rate of seven per cent., payable November 1st to stockholders of record by October 25th.

An automatic telephone exchange is being installed for the University of North Dakota at Grand Forks.

The war between telephone companies at Park Rapids, Minn., is ended, the new local company—the Citizens'—selling to the Central Minnesota Telephone Company, which pays all expenses incurred and takes all material. The Central Minnesota also falls heir to the 30-year franchise lately secured by the Citizens'.

The Wisconsin Telephone Company has awarded contracts for the erection of its new exchange building at Oshkosh, Wis.

The Rural Mutual Telephone Company has been incorporated at Ottosen, Iowa, with $25,000 capital stock.

The Clark Automatic Telephone Company of Providence, R. I., has established headquarters at Sioux City, Iowa, and will begin upon a campaign of expansion, working first through Iowa and Nebraska. The Iowa Clark Automatic Telephone Company has filed articles, as has also the Nebraska Clark Automatic Telephone Company in their respective states. An effort will be made to place automatic exchanges in the smaller towns all over the country.

The Crawford County Telephone Company has begun the construction of a local exchange at Denison, Iowa. There will be about 350 connections at the start.

The Mutual Telephone Company of Des Moines contemplates installing a modern switchboard of 6,000 connections, if the city will yield the matter of the five per cent. tax upon its gross income. The company owes the city about $1,500, after deducting the claim against the city for telephone service. The council is opposed to the remission, but may be willing to remit the tax due up to January 1, 1902. R.

Southern Telephone Developments.

The Hampton Telephone Company of Hampton, Va., has changed hands, with the exception of 15 shares, and it is rumored that the Bell company is the real purchaser. The new company has elected W. T. Gentry of Atlanta president, and Hunt Chipley of Richmond, secretary and treasurer.

The Jefferson City Telephone Company, of Jefferson City, Mo., has been bought by Lester A. Parker, H. McHenry and A. M. Hough. The exchange was formerly owned by the Capitol Telephone Company.

The Bell company has purchased the plant and exchange of the Lincoln Telephone Company of Lincolnton, N. C. A number of private lines were cut out, and Dr. Hunter of Stanley Creek, N. C., one of those owning these private lines, has applied for and been granted the right to put in an exchange in Lincolnton.

The plant of the Sebree Independent Telephone Company of Sebree, Ky., has been damaged by fire to the extent of $12,000. There was no insurance.

The recent consolidation of telephone interests in Petersburg, Va., places the Bell company in entire control in that city. It is said that rates will be increased. L.

Indiana Telephone Items.

The Seymour Home Telephone Company was incorporated on October 15th with a capital stock of $15,000. The company proposes to establish a telephone system within the city of Seymour and throughout Jackson County, and ultimately to extend the system to adjacent counties. The incorporators are Ed. L. Barber, John C. Monteith, Claude Hymen, J. H. Peter and S. A. Barnes.

The Wilkinson, Simmons & Woods Telephone Company of Wilkinson, Hancock County, has filed articles of incorporation and will build and operate a system in Wilkinson.

The Cumberland Telephone Company of Evansville is advertising for bids for the erection of a telephone building at Evansville. This action of the telephone company is a puzzle to the city officials, as the company is under orders of the Common Council to remove its poles, wires, etc., from the streets and alleys of the city by the middle of November. F.

Central Intercommunicating Telephones.

A new line of battery-call telephones for intercommunicating and hotel use is offered the trade by the Central Telephone and Electric Company of St. Louis, Mo. The desirability of telephones for interior use is now generally recognized, and these instruments are put out by the manufacturer with the assurance that they will meet the requirements for reliable, durable and highly efficient apparatus. They are guaranteed to be perfect in mechanical and electrical construction, to develop no cross-talk, if properly installed, and to require less battery than any other system. The plugs can be left in any jack without disturbing the stations by so doing.

Fig. 1. Exterior View of No. 5 Instrument.

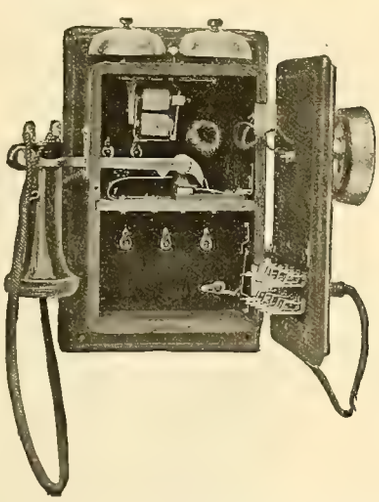


Fig. 2. Interior View of No. 5 Instrument.

Fig. 3. No. 6 Wall Telephone.

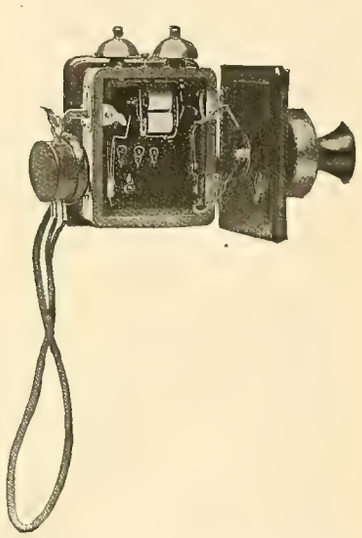


Fig. 4. Interior View of No. 8 Instrument.

CENTRAL INTERCOMMUNICATING TELEPHONES.

In Figs. 1 and 2 of the accompanying illustrations are shown closed and interior views of the company's No. 5 wall telephone. Fig. 3 shows the No. 6 wall instrument, which has the same working parts as the No. 5 telephone. The woodwork of the No. 6 is dark antique oak, and an adjustable-arm transmitter is used, with a black-enamel iron plug box. This combination makes a handsome instrument for either large residences or business houses.

The following are set forth as a few of the most desirable points of the No. 5 and 6 telephones: Long-distance, solid-back transmitters, with heavy metal case, imported granular carbon and gold electrodes; solid receivers, impossible to throw out of adjustment, and practically unbreakable; all gravity hooks made with german-silver lever springs, no spiral springs being used; bells of five ohms resistance, platinum-contact jack springs, german silver, and of perfect design; plug and cord made of best material and durable construction; push-buttons of strap-key design, springs heavy german silver; no induction coils used, but all telephones furnished with non-inductive resistance coils, practically eliminating all cross-talk; no local batteries, both ringing and talking power furnished from one set of batteries.

The company also makes a desk telephone with nickel-plated stand and furnished with plug box and

push-button for the interior systems. For use with two stations only or for hotel use in connection with an annunciator the instrument shown (with door opened) in Fig. 4 is made. Special attention is called to the receiver hook used in this telephone, as it is said to be the only short hook made without spiral springs. All springs are of german silver, with platinum contacts. The Central Telephone Company is meeting with considerable success in this line of telephones and is offering them to dealers generally.

Co-operative Farmers' Telephone System in Indiana.

The Independent Telephone Company of Decatur County, Ind., is the outgrowth of the need of the farmers of that county for a practical telephone system. The company was organized two years ago, and within 10 months 1,352 miles of wire was in use. Beginning with 200 subscribers, there are now over 900 telephones in use. There are at present 681 stockholders, representing $22,100 paid-up capital stock. The amount of each share is $25, but no person is allowed to buy more than four shares from the company. At an election for directors each stockholder is allowed one vote for each share he holds, and in case anyone has purchased shares from other stockholders and holds more than four, he is entitled to only four votes. This last regulation is to prevent a monopoly of power. If a person wishes to obtain a monopoly it will be necessary for him to buy all but three shares.

Of the 900 telephones in use more than 53 per cent. are in farm residences and villages. The remainder are in the city of Greensburg. The company has long-distance connections with Indianapolis and surrounding towns.

For local service the company charges stockholders 80 cents a month for residences and $1.50 a month for business houses. The rates for non-stockholders are $1.25 and $2.00 a month for the same service. The company employes 10 operators, one manager, one bookkeeper and three men to keep the lines in repair. The system is of the Stromberg-Carlson central-energy type. On the country lines three or four telephones are put on one line, but in the city the lines are individual. All the wires are carried into the exchange building in five large cables. The company owns its own power plant, consisting of a gas engine, dynamo and storage battery. The company is constantly extending its lines and expects soon to have a patronage of 1,500. The company has been a success, both financially and otherwise, and is confident of being able to pay dividends to stockholders in a short time.

Anglo-Belgian Telephone Service.

Consul G. W. Roosevelt, writing from Brussels under date of September 11th, gives the following concerning the telephone system, now nearly completed between England and Belgium: "The Anglo-Belgian telephone service will be inaugurated in about two months. The submarine cable stations are located at St. Margaret's Bay, near Dover, and at La Panne, a Belgian seaside resort. The work of laying the cable is completed, and the company is now placing the aerial extensions in both England and Belgium. The cable is 90 kilometers (55.422 miles) in length and has two circuits. The total cost when completed will be about 2,000,000 francs ($386,000), to be shared equally by England and Belgium. Belgium will communicate with England from the cities of Brussels and Antwerp only. If communications are numerous and the new line is profitable to the government, the service will be extended to other cities. The rate of communication has been fixed at 10 francs ($1.93) per three minutes."

A San Francisco Application.

The California Automatic Telephone Company, through William F. Smith, San Francisco, secretary and manager, has applied for a franchise for an Independent telephone, telegraph and burglar-alarm system in the city of San Francisco. The company plans to place all its wires inside of the district bounded by Central Avenue, Twenty-sixth Street and Townsend Street. The system employed is to be a central-energy one, with no batteries employed in the telephones. In its petition for a franchise the company offers to give official service free and to put up a bond of $100,000 guaranteeing the service to be completed within one year.

A new telephone company, the Northeastern Telephone and Telegraph Company, has been incorporated with the following-named officers: President, W. W. Jones, Toledo; vice-president, J. F. Land, Detroit, and secretary and treasurer, George E. Button, Saginaw. Lines are in operation from Bay City to East Tawas and in progress of construction from East Tawas to Alpena and Onaway, and from Saginaw to Cheboygan up the Mackinaw division of the Michigan Central Railroad. Twenty offices are in service. The equipment and wire will be first class, representing an investment of $200,000. The company has a service contract with the Michigan Telephone Company for interchange of business.

Stromberg-Carlson Farewell Party.

On Saturday evening, October 11th, an enjoyable luncheon and dancing party was given at the Stromberg-Carlson Telephone Manufacturing Company's factory in Chicago. The entertainment was arranged by the employes of the insulation and winding department, and tendered to the employes of other departments throughout the building. It was in the nature of a farewell party, due to the fact that during the week of October 13th many of the employes of the insulation and winding department of the Chicago factory went to Rochester, N. Y., where in future the insulated-wire and cable product will be manufactured.

About a year ago a restaurant service was provided for the young women employed by the company, and since that time luncheon has been served daily in this department. It has been in part self-sustaining, and it was the surplus in the treasury which the young women proposed to use toward defraying the expenses of the entertainment. Mr. Alfred Stromberg was heartily interested in the programme from the beginning, and generously defrayed the greater part of the expense in order to make the affair more enjoyable. As a result, the occasion was one which will be long remembered most pleasantly by all.

The seventh floor, east side, was cleared in the afternoon, and within a few hours complete preparations were made to accommodate the company. Additional electric lights were placed, tables prepared, and seats arranged for 100 couples. Much credit is due the ladies who had the service in charge. Music was furnished by Bredfield's Orchestra, consisting of seven pieces. Vocal solos were rendered by Mr. Hedman and Miss Frobenius. Short speeches were made by Messrs. Stromberg, Stiger, Nate, Mahon, Runzel, Hedman and others. Mr. Stromberg expressed the sincerity of his interest and his gratified pride at the faithfulness of his employes, and the manner in which the business has been carried to its present successful issue.

Dancing was indulged in until midnight. Over 400 persons were present, and the following is a partial list of the names:

Officers and representatives—A. Stromberg, C. W. Stiger, A. J. Rousseau, J. J. Nate, T. R. Finucane, A. J. Mahon, W. H. Durrant, C. E. Knickerbocker, F. L. Middleton, Carl Schafer, A. A. Anderson, Joe Carlson, W. H. Gray, W. L. Roberts, C. M. Hedman, J. Peterson, Wm. Schuber, Wm. Runzel, E. W. Anderson, A. O. Stigberg, T. C. Troy, Frank Lind, J. N. Woods, W. Ratke, S. E. Wallace, J. S. Troy, C. B. Arbeen, J. P. Lillig, N. Engstrom, A. Peterson, John Meinema, Jas. Krabec, J. Kaiser, A. Hendrickson, A. B. Blidd.

Employes—Messrs. Backstrom, John Johnson, Ryan, Kuepper, Thorsell, Schneberg, J. W. Johnson, Griffith, Lillig, Briggs, Knudsen, Reinke, Marriner, Bowles, Engstrom, Carruthers, Larson, Garney, C. Anderson, Dolan, A. Johnson, L. St. Pierre, L. B. St. Pierre, Willet, Donnelly, Green, Cram, Parker, Shroder, Newberg, Kviteck, Shotts, Rudland, Rickter, Smith, Peter Johnson, Miles, Ben Anderson, Larson, Robt. Larson, Cederleaf, Lindell, Erickson, Walin, Jas. Bowles, Reinhard Johnson, Wirlin, Victor Carlson, Telefson, Chas. Carlson, Abbe, Ed Johnson, Samlow, C. F. Johnson, Gleudenning, Leopold, Denny, Lundine, N. Anderson, Olson, Theo. Anderson, Gustafson, Bain, Alec. Bain, Borowinski, Wolf, J. Carlson, A. Anderson, Paul Hirsh, Richter, Stull, J. Carlson, M. J. Thomas and M. Devito.

Ladies—Mrs. Senn, Mrs. Casle, Misses Durrant, Hanson, Laiger, Sullivan, Murray, Akyroid, Hendrickson, Straka, Cunnalley, Winner, Kirk, Shillo, Soucke, Swanson, Troy, Logan, Amstead, Faudrop, Lottie Peterson, Dureer, Taylor, Alice Nelson, Nagorsen, Neitz, Armer, Becker, Mae Anderson, Spiak, McKinney, Lizzie Fister, Kittie Murphy, Lizzie Daker, Radora, Mame Fister, Rena Nelson, Voight, Roberts, Brode, Fay, Dwyer, Almsted, Anna Anderson, Dillon, Patra, Peterson, Epstein, O'Neill, Minnie Roberts, Desparroes, George, Rose Anderson, Mae Peterson, Rena Nelson, Klinger, Murray, Webb, Gloss, Rapke, Straube, Smithson, Kallal, Hanson, Buntrock, Coates, Behnke, Bieljewske, Kober, Kent, Madog, Eilers, Fraedrick, Hattie Fraedrick, Kallal, Powers, Shwekann, Inwood, Florence Nelson, McKeon, Meyer, Hanna Anderson, Beason, Casle, Bennecke, Teal and Pettee.

New Exchange for Cheyenne.

Superintendent A. J. Vance of the Rocky Mountain Bell Telephone Company has just received a set of plans for a fine new exchange building to be erected in Cheyenne, Wyo., this fall. The building, which will be either of stone or pressed brick with stone trimmings, will have two fronts and will be practically a duplicate of the Salt Lake exchange. It will be 25 by 75 feet, and will be the only absolutely fireproof building in the state, it is said. There will be two stories with basement, the latter for batteries and storage purposes. On the first floor will be the manager's office and toll office, while on the second floor will be the local exchange and girls' rooms, with the superintendent's office in the rear. The building is arranged to provide space for a much larger telephone exchange than now exists at Cheyenne.

The city of Washington, Iowa, is about to install a lighting plant. The equipment includes a Westinghouse, three-phase, 60-cycle generator, direct-connected to an Ideal engine. The Electrical Equipment Company of Chicago has the contract.

Peerless Automatic Smokeless Stoker.

An automatic boiler-furnace stoker which is said to insure perfect combustion in the generation of steam, involving absence of soot, smoke and cinders, is that shown in the accompanying illustrations and known as the Peerless stoker. In Fig. 1 is shown the furnace of an ordinary boiler fitted with this stoker. At the left a hopper receives the coal. A mechanical movement is exerted upon the drums which carry the endless-chain bars of the grate toward the interior of the furnace. The same mechanical movemnt operates a rod which causes the inclined sliding grate to shift from right to left. The coal is completely coked before it reaches the hottest part of the furnace, and all gases and smoke are said to be completely and effectually prevented

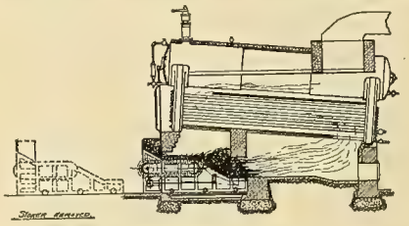


FIG. 1. PEERLESS STOKER.—BOILER FITTED WITH STOKER.

before reaching the outer air, making perfect combustion.

The mechanism also works perfectly without the automatic attachment, and can be fed by hand in the ordinary way. A striking feature is that the fires can be forced without in any way affecting either the prevention of smoke or the evaporative efficiency. To apply the stoker, but slight and inexpensive changes in the firebox are necessary. In the manufacturer's words, it is as simple in construction as it is simple, direct, efficient and economical in operation.

The stoker and furnace is the invention of Frederick Gertanner and is handled by the United States Mining and Trading Company of 11 Broadway, New York city. An interior view of a stoker before installation is shown in Fig. 2. The apparatus is readily adjustable to all forms of boilers and boiler settings, and is susceptible of application to boiler settings where the space is already limited. It is

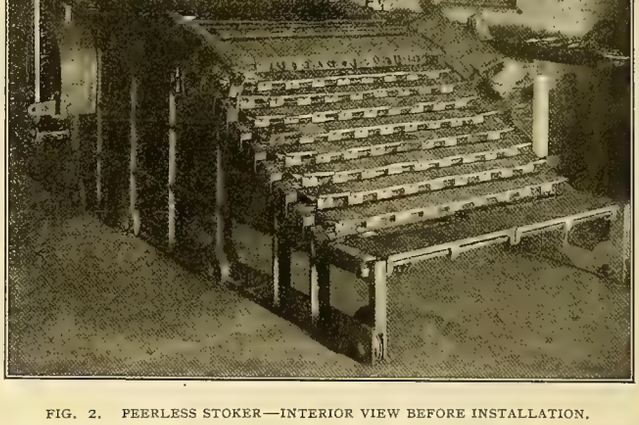


FIG. 2. PEERLESS STOKER—INTERIOR VIEW BEFORE INSTALLATION.

of comparatively low first cost. Repairs are small in amount, easily made and low in cost, and it can be operated without injury to boiler or other accessories.

The stokers will consume crude petroleum oil mixed in the quantity of one ton slack with 500 pounds of oil, giving greater heat and efficiency than coal alone, at much less cost, without a particle of smoke, thus providing the cheapest kind of fuel. This experiment has been made with the stoker with great success.

The practical efficiency of the stoker and smoke consumer over the ordinary method of hand firing is shown by the results obtained at a brewery in Guttenburg, N. J., where it was found that 10.20 pounds of water at 212 degrees Fahrenheit were evaporated with one pound of coal, as compared with 8.24 pounds of water to one pound of coal by the old methods, demonstrating a saving of 20 per cent. In the automatic stoker 480 pounds of ashes and clinkers were left, as against 1,123 pounds in the old method. The double utility of this device in effecting economy in fuel and an elimination of smoke commends it to all users of soft coal.

Articles of incorporation have been filed in Portland, Me., by the Chartered Company of Lower California. The capital stock of the company is placed at $10,000,000. The purpose of the concern is to build steam and electric railroads and "buy and sell lands in Maine and California and any other place in the world." Paul Faber of Boston is president of the company.

The Old and the New in Appleton.

The Wisconsin Traction, Light, Heat and Power Company has just finished the installing of machinery in its new hydro-electric power house at Appleton, Wis. Less than a quarter of a mile from the spot where, not quite a score of years ago, was located the first central electric-lighting station in the world, now stands a complete modern electric plant. This new plant furnishes current for all the lighting and power interests of Appleton and also for the interurban-railway line between Neenah and Kaukauna. The first plant was housed in a rude wooden building, 20 feet square, which contained a miniature dynamo of the simplest type, while the new power house is a large stone structure, covering an installation of the most modern design.

The new building is located on the government canal, just below the upper dam in the Fox River. The generator room is 60 by 82 feet in dimensions, the boiler house 56 by 90 feet, and two flumes 46 by 104 feet. In each flume there are six 50-inch turbine waterwheels, developing 1,600 horsepower for one of the two generator sets, also one pair of 18-inch wheels for one of the two exciter sets. Each waterwheel set has one combination generator set consisting of a 750-kilowatt, direct-current and a 750-kilowatt, three-phase, alternating-current machine. The direct-current is used for the operation of the railway systems and the alternating for lighting purposes. Each generator set is also equipped with one 1,000-horsepower Corliss tandem-compound engine, to be used either in conjunction with waterpower or in case of a failure of the water supply. Steam for the engines is furnished from four 500-horsepower Stirling boilers.

The credit for the location in Appleton of the first central station is mainly due to Henry D. Smith of the same place, who is secretary of the Wisconsin Traction, Light, Heat and Power Company. It was during a visit to Chicago in the winter of 1881-1882 that Mr. Smith met Thomas A. Edison and became interested in the project of supplying his home town with electric lights. Prior to this time the use of electricity for lighting purposes had been limited to experimental plants used for lighting isolated buildings. Mr. Smith's conference with the noted inventor led to the organization, on May 24, 1882, of the Appleton Edison Light Company of Appleton, Wis., the incorporators of which were Henry J. Rogers, Augustus L. Smith and H. D. Smith, of whom the first two are now deceased.

For a large sum the company purchased a single dynamo of the Edison bipolar "K" type, which was capable of supplying electricity for 250 16-candle-power incandescent lights. The machine was set up in a rude wooden building, waterpower being used to drive it, and several electrical experts from New York were employed to supervise the installation. The operation of the plant as a lighting station was first undertaken in October, 1882. Lights were furnished to a number of residents and to the Appleton Furnace Company, the Patten Paper Company and the Valley Iron Works. Light was furnished at the rate of $2 per lamp per month, time being figured by the length of time the dynamo was run, this being a necessary method, since the machine was liable to be shut down at any time.

W. D. Kurz and his brother, Frank G. Kurz, both of Appleton, who were connected with this first plant, tell many incidents in connection with its operation. "When I tell you that we had neither a voltmeter nor an ammeter, which are standard essentials in every plant nowadays," said W. D. Kurz, "you will get some idea of the kind of an institution we were running, if you know anything about electricity. We had to sit up nights with the dynamo, as if it were a sick child. The driving shaft frequently became so heated that we had to pack it in cracked ice. Later we arranged a little contrivance by which a stream of cold water was kept running upon it." The operators could count upon a "burn-out" about once a week, according to Mr. Kurz. One night a party was to be given at one of the residences which was lighted by electricity. On account of the electrical display it was to be one of the biggest social functions in the history of the city. All went well until 11 o'clock, when the guests sat down for refreshments—and the lights went out. The host and hostess groped their way into the attic to search for kerosene lamps and candles, while the dynamo tenders at the power house sweated and tugged with the balky machine.

In spite of the many drawbacks the company progressed slowly and its patronage constantly increased. On December 16, 1885, it obtained a waterpower site on the government canal and built a new power house. To this place were moved the old dynamo from the former plant and also a dynamo from a paper mill up the river. The two machines were hitched together on the Edison three-wire system, which proved much more satisfactory and effected a great saving in expenses. This is said to be the first commercial trial of the three-wire system. Two new dynamos of double the size of the old ones were later purchased, a large portion of the residences and business houses of the city were lighted, and all doubt of the success of the enterprise was removed.

Since that time additions and improvements were constantly made until July, 1900, when the power house burned to the ground and threw the city into darkness. The Appleton Electric Light and Power Company, which succeeded the old company, was incorporated January 29, 1896. This company, in common with all the other electric power and lighting interests in Appleton, was absorbed by the present company, which has just completed the building of the new plant.

Battery Plates and Dinner Plates.

On October 13th, 14th and 15th the staff of the Electric Storage Battery Company of Philadelphia, Pa., assembled from far and near in convention in that city. The company tendered a banquet to the assembled employes on the night of October 15th at the Germantown Cricket Club, Manheim, Philadelphia. The menu shows that the dinner was a good one, and it likewise embraces some original and amusing features. Terms used in the storage-battery trade are employed wherever possible. The word "Charge" displaces the orthodox "Menu." Under this word was printed the following:

Elements of Type, E. S. B.
Sizes of Plates, Various
Number of Plates 32; Capacity?
Outside Measurements from 5'4" to 6'2"
Weights, 115 lbs. to 225 lbs.

Following the menu, under the word "Discharge," were the words of a number of songs which were sung by the banqueters. The following-named "assembled elements" were attendant at the banquet: Joseph Appleton, G. H. Atkin, Charles Blizard, R. B. Daggett, P. W. Davis, J. B. Entz, Bruce Ford, H. B. Gay, W. G. Henderson, Carroll Hodge, G. M. Howard, R. C. Hull, F. L. Kellogg, R. H. Klauder, W. O. Knudsen, Hugh Lesley, Herbert Lloyd, S. M. Nicholas, O. E. Osthoff, Carroll Potter, Carl H. Reed, E. L. Reynolds, A. B. Sanders, E. Vail Stebbins, F. J. Stone, A. B. Stoughton, Albert Taylor, J. M. S. Waring, J. A. White, John R. Williams, J. Lester Woodbridge and C. W. Woodward.

Possible Power Developments on the Colorado River.

Arthur P. Davis, a well-known hydrographer of the United States Geological Survey, has spent some time along the Colorado River studying the feasibility of a plan for utilizing the waters of the Colorado for irrigation and power purposes. As a result of his investigations, Mr. Davis has formulated a possible scheme whereby the Colorado River might be used to irrigate vast tracts of land during the flood season in some such way as is done along the Nile River in Egypt. By Mr. Davis' plan a succession of dams would be built, by means of which the sediment and mud in the water would be deposited in these reservoirs and the river bottom raised. An opening would, after a time, be made in the middle of the dam and the water allowed to resume its old channel. In this way a large deposit of fertile soil would be obtained and held, with the possibility of at all times securing sufficient irrigation to make it productive. Electric power stations could be built at these dams, and the current generated by them transmitted to the different mining properties near by and also used in pumping water from the Colorado for irrigation purposes for tracts of land on higher levels where the rainfall is light.

Electric Elevator of Great Magnitude Proposed.

A Baltimore report says that the Gould-Wabash railroad system contemplates undertaking a remarkable enterprise in West Virginia on the West Virginia Central and Pittsburg Railway. Plans have been drawn, it is asserted, for an electrical mechanism by means of which whole train loads of coal or merchandise are to be lifted up the side of a precipitous slope of the Great Backbone Mountains in Tucker County, W. Va., and placed upon a level from which double tracks of easy down grade will be built. If the scheme should be carried out, which is, of course, doubtful, the laying of a considerable length of track around the mountain range will become unnecessary, and a great saving of time will be brought about.

The Kemp (Texas) Electric Light Company has been incorporated with a capital of $30,000.

Extensive Interurban System Proposed in Texas.

H. F. Farnham of Cleveland, Ohio, representing the Union Traction Company of that city, has been meeting with the people of a number of cities in Texas during the last two weeks and has submitted propositions looking to the building of a system of electric railway in Texas, embracing more than 300 miles. The plan of the company is to build a direct line of railway between Sherman and Austin, a distance of about 250 miles by direct route, and to construct several branches to smaller towns in the territory through which the proposed road will pass. It is estimated that the road would cost about $3,000 a mile. The proposition which Mr. Farnham is making to the people of the different counties through which the road is to run is that they furnish the right-of-way to the company, in return for which they will be given a certain amount of preferred stock in the corporation. This proposition is being received with favor by the farmers of the different localities along the proposed route, and it is believed that no great difficulty will be experienced in obtaining the right-of-way on the basis named.

The route of this road is through the richest agricultural section of the state; it is also a territory which is thickly populated with well-to-do farmers and dotted with many thriving cities and towns. It is announced that the road is to handle both freight and passengers, and it has been stated that it will carry freight nearly 50 per cent. cheaper than the steam railroads, which it will practically parallel for most of the distance.

The incentive which has led to the proposition to build this big system of electric railway in Texas is the great success which the interurban lines between Sherman and Denison and between Dallas and Fort Worth are meeting in a financial way. The proposed new system will connect with both of these lines, and they will act as valuable feeders.

The country between Sherman and Austin is comparatively level, and at no point on the proposed route will there have to be any heavy and expensive construction work done. The uniform grade will be low and the expense of operation thereby placed at a minimum figure.

Drainage-canal Power Litigation.

On October 16th the second legal hearing of the case for the control of the waterpower development of the Drainage Canal at Joliet, Ill., began in Judge Hilscher's court in Joliet. It will be remembered by the readers of the Western Electrician that this litigation is the outgrowth of the controversy between the Sanitary District of Chicago and the Gaylord syndicate of private capitalists. Some two months ago, in preliminary proceedings before Judge Tuley in the Cook County Court, it was decided that the Sanitary District has a right to control the waterpower of the Drainage Canal, though the work on any dam must be by contract. In the present suit the Gaylord syndicate seeks to condemn the land of the Sanitary District under a law known as the mill and dam act, passed in 1871.

The existence of a signed contract between Robert Gaylord and the Illinois and Michigan Canal Commission has come to light. This contract with the state board gives Mr. Gaylord the right to build a lock from the river to the canal at such place as the canal commission may designate, and also the right to raise the towpath to a sufficient height to prevent overflow in times of flood. This grant to the Gaylord syndicate removes the objection to its plans by the Sanitary District of the overflow into the state canal. The drainage trustees are much wrought up over the act of the state board, and say that it has taken unto itself powers that do not belong to it. The outcome of the controversy is awaited with interest.

Consolidation in Dallas.

The Dallas Electric Corporation, which was recently organized under the laws of New Jersey, with a capital stock of $8,500,000, is reported to have acquired the holdings of the Dallas Electric Light and Power Company, the Standard Light and Power Company, the Rapid Transit Street Railway Company and the Consolidated Street Railway Company for the purpose of merging them into one big company with consequent economy of operation. It is also stated that this company will build and operate a network of interurban electric-railway lines between Dallas and neighboring towns. A. K. Bonta, representing the United Securities Company of Boston, Mass., has acquired a franchise for an electric street-railway system in Dallas, and has already installed part of the system.

New Development in X-Ray Work.

On October 9th Dr. O. S. Barnum of Los Angeles read a paper before the Southern California Homeopathic Bureau at that place in which he explained what he asserts to be a new discovery in the use of the cathode ray. In speaking of the new discovery Dr. Barnum said: "I wish to lay claim to a method of increasing the efficiency of all X-ray tubes by the use of multiple-spark gaps. Heretofore it has been customary to have one adjustable spark gap on each side of the tube in circuit, and the variation in penetrating power of the ray has been judged due to the high or low vacuum of the tube alone. By the method of introducing more small sparks in circuit I am able to make a very low tube give out as penetrating rays as much higher tubes have up to this time done. I will explain this to even the novice when I say that the effect is to make the apparent resistance of the tube equal to a spark of 12 or 15 inches, instead of five or seven inches, which has been almost the limit for high tubes. I have found that, theoretically, this method increases the potentiality of the current, so that it has to be more carefully constructed to prevent leakage; that there is, without doubt, more danger of puncturing tubes; that it does away with the necessity of high-speed machines; that it increases the penetrability of any tube by fully 100 per cent.; that it makes fluoroscopic work possible in regions hitherto thought beyond the power of the ray to penetrate except on long exposure; that, whatever the degree of vacuity of a tube, it may, by this means, be raised to a point of efficiency far beyond its possibility under the old method. In the application of the ray for malignant tumors and cancer my method enables the operator to adjust perfectly a medium vacuum tube for superficial or deep tissues as necessity demands."

Central Electric Catalogue.

The new general catalogue of electrical supplies that has just been issued by the Central Electric Company of Chicago is a credit to the electrical trade. It is a 7½ by 10½-inch book, contains 607 pages, weighs over four pounds and is bound substantially with a light-gray cloth cover, stamped in red. The book was compiled and edited by the advertising department of the Central Electric Company, and the care taken in its preparation is shown by the selection of its contents and its typographical appearance. The company has endeavored to include all material and appliances that are useful and necessary in the construction and operation of electrical installations and apparatus of every character. That this aim has been successfully carried out may be demonstrated by inspection of the general index, which covers 14 pages, and runs the gamut from arc lamps to zinc plates. Specially to be noted are the listing of the Nernst lamp (to which seven pages of the catalogue are given), sockets, switches, fittings, tools, instruments, insulators, wire, switchboards, transformers, rheostats, telegraph supplies, telephones, electric-heating apparatus, etc. At the end of the book 14 pages are given up to tables of an electrical and mechanical nature. Every article in the book is given a trade word, and these words are listed in an index of 25 pages. Care has been exercised in preparing the illustrations, which are very numerous. The company's belief that the function of a catalogue is to present to the customer the most recent and best appliances, in compact and convenient form for easy and quick reference, is certainly well carried out in this catalogue.

Storage-battery Trade Abroad.

Soon after the incorporation of the Electric Storage Battery Company in Philadelphia a company was formed in England under the name of the Chloride Electrical Storage Syndicate, Limited. This company acquired all the patents and improvements, past and future, of the Electric Storage Battery Company, for the world, outside of the United States and Canada. Electrical development has been very slow in Great Britain, so that the company has only very recently reached a dividend-paying basis. That a vast amount of electrical work is to be done in Great Britain in the next few years is shown by the very large works put up by the British Westinghouse Company and the British Thomson-Houston Company in Manchester and Rugby.

The Electric Storage Battery Company of Philadelphia, seeing the opportunity for a large and profitable business, not only in England, but in other countries, where the low price of labor and material existing in Europe makes it impossible to compete with storage batteries manufactured in America, decided to purchase control of the English company. This has been done on a satisfactory basis, so that the Electric Storage Battery Company will now be able to sell batteries in foreign countries and have shipments made from England.

Winnsboro, S. C., is asking bids on an electric-lighting plant. Plans and specifications for the same may be obtained from J. E. McDonald, Winnsboro.

CORRESPONDENCE.

New York Notes.

New York, October 18.—The Metropolitan Street Railway Company, which obtained control of the Third Avenue line in May, 1900, owns or controls every other surface-railway line on Manhattan Island. Notwithstanding this, the Metropolitan company or its recent lessee, the Interurban company, has never granted transfers from its own lines to those of the Third Avenue Railroad Company. The newspapers now demand that such transfers be given.

The Pennsylvania tunnel franchise, which has reached the Board of Aldermen, seems likely to stay there for a while. At the board's last meeting the franchise question was only dealt with in a casual way and nothing was done as to bringing the matter to a close. The aldermen seem inclined to be willing to pass the franchise without the labor clauses, if no other solution to the problem can be found, but it is certain that any mistake made will not be due to lack of sufficient deliberation. Quite a number of labor unions have held meetings and framed resolutions to be presented to the Board of Aldermen objecting to the granting of the franchise without the labor clauses. Little attention will be paid to these. It is said that the Pennsylvania Railroad Company will spend between $40,000,000 and $50,000,000 on the tunnel, and that its completion will require nearly three years.

Work on the rapid-transit subway is progressing rapidly, and everything looks to an early completion of the excavating work.

Property of the Christ Protestant Episcopal Church at Third Avenue and Sixty-eighth Street, Brooklyn, has been purchased by the Brooklyn Rapid Transit Company. The consideration paid for the property was $30,000. The edifice is to be removed to make way for the construction of an inclined plane to connect the elevated-railroad structure with the surface line on Third Avenue. The company plans to operate trains over the elevated road through to Fort Hamilton.

The Standard Technical Company of New York has been incorporated with a capital of $2,000 to manufacture electric machinery. The board of directors are J. H. Alexander, C. C. Morton and A. L. Beveredge. O.

New England News.

Boston, Mass., October 17.—Sargent, Conant & Co. of Boston have obtained the contract for an intercommunicating telephone system for the Boston Athletic Association's building. The same company electrically equipped Thomas W. Lawson's farm Dreamwold at Egypt, Mass., installing telephones, a fire-alarm system and an arc and incandescent lighting plant. All the wires were placed in underground ducts.

Employes of the Boston Elevated Railway Company had a "field day" last week on the Christopher Gibson playground in Dorchester. There were 15 events on the programme, first and second prizes being offered by President Bancroft of the company. Division Superintendent F. J. Wilkins gave a cup to the winners of the tug of war. Many of the company's officials were present.

The annual meeting of the Edison Electric Illuminating Company of Boston was held October 14th. The old board of directors was re-elected, and the directors declared the regular quarterly dividend of 2½ per cent., payable November 1st. The annual report for the year ended June 30, 1902, contains the following statement, the statements of the Boston Electric Light and the Suburban Light and Power Companies being included in both years given:

Year ended June 30,	1902.	1901.
Gross receipts	$2,460,158	$2,367,359
Expenses	1,510,427	1,449,629
Net receipts	$ 949,731	$ 917,730
Other income	25,981	13,948
Total net	$ 975,712	$ 931,678
Charges	859,614	879,285
Balance	$ 116,098	$ 52,393

BALANCE SHEET JUNE 30, 1902.

ASSETS.

Installation	$11,951,626
Live pool wharf	225,912
Cash on hand	165,914
Stock on hand	361,160
Notes and accounts receivable	246,778
Open accounts	37,613
Total	$12,989,003

LIABILITIES.

Capital stock	$ 7,850,400
Trust mortgage bonds	1,250,000
Notes and accounts payable	1,247,789
Dividends payable	196,260
Reserve for maintenance	654,000
Premium on new stock	1,660,387
Accrued interest and taxes	69,217
Profit and loss	60,950
Total	$12,989,003

The report says: "The purchase of the Boston Electric Light Company was completed in October, 1901, and the property and assets of the Suburban Light and Power Company were purchased for cash, the property being delivered in September, 1901. The acquisition of the Boston company added 112,734 incandescent lamps, 5,128 arc lamps, and motors aggregating 5,408 horsepower to the company's installment, and the acquisition of the Suburban company added 22,812 incandescent lamps, 356 arc lamps, and motors aggregating 772 horsepower to the company's installment. The net increase during the year amounted to 58,533 incandescent lamps, 561 arc lamps, and motors aggregating 2,299 horsepower. The Boston company's Ferdinand Street and Condor Street stations were sold and the Boston Street, Norfolk Avenue and Stanhope Street properties of the same company are to be sold, as they are not needed by the Edison company. Property for sub-stations was purchased in Zeigler Street, Roxbury, and Central Square, East Boston, and suburban offices were opened in East Boston, Dorchester and West Roxbury."

At a special town meeting, October 13th, the town of Manchester, Mass., rejected the proposition for a municipal electric plant at an estimated cost of $161,000.

The United Gas and Electric Company of Dover, N. H., is preparing to build a power house that will cost $75,000.

The General Electric Company is contemplating the use of fuel oil at its West Lynn (Mass.) plant.

The Providence (R. I.) County grand jury has brought in indictments, against the Union Railroad Company and the Pawtucket Street Railway Company, charging violations of the 10-hour law. The complainants were Harrison G. Hutchins and Benjamin F. Smith, motormen employed by the Union and Pawtucket companies, respectively. The corporations furnished bail. B.

From the Buckeye State.

Cleveland, Ohio, October 18.—The Cincinnati Traction Company has given ill and crippled children of that city more than a score of outings during the last summer. Private cars, the best the company has, are furnished for these outings, on request of the hospital authorities. It is said that President Schoepf was once confined in a hospital in the city of Washington years ago and that the kindness shown him there was such that he has always remembered it with gratitude.

It is reported that the Baltimore and Ohio Railway Company has secured an option on the Fairmont and Clarksburg electric-railway line, which will be 32 miles long when completed between the two towns in West Virginia.

The Mansfield and Eastern Railway Company will shortly be incorporated to build an electric line from that city to Ashland. W. J. Prentz of Cleveland, Charles Miley, J. W. Galbraith and J. J. Maguire of Cleveland and J. W. Giffin of Mifflin are interested in the project. The capital stock will be $300,000, and it will be incorporated in New Jersey.

The case of the Suburban Electric Company against the city of Covington, Ky., to prevent the issuance of bonds to build a municipal electric-light plant, has been appealed to the United States court. The case was recently decided in favor of the city. The Suburban company claims an exclusive franchise for furnishing electric lights in that city.

Electric cars at Bowling Green will be heated with coke this winter instead of hard coal. Bundles of sticks soaked in tar will be used to rekindle in case the fires begin to die out. At Columbus electric heaters are used exclusively and have proved satisfactory, except when the plant is extremely heavily loaded.

The Conneaut and Eastern Traction Company has awarded the contract for its power house to Henry Shenk of St. Louis. The plant will be built at Elk Creek and will cost about $150,000.

C. C. German, H. A. Tremaine and M. C. Briggs have been designated by the City Council of Fostoria to investigate the advisability of establishing a municipal light plant to be operated in connection with the waterworks plant. The town is now paying $90 a light for street lighting.

The Urbana, Bellefontaine and Northern Railway Company has filed a mortgage of $500,000 made in favor of the Continental Trust Company of New York. This shows that the company has been financed and that it will be built in the near future. J. S. Harshman and Fred J. Green of Dayton are among those interested in it.

The Chamber of Commerce of Toledo has passed resolutions asking that franchises be granted to the Central Heating and Lighting Company, and a committee was appointed to work with the City Council in preparing such an ordinance. At present but one company operates in the city.

President W. D. Mahon of the Amalgamated Street Railway Employes' Associations has been in Cleveland for a few days consulting the men in regard to separate organizations for the interurban lines. He thinks that it would be more satisfactory to have this done.

The organization of the Zanesville Street Railway and Light Company of Zanesville is as follows: President, F. A. Durban, Zanesville; vice-president, H. M. Byllesby, Chicago; treasurer, W. D. Breed, Cincinnati; secretary and general manager, W. A. Gibbs, Zanesville. John Roth, George Koeler and G. H. Warrington of Cincinnati are in the directorate and the purchasing syndicate was represented by Rudolph Kleybolte & Co. of Cincinnati.

The Standard Electric Manufacturing Company of

Niles has increased its capital stock from $30,000 to $75,000.

At a meeting held in Springfield on Wednesday the stockholders of the Dayton, Springfield and Urbana Railway Company voted to increase the capital stock of the company to $1,500,000. It was also decided to double-track the road on both branches at a cost of nearly $750,000. When this is completed it will be one of the ideal lines of the state.

The state Senate has refused to repeal the bill passed last winter which released railroad companies from maintaining electric lights at crossings in cities and towns.

Within the next few weeks the Columbus, London and Springfield Railway Company will have its new power house completed, and then a through service between Columbus and Dayton will be established. The power house and equipment will cost something like a quarter of a million dollars.

It is rumored that a syndicate is endeavoring to purchase the property of the Columbus Edison Electric Company at Columbus at $125 for the preferred and $75 for the common stock. Brokers and investors have looked into the matter, but have been able to tell very little about who is behind the proposed deal. The Columbus Railway Company and the Mandelbaum-Pomeroy syndicate are both suspected of looking upon this money-making plant with covetous eyes. But it is said that the owners of the stock are not anxious to sell at this figure, as it is too good a thing to let go of without greater inducements.

W. D. Mahon, president of the Amalgamated Street Railway Employes' Associations, in an address to the street-railway men in Cleveland a few days ago, said that their organization is opposed to the three-cent-fare policy, because it does not give the companies sufficient margin to pay fair wages for their work. He said that in New York state it costs three cents and a half to carry each passenger.

The officials of the Terminal Depot Company at Cincinnati estimate that there will be 600,000 people come into the city every month over the interurban lines, a great majority of them traveling to that city to do their shopping.

It is stated that the Fremont Yaryan Company of Fremont will have its plant completed by November 10th, when electric lights, heat and hot water will be much cheaper than at present.

Risenbach & Maxon, a Coshocton firm, has purchased the electric-light plant at Galliopolis for $12,500. O. M. C.

Information from Indiana.

Indianapolis, October 20.—The Huntington and Winona Traction Company of South Whitley has filed articles of incorporatin with the secretary of state. The initial capital stock is $10,000. The directors are George Lee, E. B. Bowers, C. R. Banks, M. W. Webster and E. L. Eberhard. The company proposes to build an electric line from Huntington to North Webster, by way of South Whitley, Pierceton, Winona and Warsaw.

The New Albany, Paoli and French Lick Valley Traction Company, which was recently incorporated for the purpose of building an interurban line between New Albany and French Lick and West Baden Springs, has obtained an option on the toll road of the New Albany and Paoli Turnpike Company for $51,000. The company has secured rights-of-way through all the counties through which the line will run and the City Council is expected to grant the company a franchise to enter New Albany at its next meeting.

Alexandria and Tipton will within a few days be connected directly by the interurban line, via Elwood. The frog at the Lake Erie crossing is being put in. The trolley wires and telephone stations and all overhead work is done from Elwood to Tipton and the finishing touches are being put on the entrance track at Tipton.

The first work on the Dayton and Northern electric-traction line, that is to connect Muncie and Dayton, Ohio, and thus make possible a trip from Indianapolis to Cincinnati by electric-traction lines, was begun at a point near Winchester on October 13th, a large number of workmen being employed. This road will connect Muncie with Farmland, Winchester, Union City, Ind., and Greenville and Dayton, Ohio. The road is to be constructed east and west out of Winchester.

United States Senator Charles W. Fairbanks was on the 17th inst. conveyed in a special interurban car from Fairmount to Marion, a distance of 17 miles, in 18½ minutes. This was necessary to catch a train for Wabash, and the senator said it was the wildest ride of his life.

Thomas Griffin and others have purchased the Cromer Mill dam north of Noblesville, and will at once construct an electric-lighting and motor-power plant, the current to be brought to Noblesville and other towns.

Lower rates for commercial electric lighting are already resulting from an invasion of the downtown districts by the Merchants' Heat and Light Company of Indianapolis. Competition, that may be carried to rate cutting, is expected to begin soon between this company and the Indianapolis Light and Power Company. The maximum charge for electric lighting, permitted by the Merchants' Company's franchise is 10 cents per kilowatt-hour. The Indianapolis company now charges 12½ cents, but will make a contract for 7½ when the new company competes with it. F.

Southern Developments.

Charlotte, N. C., October 18.—The McKay Engineering Company of Baltimore has been awarded the contract for laying a cable between Key West and Sand Key, Fla., for the government weather service.

The Town Council of Bennettsville, S. C., has provided for a municipal electric-lighting plant, the action being taken over the protest of Mayor C. S. McCall.

The Rapid Transit Company of Chattanooga, Tenn., is building an extension to Alton Park, duplicating a line of its rival, the Chattanooga Electric Railway Company, this being another step in the strong competition between these companies.

J. E. Duval of Spartanburg, S. C., has been awarded a contract to install an electric plant in the Bessemer City (N. C.) cotton mill.

The Asheville Electric Railway Company has completed an extension 1½ miles in length back into the mountains north of the city of Asheville, N. C.

The electric companies of Virginia are in many cases suffering great inconvenience on account of the coal shortage. The Winchester Electric Light Company has perfected an agreement with the city by which the lights are to be extinguished at midnight.

J. U. Jackson announces a new deal in Augusta, Ga., by which the Augusta Railway and Light Company takes over the Augusta Railway and Electric Company, the North Augusta Electric and Improvement Company, the Augusta and Aiken Railway, the North Augusta Land Company and the North Augusta Hotel Company. A charter has been asked for the new company. The new company will have a capital of $800,000 preferred and $4,000,000 common stock. There will also be an issue of $3,000,000 bonds, of which amount $2,000,000 will be used to retire outstanding bonds and $1,000,000 will be set aside for improvements and extensions. The Railways and Light Company of America has been employed to operate the combined railroads by the syndicate. The purchasers are John L. Williams & Son of Richmond, J. W. Middendorf & Co. of Baltimore, Jas. U. Jackson of Augusta, and Philadelphia and Wilmington (Del.) capitalists. L.

Northwestern Notations.

Minneapolis, October 18.—The Waterloo and Cedar Falls Rapid Transit Company has filed a trust deed covering all its property, to raise $800,000, which will be used to extend the line from Denver, Iowa, to Sumner, where connection is to be made with the Chicago, Great Western Railway. Other changes and improvements are to be made.

Considerable complaint is made in St. Paul over the new ordinance which requires all wires underground in a certain district. It is claimed that the ordinance is unreasonably drastic, in that it requires the removal of all wires from the tops of buildings as well as from streets, and would thereby cause the withdrawal of the messenger service of the telegraph companies and of the fire-alarm and watchmen's report boxes and similar wires.

It is understood that work is to be rushed on the construction of the proposed Madison and Northeastern Railroad Company as quickly as possible. A right-of-way is now being secured. Franchises will be asked at once in Madison, Wis., Sun Prairie, Columbus, Beaver Dam, Wapun, Fond du Lac, Oshkosh, Brandon, Ripon, Dartford and Berlin.

The Crowley Electric Company of Duluth, Minn., was awarded the contract to furnish machinery for the municipal electric-light plant for Verndale, Minn., at $6,456.

The electric and telephone corporations of St. Paul will jointly construct a large conduit for all their wires under Seventh Street west from Seven Corners to Tuscarora Street. The conduit will be cut through the soft sandstone which underlies the city, being tapped and bored. It will have laterals at every cross street and will have a capacity for thousands of wires.

The Des Moines Electric Railway Company has received four handsome cars to be used on the run between Des Moines and Colfax when the line is completed. They are fitted with air brakes and whistle, steam heat, toilet room, electric buttons, storm and screen windows, finished in rosewood, and have plush seats.

The Highland Canal and Power Company has made a proposition to Superior, Wis., to furnish the city with electric power. The city will advertise for bids for furnishing power, and will thus be in a position to accept the proposition, if it is concluded to be acceptable.

The Missabe Electric Railway Company proposes to build a line in the spring from Buhl, Minn., to Stephenson. A right-of-way is being secured as fast as possible. R.

Among the Rockies.

Salt Lake City, Utah, October 17.—The Town Board of Montclair, Colo., held a meeting on the 13th inst. for the purpose of voting on the installation of an arc-light system for the city. An ordinance was introduced granting a franchise for the installing of an arc-light system similar to that given the Lacombe Company in Denver. T. J. Andrus is named in the ordinance as the grantee, and the project is backed by several prominent residents of Montclair.

An electric power plant is being installed at Fall Creek, Idaho, for use with Cowan's placer mines near that point.

The machinery for the electric-light plant has been received at Mount Pleasant, Utah, and will be put in place at once. Fountain Green and Moroni will be furnished with electric light by the plant, as will also Fairview, if sufficient support is guaranteed to justify the erection of the line across the hills. The plant will supply electric power as well as light.

The City Council of Montpelier, Idaho, granted the Montpelier Electric Light Company on October 14th a franchise to erect poles, string wires and put up and maintain an electric-light system in the city. The capital for this enterprise is furnished by local residents. The plant will be in operation inside of 90 days. G.

On the Pacific Slope.

San Francisco, October 15.—Dr. Charles Van Norden, manager of the South Yuba Water Company, with headquarters in Sacramento, Cal., reported on October 6th, that the company had placed its engineers in the field to prepare estimates of the value of the company's plant, for the sale of which negotiations are now under way. Ex-United States Senator C. N. Felton of California is acting for the purchasers. Dr. Van Norden states that the company's property consists of 400 miles of flumes and canals, of which 300 miles carry upward of 1,000 miners' inches of water and a plant of 5,000 horsepower, capable of being developed to between 20,000 and 30,000 horsepower, together with a large amount of storage-reservoir sites, giving the company a total storage capacity of 5,000,000,000 cubic feet of water.

Sydney Sprout, an electrical engineer of San Francisco, is now investigating the waterpower property owned by G. A. Wilbur & Co. on the Tuolumne River, near Jacksonville, Cal. It is intended to build a plant of about 4,000 horsepower, for the purpose of supplying electrical power to the mines of Tuolumne County. The plans include the construction of a 15-mile pole line and about 10 miles of ditches and flumes.

The Bay Counties Power Company, San Francisco, has closed a power contract with the Richmond Light and Power Company of Richmond, Cal., for supplying electrical power. General Electric transformers having a capacity of 300 kilowatts will be installed. Day circuits will supply current for electric motors through the city. The Santa Fe railroad terminals at Richmond will be supplied with both light and power. The Standard Oil Company's big plant, however, has its own electric-light plant with a 50-kilowatt generator.

The McCloud River Electric Power Company is now maturing its plans for an electric railway from Kennet, on the Southern Pacific Railway, to Delamar and the Bully Hill mining district in Northern California. A steam electric plant of 1,000 horsepower is to be installed at Kennet to supply the electric road with power. Negotiations are under way by the company to purchase the rights and properties of the Copper Belt Railway and Power Company. If this deal is consummated, the McCloud River Electrical Power Company will install an electric power plant of 27,000 horsepower on the McCloud River for the purpose of supplying electric lights and power to the towns and mines of Northern California. George H. Proctor, who recently returned from New York, states that four, 750-kilowatt generators are being constructed for the new system by the Bullock Electric Manufacturing Company in Cincinnati, Ohio, and that the waterwheels for a portion of the plant are ready to be installed. He states that contracts are to be let at once for the construction of the dam on the McCloud River.

The Truckee River General Electric Company of Carson, Nev., F. O. Broile, superintendent, is securing rights-of-way and preparing to extend its lines. A new sub-station will be put in.

General Manager E. Randolph of the Pacific Electric Railway Company, Los Angeles, Cal., stated recently that the company intends to construct a line of railway from Los Angeles to San Pedro.

The Oroville Gas and Electric Light Company of Oroville, Cal., is preparing to build a new power house and to install an additional 250-kilowatt generator. The new power house will be located about 1,800 feet from the present plant.

The California Central Gas and Electric Company has issued the following statement of earnings for the month of September, 1902: Gross earnings, $40,153.22; expenses $29,159.99, leaving a manufacturing profit of $10,993.23. The bond interest of the company was $4,166.66, leaving a surplus of $6,826.57. The sinking fund of $1,666.66, deducted from the surplus, leaves a net surplus of $5,159.91. A.

According to London (England) advices, the minister of finance of Poland has been petitioned by a syndicate of American capitalists for a concession to build an electric railway from Warsaw to Lodz, Poland, a distance of about 75 miles.

PERSONAL.

F. F. Barbour, local sales agent of the General Electric Company, San Francisco, Cal., is suffering from a severe attack of typhoid fever.

R. D. Ayers of Chicago succeeds R. D. Manson as manager of the Electric Railway and Power Company of Keokuk, Iowa. Several interurban-line extensions are under consideration by the company.

E. W. Moore, the Cleveland street-railway and telephone magnate, has returned from a long stay in Europe and can again be found at his desk in the Electric Building. He is in very good health and ready for work.

J. H. Crouch has resigned as superintendent of the electric-light plant at Sleepy Eye, Minn., and will go to Minneapolis, where he will become superintendent of motive power for the Minneapolis Steel Manufacturing Company.

George H. Switzer of Parkersburg, W. Va., has been appointed general superintendent of the Morgantown (W. Va.) Electric and Traction Company. Mr. Switzer was in the employment of the Westinghouse company in Pittsburg for five years.

Frank Turner of Toronto, Ont., has accepted the presidency of the Central Ontario Power Company of Petersborough, Ont. Mr. Turner is a man of considerable engineering experience. He was a member of the Trent Canal Commission in 1886.

W. L. Granger, electrical superintendent of the Grand Rapids, Holland and Lake Michigan Rapid Railway of Holland, Mich., has resigned, to take a position in New York. Mr. Granger has been connected with the electric-railway company for several years and his services have been invaluable in the work of equipping the new line so far as the electrical department is concerned.

The employes of the Mill Creek Valley Street Railway Company of Cincinnati presented their former manager, W. G. Wagenhalls, a handsome gold watch, chain and locket one evening last week as a token of the appreciation in which they hold him. They marched to his home in a body, with a band of music at their head, and completely surprised him. Mr. Wagenhalls retired as manager when the lines were taken over by the Cincinnati Interurban Company.

Y. Nogami, chief engineer of the Tokyo (Japan) Electric Light and Power Company, is now on the Pacific coast, visiting the electric-power and street-railway plants of California. From the coast Mr. Nogami will go to Chicago and New York and thence to Europe, after having inspected the electrical works of the East. Mr. Nogami states that his company is making plans to increase the capacity of its works to the extent of 1,200 horsepower. The present capacity of the plant is 4,000 horsepower. While on his tour Mr. Nogami will arrange for the purchase of additional machinery.

Clarence H. Mackay was elected president of the Commercial Cable Company, of the Postal Telegraph-cable Company and of the Commercial Pacific Cable Company on October 14th. Mr. Mackay is said to have announced that he will carry out the plans which his father made regarding the Pacific cable extension, and a formal statement was made that it was the intention of the company to complete the line from Honolulu by way of Guam to the Philippine Islands. George G. Ward was elected chairman of the board of directors and of the executive committee. Mr. Ward continues to be vice-president and general manager of the Commercial Cable Company.

ELECTRIC LIGHTING.

Plymouth, Pa., is to be the locating place of the recently incorporated Kingston Township Light Company. The capital stock of the company is $1,000.

J. A. Johnson of Fargo, N. D., has been granted a franchise to erect an electric-light plant in Ellendale, N. D. The plant to be erected will cost about $10,000.

The Powell Power Company of Helena, Mont., has been incorporated with a capital of $200,000 to manufacture and sell electricity for light and power purposes.

Lesueur, Minn., has called a special election at which to vote on the question of issuing $4,000 in bonds for the purpose of installing an electric-light plant at that place.

The Merchants' Electric Company of Wilmington, Del., has been incorporated, with a capital stock of $150,000, to manufacture and sell electricity for light, heat and power purposes.

Burlingame, Kas., will hold an election on November 3d to decide the question of issuing $30,000 bonds, the proceeds to be used in the erection of an electric-light and waterworks plant.

The residents of Lake Forest, Highland Park, Fort Sheridan and Highwood, all suburbs of Chicago along the North Shore, called into use lamps, candles, etc., on the night of October 19th, owing to a failure of the electric-lighting service. The cause of the trouble was an explosion in the plant of the Highland Park Electric Light Company. One of the boilers of the plant burst. No one was hurt, owing to the fact that the engineer had just left the building, and no one else was around the plant. It will require two or three days to get things in running order again.

Sealed proposals will be received until November 1st for the furnishing of 100 arc lights to light the city of Baton Rouge, La., from one to 10 years. Specifications can be obtained from Edward Wax, secretary of water and lighting committee, Baton Rouge.

The Electric Light and Power Company of Syracuse, N. Y., at a meeting of the board of directors held on October 15th, authorized J. J. Cummins, vice-president, to proceed with plans for enlarging the company's plant in Syracuse. In addition to a new building, considerable new machinery will be purchased.

Escanaba, Mich., at an election held recently, decided to issue $50,000 of bonds, with the proceeds of which to buy the present gas and electric-lighting plant. The town will run a municipal lighting system from now on. The present gas and electric plant will cost the town $48,000.

ELECTRIC RAILWAYS.

Work on the interurban railway between Champaign and St. Joseph, Ill., is progressing rapidly. The power for the line will be taken from a central station to be located at Champaign.

The annual meeting of the stockholders of the Dayton (Ohio), Springfield and Urbana Electric Railway Company was held in Springfield, Ohio, recently. At this meeting the stock of the company was increased from $750,000 to $1,500,000. In addition to this, it was practically decided to double-track the line between Springfield and Dayton.

The Grand Rapids, Grand Haven and Muskegon Interurban electric railway, running between Grand Rapids and Muskegon, has commenced the laying of steel into Grand Haven from Spring Lake. This company has just received a contract from the Postoffice Department for the carrying of mails, and will give Muskegon a much earlier delivery of eastern mail.

The Chicago and Milwaukee Electric Railway Company has an arrangement with Evanston, Ill., whereby a-year-at-a-time franchise is granted the railway company and for which it pays the town the sum of $1,000. This year's franchise expired last Monday and the railway company is endeavoring to get more favorable terms from the town, asserting that, unless it does, the cars will stop at the Evanstown city limits and not pass through the town.

Chairman Vilbert of the National Amalgamated Association of Street Railway Employes arrived in Saratoga, N. Y., on October 16th and will personally direct the strike of the motormen of the Hudson Valley Railway Company. Strikers are supposed to have placed dynamite on the company's tracks in Saratoga on the night of October 14th, which resulted in the partial wrecking of a car, the tearing up of the railway track and the shattering of the windows of a saloon near by.

Incorporation papers of the Chicago, Elgin and Waukegan Electric Railway Company have been filed. The project of the incorporators is to connect Lake, Cook, Kane, Du Page, Will, Kendall, Grundy and Dekalb Counties in Illinois by a network of electric railways. It is reported that the electric roads now running between Chicago and Waukegan and Chicago, Elgin and Aurora are to become a part of the system. One of the principal features of the scheme is to open up the Fox Lake district.

It is said that the Mandelbaum syndicate has decided to combine the Elgin, Aurora (Ill.) and Southern and the Aurora, Elgin and Chicago Traction Companies. For convenience in management, it is believed, this will be of great advantage, but from a stock trader's standpoint, it probably would not at this time, since the Aurora, Elgin and Chicago is one of the best built roads in the country, and its full earning capacity has not yet been tested, owing to its unfinished condition. However, the syndicate is looking at the matter for its own advantage, and will allow the stock market to bide its time.

Plans are being prepared for an extension of the electric service of the Hocking Valley Railway. An electric railway is proposed from Wellston to Hamden, both in Ohio. The electric road will be in the shape of an extension of the service now maintained between Wellston and Jackson. This will require the building of about one-half mile of new track and the equipment, electrically, of a little over four miles of track now used only for steam purposes. The proposed innovation will run the road directly into the town. It is probable that ultimately electric service will be extended to McArthur Junction, as this is the logical terminus for steam service.

The Pittsburg Railways Company has awarded to the McClintic-Marshall Construction Company a contract for the erection of a steel viaduct 1,500 feet long to span the tracks of the Pennsylvania Railroad at Wilmerding and the Turtle Creek and Westinghouse traction tracks. The viaduct will be a link in a belt line which the railway company will inaugurate. The viaduct will connect with what was the United Tracion Company line from Pittsburg to McKeesport and Wilmerding. The Braddock line, now operating to Wilmerding, will be rearranged to take in the viaduct and form the loop. The East Pittsburg, Braddock and Homestead division of the Monongahela system, which now ends at East Pittsburg, is being extended to Pitcairn, two miles beyond.

AUTOMOBILES.

An interesting run is suggested for 1904—from New York to St. Louis. An eastern automobilist says: "My idea is to start a car from New York with its operator and its observer, with no instructions other than to go to St. Louis. The driver must pick his own roads, feed himself and his observer, and cover the course in not less than 10 days nor more than 14 days. He must secure his own gasoline and make his own repairs." The affair may be handled by the American Automobile Association or the Automobile Club of America.

POWER TRANSMISSION.

Columbus, Ga., has granted a charter to the Coweta Power Company, which is organized for the purpose of developing the power of the Chattahoochee River in the upper part of Muscogee County, Ga.

Aluminum for line wire should not be used in too small sizes, says The Tradesman, as it has a low melting point, and in case of a short-circuit from an iron wire or copper wire falling on the circuit the aluminum wire will be melted through.

On a transmission line operating at a pressure of 25,000 volts it has been found undesirable to approach closer than three feet. In closer proximity than this to the bare wires used in such work a disagreeable tickling can be felt—a sort of warning sensation that danger is near.

The weakest part of an electric transmission system is the pole line, and full precaution should be taken to have the poles large and solid and strong, and likewise the cross-arms. It is good practice to reinforce the cross-arm with bolts on each side of pin holes to prevent the arm from splitting in case of any unusual strain.

A survey of the Huron River west of Ann Arbor, Mich., is being made by the Washtenaw Power Company with a view to installing a hydro-electric plant on the river at that point. Power for lighting purposes will be transmitted to the surrounding towns of Dexter, Chelsea and Grass Lake. Six hundred horsepower is available.

The Rouge River Light and Power Company of Rockford, Mich., is about to install a complete water-power electric generating plant. The equipment includes three General Electric Company's generators and various motors, ranging in capacity from 10 to 50 horsepower. The plant is to be in operation by December 1st. The Electrical Equipment Company of Chicago has the contract for the work.

SPACE TELEGRAPHY.

The special train of the Grand Trunk Railway which carried the western general passenger agents to their annual convention at Portland, Maine, on October 13th, was equipped with an experimental apparatus for communicating with the station at St. Dominique by wireless telegraph, and communication was successfully established. The experiment was conducted by men from McGill University, Montreal, and it was readily carried out while the train was running at high speed. Communication was kept up from a point eight miles west of St. Dominique to eight miles east of the station.

PUBLICATIONS.

The Western Electric Company is sending out a finely executed booklet describing its electric exhaust fans and steel-plate blower equipments. The bulletin contains complete information concerning the company's output along these lines and is appropriately illustrated.

The Illinois Electric Specialty Company of Chicago is distributing an amusing advertising novelty in the form of a postal card. On the back of the card is shown, amid appropriate surroundings, a large kettle placed over a hot fire. An artless cannibal is watching this culinary operation, and the reader is assured that "There is something good in the pot." What is really in the pot is a small circular, descriptive of the Illinois direct-reading ohmmeter.

At the recent street-railway convention in Detroit the Crocker-Wheeler Company of Ampere, N. J., distributed a rather striking booklet entitled "A Crocker-Wheeler Trolley Trip," which was descriptive of the Flint division of the Detroit United Railway and its power house at Rochester, Mich. This plant contains considerable Crocker-Wheeler machinery. Views are given of the power plant and of interesting scenes along the line. During the convention the Crocker-Wheeler people gave an enjoyable excursion to the Rochester power house.

The Green traveling-link grate is very well described in Catalogue C, just issued by the Green Engineering Company, 400 Western Union Building,

Chicago. The pamphlet is clearly printed and handsomely illustrated. It explains the principles of progressive combustion in furnaces under steam boilers and shows how the Green traveling-link grate is adapted to secure the end desired—the complete utilization of all the heat units in the coal. The pamphlet also includes valuable coal data and fuel tables for the bituminous field of the Middle States. The catalogue shows evidence of careful preparation and is one that engineers will preserve for reference.

TELEGRAPH.

The Lord Mayor of London, Sir Marcus Samuel, has donated $3,750 from the Mansion House Relief Fund to aid the families of the crew of the cable-repair steamer, Grappler, which was lost with all on board last May as a result of the eruption of Mount Pelee.

Repair work on the St. Lucia-Granada cable was completed on October 10th. The cable was lifted from 2,000 fathoms of water, and, owing to the fact that it was buried in volcanic mud, the strain was very great. However, the task was successfully accomplished.

The Western Union Telegraph Company filed a bill in equity on October 18th against the Pennsylvania Railroad Company to restrain that company from taking away from the telegraph company the right to use the telegraph lines along the Pennsylvania Railroad Company's tracks.

A new rapid-telegraph system is under experiment between Edinburgh and London. It is said that a speed of 300 words a minute has been attained. The system is the invention of Donald Murray, an Australian journalist. It appears to be a modification of the familiar Wheatstone method.

MISCELLANEOUS.

The annual inspection tour of the senior class of the Department of Electrical Engineering of the University of Illinois was undertaken this week. During the week the students inspected the various electrical plants in Chicago. The class was under the personal guidance of Morgan Brooks, professor of electrical engineering at the university.

In the future all the new coaches built for the Pennsylvania Railroad Company will be equipped with electric-lighting facilities. The combination dynamo and storage-battery system will be used. No other provision for lighting the cars will be supplied, it being the judgment of the company's officials that the electric system will be better attended to if the trainmen realize that there is no other means of obtaining light.

Goodwin's Weekly of Salt Lake City says: "The News circulates a story that Lieutenant Morris, late of the navy, thought the sinking of the Maine was due to an explosion on board the ship, caused by a derangement of the electric apparatus on board. When an accident comes or a calamity happens there is always some wise ass that has a theory. The keel of the Maine, or what would be the keel on an ordinary ship, was blown up higher than the ship's beams. Lieutenant Morris in his lifetime should have made a blue print showing how that could have been done by an explosion within the ship."

City Engineer Patton of Duluth, Minn., has secured all the necessary data of conduit systems to be embodied in a report to the electrical commission of that city. Mr. Patton has secured his data from a considerable number of cities in the United States, in each case obtaining information regarding the successful operation of conduit systems as owned by municipalities or by private concerns. His investigations have been carried on by order of the council in order to aid that body in the more intelligent handling of the underground-wire question in Duluth. An underground system is to be adopted in the business center of the city, and it is probable that the conduit system will be owned as a private enterprise.

TRADE NEWS.

The Commercial Electrical Supply Company of St. Louis desires it to be understood that it is in a position to furnish Nernst lamps by contract with the manufacturer, the Nernst Lamp Company of Pittsburg.

Notice has been published of the dissolution of the partnership between C. H. Sumption and O. D. Sumption, who have been doing business in Wichita, Kan., under the firm name of the Sumption Electrical Company. The business will be continued by C. H. Sumption, under the old firm name.

The Central and Northern Ohio electrical trade will be interested to know that the Fisher Electric Company of Toledo, Ohio, has just moved into a commodious store at 116 St. Clair Street, where a large stock will at all times be available for responses to requests for quick shipments of electrical supplies of all sorts. The house will also do construction work, and this branch of the business, as well as the supply department, will be personally attended to by Manager Howard O. Fisher.

N. A. Christensen, consulting engineer with the Christensen Engineering Company of Milwaukee, Wis., announces that henceforth the above-mentioned company will be the sole manufacturer of his air compressors, used in connection with air brakes. He also announces that the manufacture of compressors for all other purposes will now come under his personal direction. "There are now in use," says Mr. Christensen, "over 7,000 air compressors of all sizes and capacities constructed under my patents and used for various purposes."

The annual meeting of the stockholders of the Sprague Electric Company was held Tuesday, October 14, 1902, at the office of the company in Watsessing, N. J. The following-named directors were elected for the ensuing year: Allan C. Bakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee and E. G. Waters. At a meeting of the directors, held later in the day, officers were elected as follows: President, Allan C. Bakewell; first vice-president, S. M. Hamill; second vice-president, D. C. Durland; secretary and treasurer, Harry B. Swartz.

BUSINESS.

The Joseph Dixon Crucible Company of Jersey City, N. J., describes its graphite pipe-joint compound as impervious to heat or cold, alkalis or acids. The company claims for the compound a perfectly tight joint, and yet one that can be easily taken apart if desired.

"Goods received, and thanks for your prompt shipment." This is a sample extract from many letters received by the Electric Appliance Company, Chicago. This would not be extraordinary in ordinary times, but in this busy year and season the fact speaks volumes for the system and "hustle" in vogue at the Appliance company's shipping department.

The Steam and Electrical Equipment Company of Pittsburg, Pa., reports good sales of Wagner motors and Stirling water-tube boilers. The company also reports an order for a complete ventilating outfit of Sturtevant fans for a large Pittsburg building. A complete railway plant is offered for sale by the company. The plant includes two General Electric 100-kilowatt generators, boilers, condensers and all apparatus necessary to make up a plant.

A circular recently issued from under the hand of Manager of Sales Gary of the Fostoria Incandescent Lamp Company of Fostoria, Ohio, contains some pithy, sensible, advice of interest to the man that buys incandescent lamps. "In this grand free country of our's," says the leaflet, "it costs nothing to make statements. Therefore the thing for the buyer to do is to get the manufacturer to produce evidence that he can meet first-class specifications. Get," continues the advice to buyers, "authentic information from central stations that use the lamps." As an instance of its willingness to furnish, or put the buyer in the way to obtain, reliable information, the Fostoria company calls attention to the fact that on July 1st last it was awarded the yearly contract for furnishing the incandescent lamps for all government buildings east of the Rocky Mountains by the United States Treasury Department. The Fostoria company states that this contract, which covers upward of 50,000 lamps, was only awarded after a most exhaustive test had been made upon every American-made lamp (not barring the so-called cheap ones). In a word, Manager of Sales Gary believes he strikes a keynote when he further says, "the mere fact that a high price is quoted does not necessarily mean that the lamp is a good one. The day has long since gone when one individual or company may 'sing a song' of quality—to the exclusion of all others in the case of the manufacture of incandescent lamps. This kind of a 'solo' is out of date. This condition is speedily making itself evident to up-to-date incandescent-lamp buyers." This Fostoria circular is worth reading, particularly from its lack of advertising superfluities, to say nothing of its "trend to dividends," as is evidenced by the title page.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, October 14, 1902.

710,938. Voltmeter Scale. Walter C. Baker, Cleveland, Ohio. Application filed February 15, 1902.

The scale is adapted for co-operation with the movable pointer of a voltmeter, and has thereon graduation marks. Associated with the marks are one set of figures indicating the total voltage of the battery and a second set of figures which indicate the voltage per cell and are respectively the figures obtained by dividing the associated figures in the first series by the number of cells in the battery.

710,940. Electric Fan. Benjamin Blum, New York, N. Y. Application filed February 4, 1902.

Combined with an electric motor and a rotatable motor support are two fans carried by the support and driven by the motor and mounted on opposite sides of the axis of the support and to revolve in vertical planes at right angles to each other.

710,943. Electrode for Arc Lamps. Hugo Bremer, Neheim, Germany. Application filed March 3, 1900.

A self-fluxing electrode consists of an intimate mixture of carbon and a fluorin combined in a proportion of above 10 per cent.

710,946. Electric Bell. Charles L. Burlingham, Chicago, Ill., assignor to the McDermid Manufacturing Company, Chicago, Ill. Application filed November 2, 1901.

In the device are a magnet having a core projecting therefrom, an armature, and a support to which the armature is pivoted, mounted upon the core, and means engaging the core for adjusting the support.

710,953. Electric Battery. Albert J. Cook, Jersey City, N. J., assignor to the Federal Development Company, Charlestown, W. Va. Application filed July 20, 1901.

The battery comprises an outer cell provided on its bottom with a number of spaced-apart sets of ribs, the outer ribs of each set being spaced from the wall of the cell and combining therewith to produce an intermediate channel, an outer electrode located in the channel and partitioned into compartments agreeing in number and shape with the sets of ribs, the partitions being seated between the sets of ribs, and electrode-containing cups fitting and conforming to the compartments and sets of ribs.

710,979. Telephone Transmitter. Miller R. Hutchison, New York, N. Y., assignor to the Akouphone Manufacturing Company. Application filed July 19, 1901.

See page 296.

710,990. Device for Locating Breaks and Grounds on Electric Circuits. Matthew J. Myers, Syracuse, N. Y. Application filed June 9, 1900.

A number of oppositely acting primary conductors connected, respectively, to electric circuits are combined with a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors and means for indicating the current in the secondary conductor.

711,006. Electric Fuse for Explosives. Frederick Schroeder, New York, N. Y. Application filed January 15, 1902.

Combined with a tube containing an igniting substance and provided with an external shoulder, is a coating of a soft material applied to the tube at the shoulder thereof.

711,022. Trolley for Electric Railways. Charles E. Thomas, Springfield, and Jacob M. Olinger, Vienna Crossroads, Ohio, assignors of one-half to the Thomas Manufacturing Company, Springfield, Ohio. Application filed July 21, 1902.

The device consists of a trolley pole, a trolley head provided with a trolley wheel, the pole and head being united by a bayonet joint, the slot or groove whereof is provided with a terminal-locking seat, and a spring interposed between the head and pole to hold the projection of the bayonet joint in the locking seat when the parts are united.

711,031. Process of Making Graphite. Edward G. Acheson, Niagara Falls, N. Y. Application filed December 22, 1900.

The method consists in introducing into an electrical furnace a mass of carbon to be graphitized, in the form of lumps, and also introducing thereinto a volatizable material capable of forming a carbide, and heating the same to a high temperature, vaporizing the volatizable material, thereby causing the vapor to permeate the charge of lumps and to graphitize the same.

711,036. Circuit-closer for Trolley Signals. Winthrop M. Chapman, Newton, Mass., assignor of one-half to William Pestell, Lynn, Mass. Application filed March 9, 1901.

In a circuit-closer are a pair of contacts, a two-way-moving actuating lever pivoted to the frame to close one or the other contact of the pair according to which way it is moved, a one-way-moving arm pivoted to the frame and connected to the lever by a link, and a restoring spring connected to the arm.

711,037. Railway Block-signaling System. Winthrop M. Chapman, Newton, Mass., assignor of one-half to William Pestell, Lynn, Mass. Application filed June 29, 1901.

The system has in combination a signal, a locking device therefor, a magnet acting to set the signal and to actuate the locking device to release the signal, and means for energizing the magnet to set the signal when a car enters a block and for energizing a magnet to actuate the locking device to release the signal when a car leaves the block.

711,107. Electrical Traction System. Warren S. Hill, Hydepark, Mass. Application filed March 31, 1902.

One claim reads: In a traveling contact for an electrical traction system of the character indicated, the combination of a magnet, articulated pole-pieces depending therefrom, the lower members of the pole-pieces constituting contact shoes, each joint of articulation being at one side of the pole axis of the upper member, the contact shoe hung thereto midway of its width to enable the magnetic force exerted by the upper members to depress the contact edge of the shoe.

711,122. Accumulator. Jean B. Relin, Levallois-Perret, France. Application filed December 4, 1901.

A frame is adapted to form the supporting portion of an accumulator element or plate having the side and bottom walls of triangular form in cross section and the upper portion is provided with a series of steps adapted to receive the ends of downwardly depending strips.

711,123. Wave Detector. Lewis T. Rhoades, Phœnixville, Pa., assignor to Marie V. Gehring, Philadelphia, Pa. Application filed August 29, 1902.

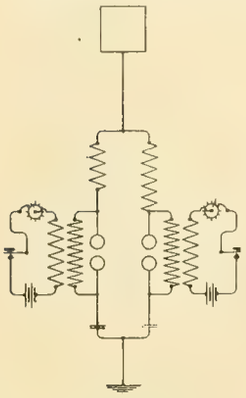
A material for a wave-responsive device comprising nickel and carbon is described.

711,130. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to the

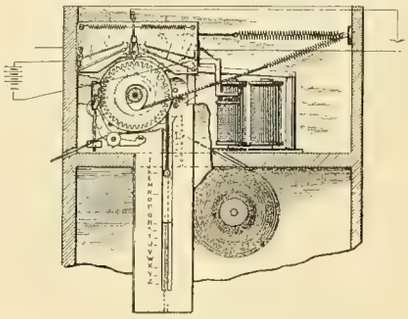
American Wireless Telephone and Telegraph Company, Philadelphia, Pa. Application filed October 16, 1901.

In the system are an aerial conductor, a spark-gap in series therewith, a source of energy in shunt with the spark gap, and a condenser directly connected in shunt to the spark gap.

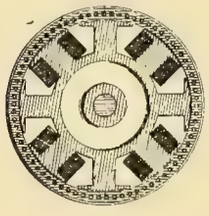
711,131. Art of Transmitting Intelligence. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Application filed August 9, 1902.



NO. 711,174.—WIRELESS SIGNALING SYSTEM.



NO. 711,453.—TELEPHONE MESSAGE TRANSMITTER AND RECORDER.



NO. 711,300.—ELECTROMAGNETIC TRANSMISSION GEAR.

The method of rendering intelligible transmitted electroradiant energy representing a signal is described. It consists in varying the resistance of a material by a magnetic field which varies with the transmitted energy, and recording the variations of resistance of the material.

711,132. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Original application filed August 9, 1902. Divided and this application filed September 19, 1902.

The system combines means for producing a magnetic field, a material located within the field and having the property of changing its resistance in virtue of change of the magnetic field, a circuit controlled by the material and means in the circuit to produce a signal.

711,150. Electric Fuse. Frank Brueggsman, Chicago, Ill., assignor of one-half to John A. Radford, Chicago, Ill. Application filed January 11, 1902.

In the device are combined an external casing, comprising longitudinal half-tubular sections, an interior casing of insulating material fitting therein and provided interiorly at one end with a contact, and a longitudinally removable fuse block inserted through the opposite end of the interior casing and provided with a contact engaging the first-named contact.

711,174. Wireless Signaling System. Greenleaf W. Pickard, Boston, Mass., assignor to Gustave P. Gehring, Philadelphia, Pa., and the American Wireless Telephone and Telegraph Company. Application filed June 22, 1901.

The system comprises a conductor, parallel branch circuits connected therewith, and frequency determining elements complementary with the conductor of different magnitudes in the respective branch circuits. (See cut.)

711,181. Method of Transmitting Intelligence. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring, Philadelphia, Pa., and American Wireless Telephone and Telegraph Company. Application filed January 11, 1902.

The method consists in generating fluctuating electric energy, supplying a transformer with the energy, increasing the potential of the energy by the transformer, supplying an oscillating circuit with the high-potential energy, and modifying the energy by and in accordance with the signal to be sent by changing the impedance of a circuit connected across the terminals of a winding of the transformer.

711,182. Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Application filed September 5, 1902.

In the system are a magnetic field, a normally magnetized member in the field, means for demagnetizing the member by the effect of received electroradiant energy, and means for producing a signal due to the motion of the member in the magnetic field.

711,183. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Application filed September 13, 1902.

The method of transmitting intelligence described consists in transmitting at uniform rate trains of waves of electroradiant energy, producing at the receiver a current fluctuating at a rate equal to the rate of succession of the transmitted wave trains, and producing a signal by the current in a circuit selective of it.

711,184. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Application filed September 16, 1902.

In the system are an electrodynamometer, means for energizing a winding of the electrodynamometer by the received energy, a source of locally generated energy energizing another winding of the electrodynamometer, and a signal-producing circuit controlled by the electrodynamometer.

711,198. Electric Time Switch. William B. Coulter, Waterbury, Conn. Application filed February 24, 1902.

A time movement is combined with a fixed shoulder upon the movement stem provided with a series of holes, a notched disk adjustably mounted upon the stem and bearing a pin to register with one of the holes, means for clamping the parts together, a lever pivoted to bear against the periphery of the disk, a weight detachably connected to the opposite end of the lever, an electric switch and chain connection between the weight and the switch whereby the latter is operated by the releasement of the former.

711,202. Electric Signaling System. Francis K. Fassett, St. Louis, Mo., assignor to the Elevator Supply and Repair Company, Chicago, Ill. Application filed June 13, 1898.

An electric signaling system for elevators is described. It combines a source of electric energy and a rectilinear sectional bare conductor, the sections being insulated from each other and disposed in definite relationship to the several floors of the building containing the elevator. A moving elevator car carries an electric signal device electrically connected to one side of the source of electric energy throughout the movement of the car from top to bottom, or vice versa. A trolley device is electrically connected to the signal device and moves synchronously with the car and contacts with the sectional conductor. A key with connecting wires is arranged to establish electrical connection with the other side of the source of electric energy and one of the sections, whereby when the trolley device engages the section the circuit is closed through the signal device.

711,243. Incandescent-lamp Socket. Walter A. Church, Binghamton, N. Y. Application filed January 10, 1902.

The socket comprises an insulated body portion composed of two parts, a casing, contact plates, binding posts, etc.

711,246. Electric Switch. Christopher J. Doran, Jersey City, N. J. Application filed January 11, 1902.

In the switch is a rotatable cylinder provided with a rotatable sleeve or collar having ratchet teeth at one end thereof, and a vertically movable member supported adjacent to the sleeve at one side of the cylinder and provided with a dog adapted to operate in connection with the ratchet teeth.

711,256. Insulated Joint for Track Circuits. Samuel P. McGough, Newark, N. J., assignor to the Continuous Rail Joint Company of America. Application filed January 13, 1902.

The improved insulated railway-rail connection described comprises rigid rail-supporting bracing billets of insulating material arranged at opposite sides between the heads and flanges of the rail-sections, and angle-plates having inclined flanges and horizontal base-flanges forming acute angles to receive the billets and the rail-flanges, and bolts for drawing the parts together into connection with the rail-sections.

711,266. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Original application filed September 13, 1902. Divided and this application filed September 22, 1902.

The system has a wave-responsive device and a number of parallel selective circuits controlled thereby.

711,276. Apparatus for Rectifying Electric Currents. George B. Batten, Dulwich, England. Application filed June 29, 1901.

The apparatus consists a of movable polarized soft-iron armature having consequent poles of constant polarity, a permanent magnet inducing the consequent poles in the armature, a contact-piece carried by the armature and forming part of a circuit carrying an alternating current, and an electromagnet adapted to be energized by the alternating current to attract and repel alternately both ends of the armature, whereby the armature is caused to make and break contact alternately with the external circuit contacts synchronously with the alternations of the alternating current. (See cut.)

711,286. Trolley. Edwin W. Clark, Columbus, Ga. Application filed April 9, 1902.

Combined with a trolley pole are a trolley head comprising a pole section hinged to the pole, a current collector pivotally connected to the section, and a latch on the section to hold the collector in different positions.

711,292. Electric Railway or Tramway. George F. Cornwallis-West, London, England. Application filed May 23, 1902.

The inventor describes a paving block of devitrified glass which constitutes the top, the bottom and one side of a conduit for carrying an electric-current conductor, the bottom having its upper surface inclined and being provided with means for escape of liquid from the conduit.

711,300. Electromagnetic Transmission Gear. Hardman A. Earle, Manchester, England. Application filed January 16, 1902.

The transmission gear consists of two members fixed respectively on two shafts in alinement, the one member being a shell of iron or steel traversed by copper bolts secured to copper end rings, the other member consisting of an electromagnet having pole-pieces extending nearly to but not contacting with the interior of the shell. (See cut.)

711,386. Means for Signaling to or Communicating with Ships. Leo Daft and Alfred Williams, Wimbledon, England. Application filed June 29, 1901.

See page 295.

711,414. Underground Electric Conductor. Charles Borel, Lyons, France, assignor to Société Francaise de Cables Electriques (Systéme Berthoud, Borel et Cie), Lyons, France. Application filed June 11, 1902.

The conductor has a conducting cover of tubular form over the whole of it, disposed concentrically with it and insulated from it throughout its length, the exterior and interior conductors being electrically connected at one end by a conductor of suitable resistance.

711,421. Apparatus for Electrically Lighting Railway Trains. Arthur B. Gill, London, England, assignor to J. Stone & Co., Deptford, England, Application filed August 25, 1902.

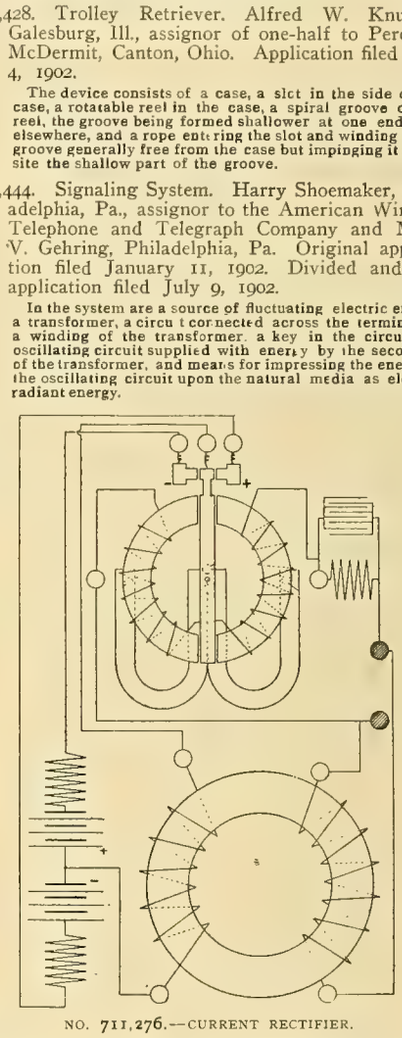
One claim reads: The combination of a rotary shaft switch contacts and electrical connections, a reversible switch lever, a stationary bearing on which the switch-lever is loosely mounted and adapted to move longitudinally and circumferentially relative to the shaft, a centrifugal governor connected to the shaft and adapted to move the switch lever toward the contacts, and means operated by the governor and adapted frictionally to engage with a part connected to the switch-lever to turn the latter, the means being moved out of contact with the part by centrifugal force when a certain speed of the shaft is attained.

711,428. Trolley Retriever. Alfred W. Knutson, Galesburg, Ill., assignor of one-half to Percy F. McDermit, Canton, Ohio. Application filed June 4, 1902.

The device consists of a case, a slot in the side of the case, a rotatable reel in the case, a spiral groove on the reel, the groove being formed shallower at one end than elsewhere, and a rope entering the slot and winding in the groove generally free from the case but impinging it opposite the shallow part of the groove.

711,444. Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the American Wireless Telephone and Telegraph Company and Marie V. Gehring, Philadelphia, Pa. Original application filed January 11, 1902. Divided and this application filed July 9, 1902.

In the system are a source of fluctuating electric energy, a transformer, a circuit connected across the terminals of a winding of the transformer, a key in the circuit, an oscillating circuit supplied with energy by the secondary of the transformer, and means for impressing the energy of the oscillating circuit upon the natural media as electroradiant energy.



NO. 711,276.—CURRENT RECTIFIER.

711,445. Art of Transmitting Intelligence. Harry Shoemaker, Philadelphia, Pa., assignor to the Consolidated Wireless Telegraph and Telephone Company and Marie V. Gehring, Philadelphia, Pa. Original application filed September 16, 1902. Divided and this application filed September 23, 1902.

The method of rendering intelligible transmitted electroradiant energy representing a signal or message consists in producing magnetic fields by the received electroradiant energy, and producing a signal by the action of the magnetic fields upon each other.

711,453. Message-transmitting and Recording Mechanism for Telephone Systems. William F. Smith, San Francisco, Cal. Application filed June 17, 1901.

The rotatable printing device and paper-feeding devices described have an electromagnet, an armature moved thereby, means actuated by the armature to rotate the printing device with a variable extent of movement in one direction, a spring effecting reverse movement, a controlling means operating to hold the printing device against the force of the spring, a second electromagnet, an armature moved thereby operating to throw the controlling means in and out of action, a battery, line-wire separately connecting the two electromagnets with the battery, circuit-closing devices in the circuits of the two magnets and the poles of the battery operating to pass the current from the pole of the battery through one line-wire to the first magnet with a varying number of pulsations, and afterward to close the circuit from the other pole of the battery through the second line-wire to the second magnet. (See cut.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, NOVEMBER 1, 1902. No. 18

Three-phase Pumping Installation at Dortmund, Germany.

By Frank C. Perkins.

It was decided by the Hösch Steel Works to introduce an electrically operated pumping plant in the Kaiserstuhl II. shaft at Dortmund, in Prussia, and to utilize one generating station for supplying the electricity for driving not only the drainage machinery but also for the hoisting gears, ventilators and various mining machinery, as well as for the necessary electric lighting of the mine.

By installing a suitable generating station with steam engines working economically and supplied with superheated steam it is possible to reduce the consumption of steam to such an extent that the losses in electrical transmission are rendered low as compared with the use of separate small steam plants about the mine for operating steam pumps, ventilators and hoists.

Another point in favor of the use of electricity for operating mining machinery is that by the electrical transmission of power there are no losses whatever when the machines at the points of utilization are stopped, which allows of the best and most advantageous manner for the division of the work. This is particularly true in mines, where the pumping plant need not be in operation at the same time as the other machines, and the power which it requires may be used for other work during its periods of inactivity.

This allows of the reduction of the generating power station to a minimum, where the pumping and other work may be carried on alternately, and it is also true that in a large equipment there are always some machines idle at any given time, and the power is thus used elsewhere.

One of the most essential features of every mine equipment is the pumping apparatus, as it is absolutely essential that the drainage of water from the mines be as nearly perfect as possible. Until recently the necessary power used in mines was supplied by steam, water or compressed air, but the electrical transmission of power has the advantages over these forms of not only cleanliness and convenience, but also the lowering of the losses and the economy of energy.

When the two shafts were sunk at the Kaiserstuhl II. mine a flow of water amounting to four cubic meters per minute had to be dealt with above and below the first green sand, and in the marl beds the total flow was estimated at about seven cubic meters per minute. Until three years ago the plant at Kaiserstuhl II. was only equipped with one hydraulic drainage machine on the Kaselowsky system. This apparatus had a capacity of lifting four cubic meters of water per minute about 1,000 feet, and was ample for the purpose, as the drainage then amounted to only about one cubic meter of water per minute. The recent work and development of the mine required larger pumps, as there was seven or eight cubic meters of water running in the slate, and the mine was in danger of being flooded in case of a breakage of the slate beds.

It was not desired to duplicate the old machine, as it had given more or less trouble, and there was not sufficient room at the mouth of the shaft for a pumping plant, while it was considered out of the question to place a steam pumping outfit at the bottom of the shaft, which is 300 meters deep. The electric pumping apparatus was decided upon, as it offered the highest economy with the smallest space as well as permitting of the lighting of the mine and the supply of current for driving the two winding gears of the secondary hoists.

The actual work required of the electric drainage pump was the lifting of five cubic meters of water per minute from a depth of 300 meters, but the plant installed is capable of raising this amount of water 400 meters. The new electric pump operates about five hours a day to carry off the flow of one cubic meter per minute in the shaft.

In the central power station (Fig. 1), which was installed at the same time that the pumping plant was placed in the mine, there was added a small generating unit for supplying the necessary current for hoisting the coal when the large machines were not in operation, on account of the pumps not being required. This small outfit also supplies the necessary current for lighting the mine as well as operating the electric hoists. It is said that the efficiency of the pumping plant is about 65 per cent. between the indicator and water pumped to the shaft mouth when the steam engine is fully loaded.

The boiler plant consists of the old installation of water-tube boilers and the new fire-tube boilers recently added. The latest type of condensing plant has been provided, as well as the most improved steam-drying apparatus. The boilers supply a pressure of steam of seven atmospheres at the throttle of the engines, the fuel used being partly retort gas and partly coal.

The large steam engine has a capacity of 840 horsepower when operated at a speed of 90 revolutions per minute. It is of the compound horizontal type, with the cylinders in tandem, the high pressure being 0.68 meter in diameter and the low-pressure cylinder 1.05 meters in diameter, while the length of stroke is 1.2 meters. The valves of this engine are of a different character in the two cylinders, the low-pressure having round slide valves, while the high-pressure is supplied with distributing valves. The revolving portion of the electrical generator acts as the flywheel of this engine, being keyed directly to the engine shaft.

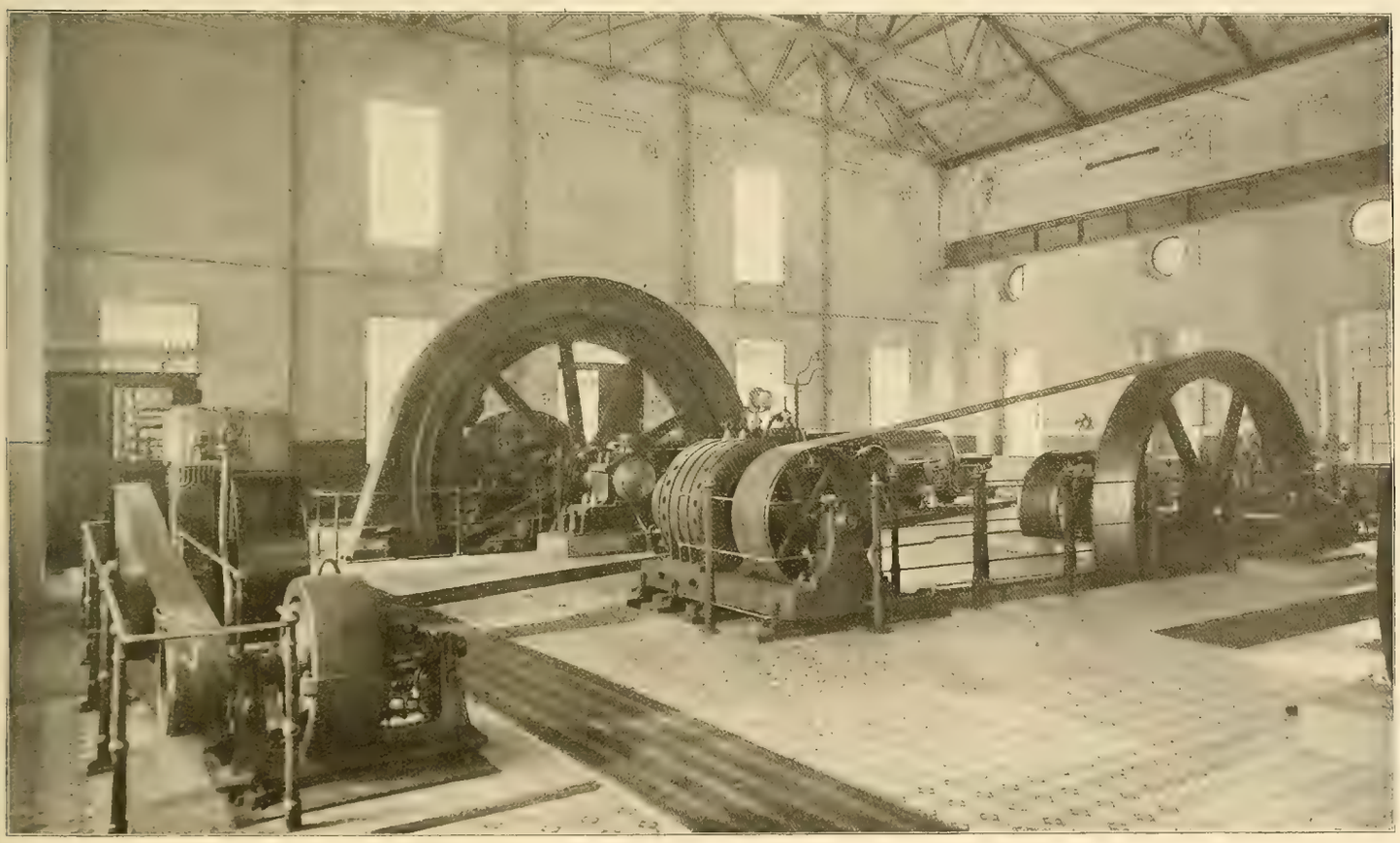


FIG. 1. THREE-PHASE PUMPING INSTALLATION AT DORTMUND.—GENERATING PLANT.

The smaller steam engine is also a compound, single-crank engine of the tandem type. It has a capacity of 150 horsepower at a speed of 105 revolutions per minute. The stroke of this engine is 700 millimeters, and the high and low-pressure cylinders measure 373 and 580 millimeters in diameter, respectively.

The electrical equipment of the power station includes a large three-phase alternator with a revolving field, and the load of this generator is largely the great pump motor down in the mine. Like the motor, this generator is of Oerlikon manufacture. This three-phase generator was designed of such a periodicity that the number of poles for the generator would not be too small and the number of poles of the motor too large. It was desirable to have a large revolving flywheel field magnet for the generator, in order to get the proper regulating effect of this great weight. The frequency decided upon was 22.5 cycles per second, which allowed 36

poles for the motor and 30 poles for the generator, the potential of the latter being 2,000 volts. The magnet flywheel of the alternator is 4.8 meters in diameter, while the air gap is only 10 millimeters, and the flywheel effect at a radius of gyration of 2.2 meters is 17,000 kilograms.

The armature of the generator is supplied with two slots per pole per phase, or a total of 180 slots, while each of these contain seven conductors made up of four wires of a cross-section 4.8 by 5.3 millimeters. There are 68 turns of wire on each of the 30 field-magnet coils, the conductors having a section of 10 millimeters by 11 millimeters.

The field is excited by a direct-current generator driven by a vertical compound engine, although for normal working an exciter might have been coupled directly to the alternator shaft. The separate engine was chosen, as there were some advantages in a plant of this character in being able to start the motor and pump without starting resistance, and this called for separate excitation, absolutely independent of the running of the steam engine.

The current supplied by the large generator not only drives the pump, but also operates various mining tools, haulage gears, bucket elevators and belt conveyors. It is said the full-load efficiency is about 94 per cent. and that the generator showed in actual working an efficiency of 93.4 per cent. at 55 per cent. of normal output.

The smaller unit operated by the 150-horsepower engine is belted to a pulley on the engine 1.165 meters in diameter and half a meter wide, which has a speed of 337 revolutions per minute. The armature of this generator is 0.8 meter in diameter and has 48 slots with 12 double coils, each consisting of 30 conductors having a section four by 4.6 millimeters. The eight field coils each have 182 turns of wire having a section 4.8 by 5.2 millimeters, all of the coils being connected in series. The exciter is directly coupled to the shaft of the alternator, the magnet wheel of which has a diameter of 0.79 meter.

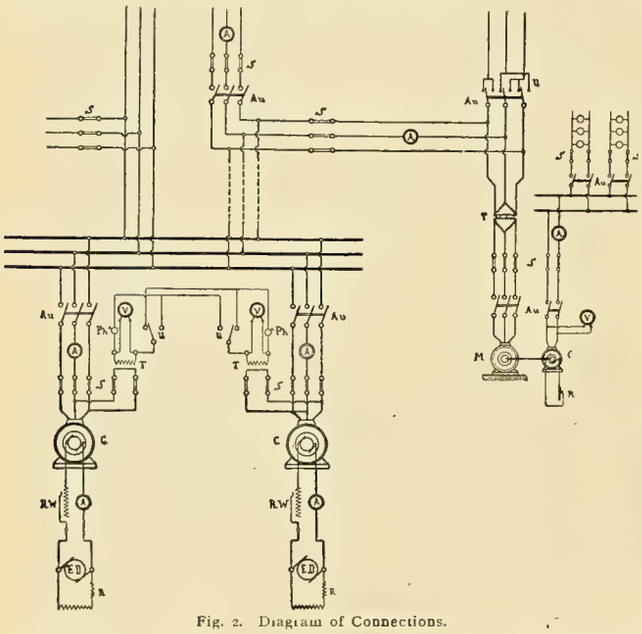


Fig. 2. Diagram of Connections.

In order that the small tools may not be interrupted in working when the large generator and large pump cease to be needed, the small machine is arranged to be switched in parallel with the large alternator before breaking the pump-motor circuit.

The switchboard of the central power station is provided with a panel for each generator, equipped with the necessary voltmeter, ammeter and main high-tension switch, as well as ammeter for the exciting current and regulating rheostat for the field current. Behind the switchboard are placed the transformers, cut-outs, resistances and non-arcing switches.

Fig. 2 gives a diagram of the connections of generators and underground pump motor. A key to the reference letters is as follows: (A), ammeter; (Au), switch; (ED), exciter; (G), generator; (M), motor; (Ph), synchronizing lamp; (R), regulator; (RW), regulating resistance; (S), fuses; (T), transformer; (U), change-over switch; (V), voltmeter.

Power is transmitted from the generating plant to the mine workings in cables consisting of three tinned and well-insulated conductors, bound together and well protected by a lead covering, and over that an armor of steel wires, the whole being bound with jute and treated with asphalt compound. The advantage of using electric cables is particularly noticeable in the laying of these conductors in the mine galleries instead of the piping which would be required for steam or air.

Passing now to the underground electric-pump room (Fig. 4), the pump itself will be first considered. It has a cylinder diameter of 0.225 meter and a stroke of 0.6 meter. The height of suction was fixed at somewhat more than 10 feet, although it might have been chosen at five meters. This pump is constructed with cranks 120 degrees apart on the system having the three cylinders side by side. This arrangement is said to offer an advantage over the simple twin system of a more regular absorption of power, speedier delivery and more regular suction.

The pump is constructed so that the plunger piston works directly between the suction and delivery valves, reducing the quantity of water subject to back pressure to a low point and allowing the high speeds necessary with the electric drive. Near the valves are also located the air chambers for the suction and delivery, and the three valve chambers are connected together by a circulation pipe. The pump can be brought up to speed with this arrangement and a single circulation cock.

Cast-iron suction chambers are employed. They are provided with safety valves to protect them against too high a pressure, while cast steel is used for the construction of the delivery chambers. Central lubrication is employed for oiling all moving parts, the oil being collected in the bed-plate and carried away by proper grooves.

A very high efficiency was obtained at the test of this pump, 95 per cent. being attained with the pump raising 5,100 liters of water per minute, the speed of the pump being 75 revolutions per minute. It was also noted that the discharge losses were only eight per cent. with this circulation arrangement and the actual working head, while this loss will be reduced as the head reaches the maximum which the pump was designed for. This gives the very high combined efficiency of 85 per cent. for the pump, including the water pipes.

It is instructive to consider some of the details of construction of the large three-phase asynchronous motor (Fig. 3) which drives this mining pump, which operates at a speed of 75 revolutions per minute, and with a maximum starting torque develops 570 horsepower, which is about 20 per cent. higher than the normal torque.

One of the conditions of the design of this motor was that the heaviest piece could only weigh 10,000 kilograms and be of a certain size, as it had to pass through a shaft 1.95 by 2.05 meters in cross-section. It was also necessary in the design of this motor that the rotating part should have a very large moment of inertia to take care of and equalize the irregularities of the force diagram of the pump, which made it desirable to allow a slip of more than two per cent. in its speed.

There are two cast-iron spiders mounted on bearings held by three bolts, which, when loosened, allow the support to move round the bearings with the frame. There are 54 bolts used to screw each wrought-iron core to the cast-iron cheeks, each bolt being 20 millimeters in diameter and fixed by hooks to the frame through ventilating ducts.

A small Sulzer pump is used to supply lubrication for the bearings, and the escaped oil returns to a chamber under the bearing and is again pumped up to the distributor over the bearing.

The frame of the motor has an outside diameter of four meters and its width is 0.9 of a meter, the overall width outside of bearings, however, being three meters. The total weight of the motor is nearly 30,000 kilograms, of which nearly one-third is wrought-iron laminations and 1,400 kilograms copper. The rotating portion of the motor weighs 11,000 kilograms.

The stator is mesh-connected, and the resistance of one phase of the stator winding is 0.4 ohm. The intake of the motor when running at 75 revolutions per minute with no load is 1,900 volts and 62 amperes, the frequency being 22.5 cycles per second. When the motor is short-circuited and held at rest the current is 110 amperes at 22.5 cycles and 390 volts pressure and 200 amperes at a potential of 600 volts. At full load 170 amperes is required to operate this pump motor, the power factor being 0.82 and the slip 2.7 per cent., while the efficiency is 92 per cent. The full-load torque is doubled for a maximum torque, which is 11,500 kilogram-meters.

It is stated that the starting resistance is so designed that the motor may be run up to full speed without undue shocks, while at the same time it is possible to bring the pump up to its full output after discharge by a single discharge cock and without requiring other starting apparatus, which is often found necessary and yet troublesome.

The rheostat is not necessary when the motor is started up at the same time that the large generator is started, and it has been found that this can be done equally as well with the motor at full load as with no load.

There is a marble switchboard provided in the electric pump room, with the necessary ammeter and cut-outs, as well as a non-arcing switch, which is used to break the primary circuit. Combination high-tension cut-outs and circuit-breakers are also mounted on the switchboard, and the accurate working can be noted by the ammeter. Three cables are used to conduct the current from the central power station to the pump room. These cables are 120 square millimeters in cross-section and are fastened to the walls and to the main shaft by means of iron hooks. The loss on the line is about two per cent., and the same cables supply current for lighting as well as running the underground haulage gears and electric hoists. There are distribution boxes in the pump room, and the feeders run from this room to various parts of the mine for operating the other electrically driven machines.

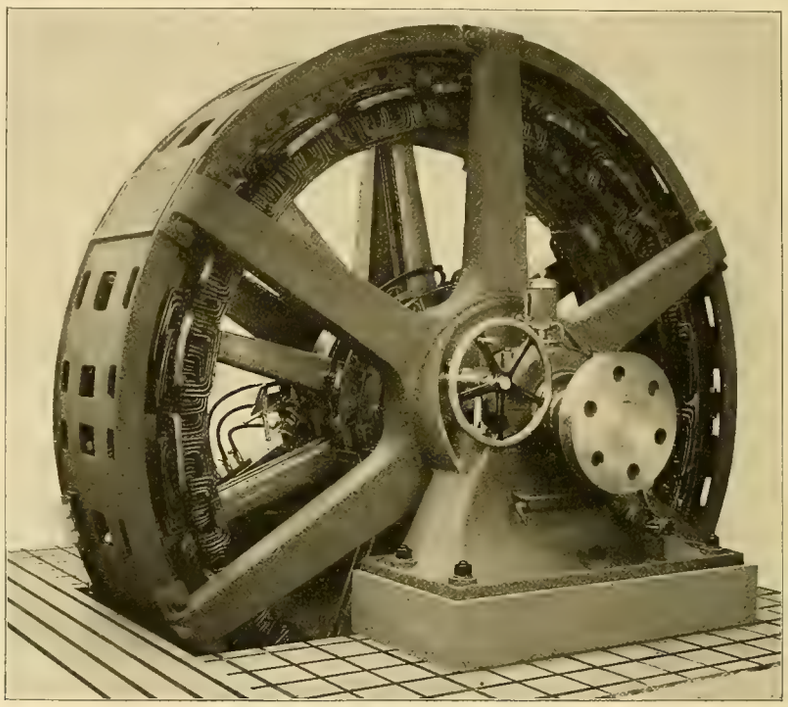


Fig. 3. 570-horsepower Asynchronous Motor for Undergrou d Pump.

THREE-PHASE PUMPING INSTALLATION AT DORTMUND.

The Postal Telegraph-cable Company has opened a new line between Ionia and Greenville, Mich.

Sidney H. Short.

The death of Sidney H. Short, technical director of the English Electric Manufacturing Company of Preston, England, and an American electrical engineer of wide reputation, was briefly announced in the Western Electrician of last week. The news was a great shock to Professor Short's friends in the United States, and expressions of regret at the untimely cutting off of a brilliant career were universal. The following appreciative biographical sketch was prepared by Frank T. Brown and Samuel E. Darby of Chicago, who were not only the attorneys but the intimate personal friends of the deceased.

Sidney Howe Short, a man famous on two continents, departed this life on October 21, 1902, in London, England, as the result of an operation for appendicitis, and in the forty-sixth year of his age. Mr. Short's boyhood was spent in Columbus, Ohio, and he there graduated from the Ohio State University, and almost immediately upon his graduation was offered an instructorship in that university, which he accepted and filled acceptably for some time. He next assumed the chair of physics in the University of Colorado at Denver, but after a very few years voluntarily terminated it, much to the regret of the faculty and the students. Even in his boyhood days Mr. Short manifested the inventive genius which afterward was so wonderfully developed. It was while he was at the university at Columbus as a student that he made improvements on the telephone which were of such merit as to attract the attention of the Bell Telephone Company, and thus realized for him his first financial start in life.

While at the university in Denver he built and successfully operated one of the very first and best underground electric railways, and, with a foresight which would rather be expected from an older man thoroughly protected his system by patents. This line of invention seemed so promising that he resigned his professorship and returned to Columbus, where he interested capital and then constructed an electric railway in its suburbs, and, later, similar railways in other places. These efforts were recognized as successful by the foremost experts of the day, and his patents were acquired for a sum said to be in excess of $100,000 by the Brush Electric Company of Cleveland (through the Short Electric Railway Company) and later passed to the ownership of the General Electric Company.

Some of the stockholders in the Brush Electric Company were also interested in the Walker Manufacturing Company of Cleveland, and entertained the purpose of adding to the line of that company an electrical department; and in fulfillment of this plan they induced Mr. Short to accept the position of general manager and chief electrician of that company, which he did about 1894. Subsequently the name of this company was changed to The Walker Company, and the electrical department, which was at first a mere side issue, rapidly became the principal business of the company, and Mr. Short was promoted to the position of vice-president, and, as soon became generally known, exercised a controlling influence in the policy of that company.

The inventions he made in developing the business of the Walker Company were almost innumerable, and it suffices to say that he obtained upward of a hundred patents on important features entering into most of the different lines manufactured by that company. From the small beginning referred to, the Walker Company grew, under Mr. Short's management, to be a formidable rival of the General Electric Company and the Westinghouse company. At first these powerful competitors were much in conflict in the courts and in the Patent Office, but it soon developed, in the interference contests for priority between Mr. Short and his contestants, that Mr. Short almost invariably was successful and proved to be the prior inventor, so that the patents granted him became very valuable. The Walker motors and the Walker generators, designed by Mr. Short, soon became well known, and the rapid growth of the Walker Company has been regarded as phenomenal.

In 1898 the Walker Company disposed of its plant, effects and patents to the Westinghouse company, and Mr. Short was made a very flattering proposition to attach himself to this latter company, but he was too big a man to renounce his independence, and accordingly declined. In his contract to assign his American patents to the Walker Company, Mr. Short, with a foresight most remarkable, reserved all rights in foreign patents on his inventions. Efforts to buy these foreign patents were unavailing, and Mr. Short immediately made good use of them by organizing in England a complete plant for the manufacture of the entire line of apparatus which he had manufactured in America. This plant, established at Preston, England, is equipped almost entirely with American machinery, and its general manager, chief draftsman, principal electrical engineers, and a number of heads of various departments, are Americans who had been trained by Mr. Short in the plant of the Walker Company at Cleveland. With such an organization, Mr. Short's British company immediately stepped to the front, and at the time of his death he was again at the head of one of the leading electrical companies in the world, and that company was planned by him, organized by him, equipped by him with men and machinery, and operated by him. Mr. Short, therefore, was a notable exception to the general rule that inventive genius and business capacity do not unite in the same person. As might be expected from his collegiate training, Mr. Short also possessed marked literary ability, and his articles on various electrical and scientific subjects attracted commendation whenever they appeared.

Mr. Short was physically as well as mentally notable. His stature was six feet and an inch; and this height he carried well, for he was both erect and graceful. His manners were polished, his demeanor that of a gentleman, and his well-known kindness of heart beamed through the windows of his soul upon whomsoever he looked, so that socially he was as popular as he was in business successful.

We had intimate business relations with Mr. Short for a number of years, and thereby had opportunity of noting his inflexible honesty, his kind sense of justice, and his cheery, kindly manner. Never have we seen the head of a large business concern whose employes more thoroughly respected, and, at the same time, universally regarded, their chief. He believed in the merit system of promotion, and all his subordinates appreciated this fact. The best proof of this is that, notwithstanding the many changes in his business career, many of his employes followed him and eagerly sought employment under him, even to the point of leaving the place of their nativity and dwelling with him in his last venture in a foreign land.

Not only do his social equals deplore the shortening of his career, but we venture to say that this sad event has cast its shadow upon thousands of humble homes where before the memory of his kindly presence was wont to dwell. And now that he has appeared before the Final Judge, that searcher of all hearts will find evidences of his good work recorded in the breasts of the lowly, and mete out unto him his just reward for good deeds performed on this earth.

And we are sure that all the readers of the Western Electrician who knew him will join us in expressing the deepest sympathy for the woman who has lost a true husband, and for the children who have lost a good father.

SIDNEY H. SHORT.

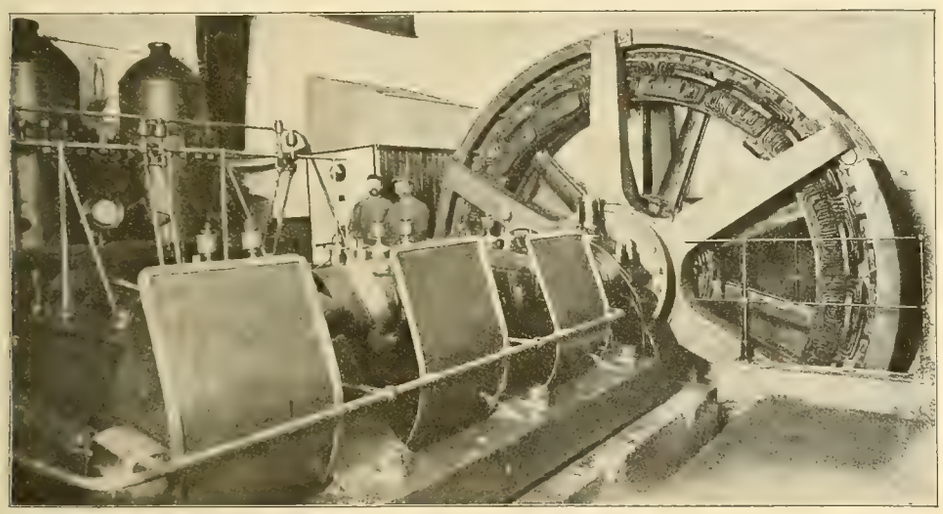


FIG. 4. INTERIOR OF UNDERGROUND ELECTRIC PUMP ROOM AT DORTMUND.

Electric Power in Rolling Mills.

Electric motors are now used in many of the large rolling mills of Europe, where their operation has proved very successful. The Nordisk mills at Stockholm have been using electric power for some time past. Here a large plate-rolling mill and a smaller mill are both driven by the same motor. The large mill has a set of rolls 28 inches in diameter, with table lengths of four and six feet. In this case it was not found practicable to drive the rolls directly by motors, but instead a mechanical device is used for driving and reversing the movement, and a friction clutch gives a progressive movement and avoids shocks. The plant is driven by a direct-current motor of 350 horsepower working at 320 revolutions per minute. The motor is belted by wire rope to a 30-ton flywheel, which runs at 150 revolutions. The flywheel is mounted on the main shaft, from which the two rolling mills and the mechanism of the tables is operated by gearing. A friction clutch is used to throw off the smaller mill and allow the larger to work alone. This plant has been running for some time past and has many advantages over the old method.

Another application of electric motors to operate steel-plate mills is found at the Antwerp Steel Works, where a plant has been lately installed. The current is furnished from the new central station erected by the Antwerp Electric Company near the city—a large plant which is to produce 25,000 horsepower from blast-furnace gas. This company will furnish current for the different industries in and near Antwerp, and one of the first is the Antwerp Steel Works, for which are used two generating sets giving three-phase current. Westinghouse alternators are used here, giving 1,500 horsepower each at 2,200 volts. At the steel works both high and low tension is used for the motors. A number of small motors drive different apparatus, such as traveling cranes, shears, small rolls, etc., and these all take current at 200 volts, which is fed from transformers. The large rolls, however, use the main current at 2,200 volts without transformation, employing non-synchronous motors which work at variable speed. One of the largest rolls, turning at 70 revolutions, and having a 30-ton flywheel, is operated by belt from a 325-horsepower motor, and a second roll, the heaviest in the plant, has a 450-horsepower motor. The two motors are lodged in the same cabin, placed between the two mills. The controlling apparatus is mounted on an elevated platform, where the operator has a view over the whole shop.

The Ashland Avenue bridge over the Chicago River, which was described in detail in the Western Electrician of September 20th, was formally opened on Friday of last week.

Small Electric Furnaces.

Small electric furnaces are coming into use for laboratory and experimental work in France and Germany, and are proving quite successful. They are generally formed of a central tube of refractory earth or porcelain, on the surface of which is wrapped a spiral of platinum wire carrying the current. Upon the wire is a layer of asbestos cord, and the whole is enclosed in an outer casing of metal or refractory matter. These furnaces have great advantages, as it is easy to regulate the temperature and keep it constant. The latter feature is especially desirable for laboratory work, and is difficult to carry out with a gas furnace. It is found that it does not cost any more to operate an electric than a gas furnace. These furnaces are especially valuable in studying the properties of steel, and to obtain the heating and cooling curves, which are of importance. In this case the ease of regulating the temperature makes these operations less difficult to carry out. In France Mr. Charpy used a furnace of

FIG. 1. SMALL ELECTRIC FURNACE.

this kind in his experiments of 1895 on the tempering of steel. He employed a tube of refractory material 25 inches long and one inch internal diameter, in which the pieces were placed. Around the tube is a platinum wire of one-fiftieth-inch diameter, then a layer of asbestos, which receives the second spiral. Asbestos cord covers the whole, and it is enclosed in a large brass cylinder, with the inner space filled up with loose asbestos. At present a furnace of the same kind is used in the laboratory of the De Dion automobile firm at Paris, where they make careful tests on the steel which enters into the machines. This type, however, has some disadvantages. The contact between the round wire and the tube takes place at only one point, and, in consequence, the heat is badly conducted to the tube. The platinum has to be raised to a high temperature, and thus takes more current than is necessary. In some places the wire adheres to the tube and forms points which are overheated and likely to burn out the wire. Then a fusible silicate is apt to form even below the fusing point of platinum.

In order to improve these conditions, a new type of furnace has lately been designed by a German firm of platinum manufacturers, the Heraeus Company of Frankfort. The main improvement is the use of a platinum band instead of wire. The band is very thin and is wound so as to leave but one-eighth-inch space between the spirals. Thus there is good conduction between the metal and tube, and both work at the same temperature. Fig. 1 shows the disposition of this furnace, with the inner heating tube and flat spiral, asbestos cover, then loose asbestos in the remaining space. The weight of the

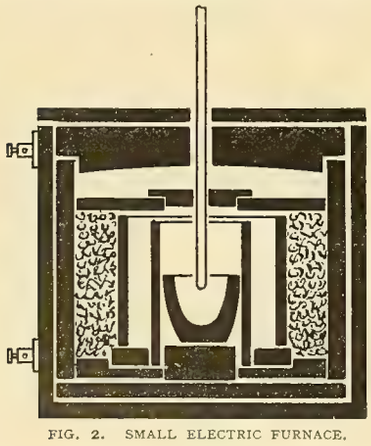


FIG. 2. SMALL ELECTRIC FURNACE.

platinum is six times less than before, which makes the furnace much cheaper. The distribution of heat is better and the regulation more rapid. In this way a tube furnace of one-inch inside diameter can reach 1,400 degrees Centigrade in five minutes, and the tube does not suffer from the quick change of temperature. A higher heat can also be reached, owing to the good conduction; this is now 1,500 degrees, and even 1,700, but no tube can be found which will stand the latter temperature. The Royal Porcelain Works of Berlin have found a new material which can stand it, but, unfortunately, between 1,600 and 1,700 degrees it becomes more or less conducting, and so electrolysis takes place and the spiral is destroyed, no doubt because it absorbs silicon. With this form of furnace it requires about 2,000 watts to obtain 1,400 to 1,500 degrees Centigrade. The maximum difference between any two points of the tube eight inches apart is only 20 degrees. The central tube is 24 inches long and has 18 inches covered by the band. Another improved furnace has been devised by Professor Holborn of the Imperial Physical Institute of Charlottenburg (Berlin). Here the porcelain tube, two inches in diameter and 4.4 inches high, is placed upright (see Fig. 2) and wound with a platinum spiral. The interior is large enough to contain a small crucible. With this furnace the inventor obtains about 1,250 degrees Centigrade. The cut shows a thermo-electric couple mounted in a porcelain tube and introduced through the cover. This has been found especially useful in taking the melting points of bodies. The platinum weighs but five grammes, and to obtain 1,250 degrees requires about 1,500 watts.

Institute Meetings in Pittsburg.

At a meeting of Pittsburg members of the American Institute of Electrical Engineers held on Monday evening, October 13th, a committee consisting of P. M. Lincoln, Professor S. M. Kintner, Calvin W. Rice, J. S. Peck and F. B. Erwin, was appointed to call a second meeting, provide a programme therefor, and to propose a plan for a permanent organization.

The committee decided to accept the invitation of the Electric Club, an organization made up chiefly of engineering apprentices, to hold the next meeting in its hall in Wilkinsburg, on Thursday evening, November 6th. The members of the club were in turn invited to attend these meetings and to take part in the discussions. As to programme, it was decided to take up for discussion the general subject of illumination, suggested by the papers taken up at the October meeting of the Institute in New York. Professor Kintner of the Western University of Pennsylvania is to give a resumé of the papers presented at the general meeting, and Charles F. Scott will give a summary of the New York discussion. Mr. A. J. Wurts will be asked to discuss the general topic of the evening—illumination. Although no definite arrangements have yet been made, it is expected to have talks on the Nernst, Bremmer flame-arc and Cooper-Hewitt lamps by gentlemen who are more or less familiar with these subjects. Acetylene lighting and indirect electric lighting will also receive a share of attention. It is also proposed to illustrate the remarks by exhibitions of the lamps themselves. A Nernst lamp, a Bremmer arc lamp, a Cooper-Hewitt lamp, and an acetylene-gas light will be exhibited in the hall during the evening. The stated communications will be restricted to not over 10 minutes each, and the subject will then be thrown open to general discussion.

As to permanent organization, the committee will recommend that an executive committee of five, consisting of a chairman, a secretary and three other members, be elected at the meeting of November 6th to take full charge of this local section, including the calling of meetings, the preparation of papers, etc.

National Electric Light Association.

Interest in the National Electric Light Association seems to be steadily increasing. The membership having expressed an almost universal desire to have the arc-lamp tests continued, a letter has been sent out asking for voluntary contributions to a special fund for this purpose. This is being liberally responded to, and the work will be resumed in a short time. If subscriptions continue to come in as generously as they have so far, a valuable report will be presented at the next convention.

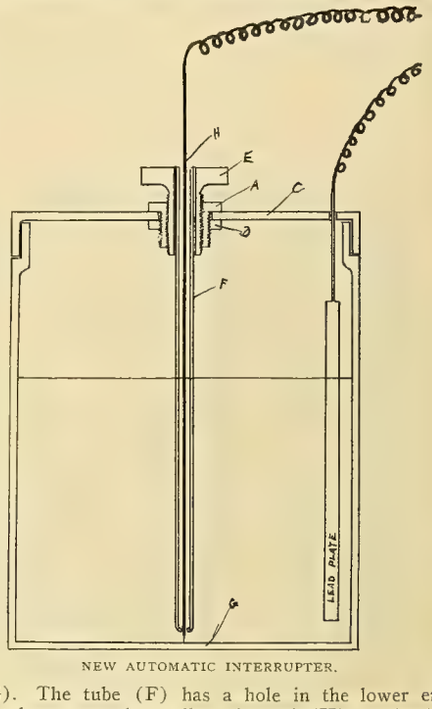
During the month ended October 25th the following-named companies and individuals joined the association:

Evanston (Ill.) Electric Illuminating Company.
Hoosick Falls (N. Y.) Electric Company.
Crookston (Minn.) Water Works, Power and Light Company.
Citizens' Electric Company, Eureka Springs, Ark.
Portsmouth (O.) Street Railway and Light Company.
Meridian (Miss.) Light and Railway Company.
Morrison County Electric Light, Heat and Power Company, Little Falls, Minn.
Westport (Conn.) Water and Electric Company.
Zanesville (O.) Electric Light Company.
Faraday Heat, Power and Light Company, Morton, Pa.
United Gas and Electric Company, Dover, N. H.
Monett (Mo.) Electric Light, Power and Ice Company.
Branford (Conn.) Lighting and Water Company.
Robert E. Strahorn, Sumpter, Ore.
Havre de Grace (Md.) Electric Company.
Citizens' Electric Company, Eaton Rapids, Mich.
Taylorville (Ill.) Electric Company.
Washington (Pa.) Electric Light and Power Company.
Larimer Light and Power Company, Fort Collins, Colo.
Janesville (Wis.) Electric Company.
Waynesburg (Pa.) Electric Light and Power Company.
Antigo (Wis.) Electric Light plant.
Key West (Fla.) Electric Company.
Canadian Electric Light Company, Quebec.
Ashland (Ore.) Electric Light and Power Company.
Big Fork Electric Power and Light Company, Kalispell, Mont.
Streator (Ill.) Gas and Light Company.
Cheyenne (Wyo.) Light, Fuel and Power Company.
North Shore Electric Company, Hoquiam, Wash.
Madison (Ind.) Lighting Company.
Lewistown (Pa.) Electric Light Company.
Dayton (Wash.) Electric Light and Power Company.
Electric Company, Connellsville, Pa.
Citizens' Electric Illuminating Company.
Erie (Pa.) Company.
Consolidated Gas and Electric Company, Batavia, N. Y.
Georgetown (S. C.) Electric Company.
Pipestone (Minn.) Light, Heat and Power Company.
Newport (N. H.) Electric Light Company.
Pine Bluff (Ark.) Light and Water Company.
Roanoke (Va.) Railway and Electric Company.

A New Automatic Interrupter.

Dr. C. O. Schneider, 237 Warner Avenue, Chicago, has invented and patented an interrupter for use with induction coils which is said to result in great improvement in X-ray work where only alternating current is available. The results with this interrupter and alternating current are asserted to be superior to those obtained from the direct current. After it has been adjusted to allow the proper amperage to flow through the circuit for the work in hand, the new interrupter requires no attention; it works continuously, the electrode feeding itself by gravity, as fast as it is consumed. This insures a definite and constant area of surface exposed to the electrolyte, which may be changed by turning the thumb-screw (E). By means of this screw the operator has full control of the current. A rheostat would be superfluous. The device works equally well without a condenser.

The diagram explains the principle upon which the interrupter works. (A) is a screw which is fastened to the lid (C) by means of the nut (D). In the screw (A) revolves the screw (E), which has fastened into it the glass tube (F), which can, consequently, be raised from the bottom of the jar



NEW AUTOMATIC INTERRUPTER.

(G). The tube (F) has a hole in the lower end just large enough to allow the rod (H), preferably of german silver, to pass through easily. The part of the rod (H) which protrudes from the bottom of the tube constantly wears off to a perfect point, which rests on the bottom of the jar.

Railway Combinations in Ohio and Indiana.

Articles of incorporation of the Traction Terminal Company were certified to in Cincinnati recently. The capital stock was placed at $100,000. This is the formal recognition of the union of the Ohio electric railways entering Cincinnati. The purpose of the new company is to build a central depot to be used by the different companies and to provide suitable terminals. The incorporators are J. B. Foraker, Jr., George H. Warrington, Dana Stevens and Frank H. Wilcox. The Mill Creek Valley interurban lines, those of the Cincinnati Traction Company and of the Mandelbaum syndicate will make use of the terminals and central station. A difference in the gauges of the interurban and city lines will necessitate some arrangement for accommodating the interurban cars, but just what is to be done has not been settled.

The Indianapolis correspondent of the Western Electrician writes: "It is now generally understood that the Ohio and Indiana electric roads are to be consolidated. The preliminary contracts signed at Cincinnati last week by representatives of the Widner-Elkins and the Mandelbaum-Pomeroy syndicates are said to be an agreement for community of interests between the syndicates, and the consolidation only awaits the formal approval of the companies interested. Hugh J. McGowan, who is the Indianapolis representative, said that the negotiations during the week are taken in traction circles to mean that the syndicates propose to consolidate all their electric lines in Ohio and Indiana, with division offices at Indianapolis and Cincinnati, the combine including the street railways of the two cities."

Electrical Manila.

By R. G. Mayse.

If the city of Manila is a criterion of what the future electrical progress is to be in the other municipalities of the Philippines, the field of electricity is going to be largely developed in that part of the world during the next few years. The writer finds that electrical devices of all descriptions are being introduced very extensively in the manufacturing establishments, public buildings, hotels, restaurants, offices, etc., not only of Manila itself, but in the surrounding towns, with which electrical connections have been effected. In order to get some ideas for American readers as to the conditions of electrical progress in Manila, I secured a few snap-shot photographs, herewith reproduced.

Electrical wiring is being pretty thoroughly introduced in the busy portions of the city, and the telegraph poles of the Spanish are so heavily laden with wires carrying electrical currents for running mechanical devices or lights that very many of them are almost ready to break down. I found defective poles to be one of the drawbacks of the city's equipment of electrical wiring. These poles are nearly all too short, and often the lower lines of wires are caught by high wagonloads. Of course, the Spanish telegraphic line corps never intended the poles to do the work now required of them.

One of the first requirements for the improving of the systems of electrical wiring in the city of Manila involves the putting in of new poles. American makers of metal poles would find it a good investment to send their poles to this country. Manila proper is not the only electrically inclined city. Iloilo, Zamboanga, Cottobatto, Cebu and a number of other leading cities and towns are quite anxious for the introduction of a better system of electrical equipment. Iloilo, for example, has subscribed liberally toward the putting in of an electric plant to furnish power, lights, etc., for Jaro, Moro and suburbs. Zamboanga is one of the leading seaport towns of the southern section of the archipelago and is developing wonderfully.

In taking into consideration the wiring of a city like Manila for lighting, power and the like, the electrical engineers have a number of problems that do not confront the average engineer in the United States. Manila is a walled city, and these walls are wide, deep and often double. There are large trenches in front of the walls to be crossed by wires. The little tunnel entrances through the walls are just wide enough for the passage of one vehicle. There is not much spare room above or below or at the sides. So when it comes to extending wires through these gates and tunnels, there is always the problem of getting space. There is not room enough to put in lights, and lights have to be at either opening of the passage or sunk into cavities specially cut in the walls. Occasionally the conditions are such that the wires can be put over the great walls. The report is that the engineers are planning eventually to remove the disfiguring walls, which have been about the city so many years. There is not very much actual underground work at present, for the reason that the Spanish never put in underground systems of drainage or the like. But the American municipal engineers have done some underground work lately, and it is likely to be extended.

There has been considerable of a building boom in the business districts of the city within the last year, and as a result many new edifices planned by American architects have gone up or are in progress of erection. One of the views shows a portion of Manila's main business street, and a lineman adjusting wires, with native helper.

The buildings are constructed so nearly like American buildings that when one passes through the newly built portion of this street, viewing the plate-glass fronts, with the electric fans, electric signs for advertising at night and other electric-light and power devices, he can readily imagine himself in some American center.

I find that there has been a great improvement in electrical things in general in the city of Manila. There are several first-class establishments in which one may purchase electrical devices, electrical working tools and fittings of all sorts. This was not the case a year or two ago. Then one was lucky if he could find an assortment of electrical equipments of any kind. Furthermore, there has been a readjusting of values. One used to pay most exorbitant prices for anything electrical, but now prices are as reasonable as can be expected under the circumstances. If you step into one of the electrical furnishing shops or stores of the city, you will find that prices are seemingly high. But this is because you are comparing prices with values in America. If you calculate on costs of transporting devices here from America, and add the costs of the custom-house duties and general percentage of breakage, you will wonder how the things can be offered so cheap. At least, this was my experience after I sat down with an electrical engineer in his office and figured the thing out in black and white.

Another feature of the Manila electrical trade which struck me this time was the improvement in the amplitude and variety of the goods carried. It used to be that you had to take what the dealer had or do without. Now you can have a selection of two or three makes of the same article, and a selection from among varied patterns. There are full cases of practically all parts of electrical everyday devices in stock, and users are not obliged to wait two or three months for some simple part to be shipped from America.

I am convinced that there is a brilliant future for electrical business in these islands, not only in the electric-lighting, power and kindred lines, but for electric street-railway service as well. Iloilo and Cebu, likewise Zamboanga and other growing places, want electric roads. Your correspondent has been in all of these places during the last three years. I found that the roads in these towns are suitable for electric-railway traffic for miles, extending in different directions, making connection with surrounding settlements possible. If I had nothing else to do, I think that I would invest capital in an electrical supply store for some one of these growing places. Manila itself is amply provided with electrical supply depots, although there is room for more under the growing conditions; but I am convinced that a supply depot in one of the more southern ports is required. Borneo and adjacent countries near the southernmost point of Uncle Sam's new possessions in the far Pacific are requiring electrical furnishings.

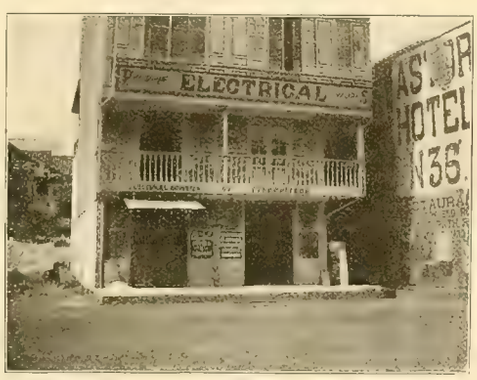
I was in Jolo and interviewed representatives of the Sultan of Sulu, and this individual, who possesses the means to carry into effect any undertaking money can put through, desires that his domains be outfitted electrically. That is, he wants an electric railway, an electric power plant for operating sugar mills and hemp works, electric lighting for the toy-like little city of Jolo, which is within walls and is swept out every morning by a gang of natives, like a child's doll village. A few of the diamonds and pearls of this sultan would alone pay for the putting in of a plant of moderate size for purposes of lighting Jolo.

A few words concerning cable and general telegraph wiring in the business sections may be of interest. There is little system in the wiring of Manila; it is simply a jumble. But what can you expect, when most of the work has to be done by natives because of lack of skilled electrical workers. Experienced linemen are rare. I met with several gangs of linemen, consisting usually of about eight brown-suited natives, with one head native to interpret and hold the gang in hand and one American to oversee the work. From the beginning to the finishing of the work the American is obliged to watch, instruct and curse the natives. Some of the natives are excellent workmen, will climb a pole and do a good piece of work. But the majority are a shiftless lot, who can do nothing more than dig post holes. If the boss has to send one of them up a pole to repair a wire, the native will probably make such a poor job of it that the thing has to be done over again. The helpers are first-class at going up a tree to fix wires in trees, and will sit on a limb indefinitely, making a repair. However, if the electrical companies cannot get skilled labor, they must use the natives. The fact that experienced linemen are scarce makes wages high, and we hear of pay ranging from $75 to $125 gold a month for the American workmen, while the native lineman gets $20. But the latter is worth no more, and the American is worth all he gets here, for he makes his knowledge extend over a large field of operations.

Poles and Wires near Water Front.

Poles and Wires in Malate, a Suburb.

Linemen at Work in Business District.



A Supply Store.

ELECTRICAL MANILA.

X-Ray in Personal-injury Claims.

In a paper on "The Adjustment of Damage Claims," presented at the recent convention of the American Street Railway Association in Detroit, and written by Mason B. Starring of the Chicago City Railway Company, this paragraph occurs: "Science has come mightily to the aid of the adjuster in throwing the tell-tale searchlight of the X-ray machine upon the human anatomy. This marvelous discovery is effecting great and good results in all personal-injury departments of those corporations which have had the good fortune to come in contact with, and secure the service of, an expert in its use. Many are the cases of fraud and imposition which it has exposed, and a great many (how many I never have gone into the details to carefully ascertain) of the claims that bones have been broken or fractured in steam or street-railway accidents have thereby been shown to be mere frauds, and that no fracture or fractures existed. Previous to the invention of the X-ray instrument it was much more difficult for the adjuster to ascertain the truth in regard to this point. A limb placed in a plaster cast is thereby put beyond the close inspection of a physician, and it is manifestly impossible to compel the removal of the cast for the direct inspection of the wound; this afforded an easy and successful mask for deceit. Now, however, the X-ray reveals, almost at a glance, the real condition of the hidden bone. Could an instrument be invented which would as indisputably and as accurately determine the extent of injuries to nerves and muscles as this machine does to bones, the task of adjusting personal injuries would be greatly lightened and the uncertainty which prevents an always accurate decision would be very largely removed."

The Tarentum and New Kensington (Pa.) Street Railway Company has been granted a franchise by the New Kensington council. The new electric street railway will be built at once.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Three-phase Pumping Installation at Dortmund, Germany. By Frank C. Perkins. Illustrated 305, 306, 307
Sidney H. Short. Portrait 307
Electric Power in Rolling Mills 307
Small Electric Furnaces. Illustrated 308
Institute Meetings in Pittsburg 308
National Electric Light Association 308
A New Automatic Interrupter. Illustrated 308
Railway Combinations in Ohio and Indiana 308
Electrical Manila. By R. G. Mayse. Illustrated 309
X-ray in Personal-injury Claims 309
Editorial 310
An Interview with Marconi 311
Parisian News Service by Space Telegraphy 311
Space-telegraphy Congress at Berlin 311
The Public and the Corporations 311
Formal Opening of New Power Canal at Sault Ste. Marie 311
Electrical Development in Southeastern Pennsylvania 311
Distributed Lighting. By Douglas Burnett. (American Institute of Electrical Engineers.) 312
Electric Elevators. By Charles R. Pratt. (New York Electrical Society.) 312
The Advance in Applied Electricity 312
North Jersey Traction Deal 312
An Integrating Photometer for Glow Lamps and Sources of Like Intensity. By Charles P. Matthews. Illustrated. (American Institute of Electrical Engineers.) 313
Development of the Telephone Field. Illustrated 314, 315
Important Telephone Change 314
International Telephone Company 314
Michigan Telephone Reorganization 314
The Telephone System of Berlin 314
Telegraph and Telephone Advancement in Japan 314
How to Use the Telephone. Illustrated 314
New Companies 314
Indiana Telephone Items 315
Ohio Telephone Notes 315
Telephone News from the Northwest 315
Colorado and Wyoming 315
Traction or Mine Telephone 315
Chicago Telephone Tunnels Inspected 315
Place of Correspondence Schools in Electrical Education. By Harris C. Trow. With discussion. (Chicago Electrical Association) 316
Cable Code for General Public 316
New Works of the B F. Sturtevant Company at Hyde Park, Mass. Illustrated 317
Steamboat Connection with Interurban Road 317
Hot-water Heating from a Central Station. By E. H. McKnight. With discussion. (Ohio Electric Light Association.) 318
How to Oppose Municipal-ownership Agitation 318
Edison's New Storage Battery in Europe 318
Electric Parcel Delivery in England 318
Alfred Vanderbilt's Electric Plant 318

DEPARTMENTS.

Correspondence 319, 320
New York Notes 319
New England News 319
Southern Developments 319
Texas and Old Mexico 319
From the Buckeye State 319
Detroit, Mich 319
Information from Indiana 320
Northwestern Notations 320
Among the Rockies 320
Personal 320
Electric Lighting 320
Electric Railways 320
Power Transmission 320, 321
Societies and Schools 321
Publications 321
Space Telegraphy 321
Miscellaneous 321
Trade News 321
Business 321
Illustrated Electrical Patent Record 321, 322

DATES AHEAD.

Interstate Independent Telephone Association, Auditorium Hotel, Chicago, December 9th, 10th and 11th.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

ANTI-AMERICAN tariff agitation in Canada seems to be bearing fruit in rather an unexpected manner. A Chicago company manufacturing arc lamps was the lowest bidder on a prospective contract in Toronto last week, but its tender was rejected, apparently for no other reason than because it was that of an American concern. It is declared that Toronto and other Canadian cities have announced their intention to refuse all tenders from the United States in future until this country reduces its tariff and changes its anti-Canadian labor laws. This looks, from a point of view on this side of the lakes, like cutting off one's nose to spite one's face. The position is an unenlightened and narrow one, and we cannot believe that it is due to anything more than a passing fit of resentment.

A CURIOUS investigation—one without a counterpart in the United States, perhaps—has been made by Professor Ernest Dubois of the University of Ghent and Armand Julin, division cheif of the Belgian Labor Bureau, who were appointed by the Belgian minister of industry and labor as a committee to make an investigation into the economic effects of the introduction of the electric motor on domestic or cottage industries. In the report an effort has been made, first, to present the economic results of the introduction of the electric motor, and second, to discover whether, in the domestic industries investigated, the introduction of machinery moved by electric power tends to prevent or retard the progress of the concentration of industry in factories. The industries investigated were watchmaking in Switzerland, silk weaving in Lyons, France, and ribbon weaving in St. Etienne, France.

In the Swiss watchmaking industry the factory, under the stimulus of American competition, has steadily enlarged its field and correspondingly lessened the opportunities of the domestic worker. In the hope of bettering the lot of the latter, he has been offered electric power, generated from waterfalls, at favorable rates. But, according to a recent bulletin of the United States Department of Labor, which reviews the Belgian report, in spite of all efforts, the small motor has not found an extensive use among the domestic workers. The expense of installation and of changing tools is usually too heavy for the limited means of this class of producers. Many of them have but little use for power in the manufacture of their specialties, but the principal reason assigned is the lack of interest on the part of the workmen themselves.

Conditions in the silk-weaving trade in and near Lyons are somewhat different. An electric company offers power to domestic weavers for 75 francs ($14.48) a year for each loom, the service not to exceed 250 hours a month. Added hours may be arranged for on the basis of a pro rata payment. As the hand looms could not be altered to meet the requirements of the new motive force, new equipment throughout was found necessary, and to meet this expense a benevolent society loaned money without interest. By this means this society has assisted in installing 300 looms for silk weaving in addition to 200 looms for other kinds of weaving. The results of this innovation are more regular employment and an increase in the earnings of the weaver. But it is objected that the use of the electric power tends to make the domestic weaver a competitor of the factory in the cheaper staple goods rather than to increase his efficiency as a producer of those grades of silk which require special artistic and technical skill.

At St. Etienne, owing to the irregular demand for ribbon, the factory has not developed to any great extent, and the ribbon-weaving industry is practically controlled by the domestic producers. The ribbon hand loom is of such construction that it can be altered for the use of mechanical motive power at slight expense. The power is secured from a stock company, which supplies electricity to the town and makes a special effort to furnish power in the form needed by the domestic weaver operating two or three looms. The minimum charge for each loom is 7.50 francs ($1.45) a month; if the motor is rented from the company a rental of one franc (19.3 cents) a month is charged.

Of the three domestic industries under discussion, the ribbon industry offers the largest possibility of introducing the electric motor. So long as the demand for the product is constantly changing, requiring different shapes and sizes for each season, and especially so long as the demand in general varies so greatly, it is probable that the domestic weaver will control the industry. The employment of the electric motor reduces the physical strain on the workman and allows the use of cheaper grades of labor, such as that of women, children, old men, etc. Without doubt, the motor increases the production of the lathe or loom and increases the net income from each machine, but, even with the aid of the electric motor, the Belgian investigators think that there is little probability of the domestic workshop ever superseding the factory. In the United States the factory system is developed to its highest point of efficiency, and research of the character of this report seems to be just a trifle archaic to the up-to-date economist. Nevertheless, where cheap and reliable waterpower is available, with the constantly extending area of practicable electrical transmission, it is difficult to set the bounds of the utilization of the power, and the small consumer may assume an importance that is not now anticipated.

SINCE the days of Jonah, fish stories, even when proceeding from the mouths of the righteous, have been received with a certain polite incredulity. Therefore, even the most zealous advocate of electric lighting will pause for a moment's reflection before accepting unreservedly the startling claims made for a certain electric fishing boat which is said to be the most interesting craft in the harbor of Norfolk, Va. According to the tale, the novelty will be the catching of fish by electricity. The boat, which is provided with two 16-horsepower "electric engines" for driving her two propellers, has a third engine of six horsepower which drives a dynamo for the generation of the electric current which "illuminates the boat at night from top to bottom, and from stem to stern, and is used in her 2,000-candlepower searchlight and four submarine lights." It is by the submarine lights, on booms extending from each side of the boat as she lies at anchor in the river at night, that fish are to be attracted. When the inquisitive fish have come in large numbers, as they are expected to do if they be true fish, "immense nets that have been lowered below the surface of the water are raised and the fish caught are thrown into skiffs stationed on either side of the boat." It all seems beautifully simple, but it appears that the promoters of the scheme have lost sight of the fact that since the great multiplication of submarine cables fish of all kinds are not nearly so unsophisticated as they once were. We shall be surprised if the finny denizens of the deep in these progressive days do more than give a contemptuous flirt of fin and tail as they turn away in disdain from the prosaic electric lights of the Norfolk fishing boat.

IN THIS era of unexampled interurban-railway building the subject of signaling and train dispatching on the electric lines acquires a constantly increasing importance. Electric-railway men are naturally concerned to secure that system which shall insure the safest operation of their cars or trains. Considerable attention has been paid to the subject, but much, very much, remains to be done. Perhaps the most systematic study of electric-railway signaling has been made in Massachusetts, where an intelligent and active State Railroad Commission is making constant inquiry into the cause and prevention of collisions on electric and steam roads. A gentleman from that state—G. W. Palmer, Jr., of Taunton—read a short paper on "Signals for Urban and Interurban Railways" before the recent street-railway convention. The paper was suggestive in nature and should have elicited an instructive discussion; but the subject did not seem to possess interest to the delegates, and the discussion was brief, being principally confined to the remarks of one gentleman. Before any widespread and radical improvement can be made the problem must be attacked in a more earnest and systematic manner than that indicated by the indifferent attitude of the association at Detroit. The steam-railroad companies have passed through a long and trying experience in this line and are still learning. They can give valuable hints to the electric railroads, but in many respects the electric companies must work out their own salvation, owing to differing conditions of operation. Merely from the financial point of view, one bad collision may use up all the available assets of a road in settlement of damage suits. For that reason, if for no other, the electric roads should give prompt attention and thorough study to this most important subject.

An Interview with Marconi.

On his recent return to England from Italy William Marconi was interviewed by the London Daily Chronicle and made some interesting statements. He said: "My stay in Italy, though short, has been extremely pleasant, and rendered more so by the courtesy of the king with whom I have spent several days. I have also pleasant recollections of the kindness extended to me by the Italian heads of departments, especially the minister of posts and telegraphs and the Italian minister of marine, who journeyed with me to Turin and Spezzia to discuss certain questions connected with the working of wireless telegraphy in Italy. My system is largely in operation in that country, where I have a contract which includes installations on ships of war. Moreover, the Italian government is considering the establishment of Marconi wireless-telegraph stations to connect Italy with both South and North America. The existing stations in Italy are for communicating with ships only."

Asked as to the difficulty of using his wireless system over wide land spaces which include mountainous districts, Mr. Marconi replied: "If land constituted a serious obstruction, we should have experienced a difficulty in communicating between England and Spezzia, but, as a matter of fact, there has been no difficulty. Personally I have never held the view that large land spaces offered a serious obstacle if suitable means were taken to overcome it. I know a contrary view is very widely entertained, but I have never shared it. This is shown by the results of communication between Spezzia and England, and Gibraltar and England, over the Alps and Pyrenees. The correctness of my conclusions have been amply demonstrated."

To the question, "What do you suppose the future has in store for you?" Mr. Marconi replied: "It is difficult to speak of the future. We have made enormous progress during the last year or two, and, realizing that, one is hopeful of similar progress in the time immediately before us."

"Have you experienced failure owing to adverse climatic or atmospheris conditions?" was then asked. "Well," replied Mr. Marconi, "all along the Mediterranean Sea thunderstorms are of frequent occurrence. We have sent messages in fair weather and in foul, and never on a single occasion has one failed to come through satisfactorily in consequence of atmospheric disturbance. The king of Italy, I may mention, was strongly impressed with the absolute reliability of our system, and he is giving me every support."

Questioned as to the international aspect of the subject and the forthcoming convention of the various countries interested in wireless telegraphy, Mr. Marconi observed: "To my mind the promoters of the international convention have not a sufficiently accurate knowledge of the subject with which they propose to deal to put forward any propositions of value. To be candid, I regard the proposed convention as neither more nor less than another attack by Germany upon British industry. It is probably thought in Germany that as matters stand wireless telegraphy is at present too much in favor of England. The general interests of navigation are not so much considered there as the local interests of Germany. The British and Italian navies have adopted my system, and there is none other in use in the mercantile marine of the world."

"You consider that the Germans have first appropriated your invention and now wish to assert their right to use it and make a profit out of it?"

"That is so. I do not wish to place myself in antagonism to Germany or any other country. I wish to serve all alike, but as to Germany the facts are these: Professor Slaby came to England and was introduced to me by the British Postoffice authorities. He came at the instance of the German government to study my system of wireless telegraphy. He received every facility from me to do this. He went back to Germany. He lectured there, declaring that he himself had attempted experiments in wireless telegraphy which had proved unsuccessful. He had seen what Marconi was doing, which represented a real invention, and he admitted that whatever he did in the future would be due to Marconi, his master. He adopted the essential features of my system—vertical wire for transmitting and receiving, for instance. These are the main features of his system. He introduced some other variations which I consider detrimental—indeed, experiment proves them to be so. He has established a so-called system of his own by which he has telegraphed one-twentieth of the distance I have covered. The German manufacturers who have no inventor's royalties to pay are prepared to sell their inferior apparatus for a small manufacturing profit. It is the desire of the German emperor, I presume, to support them in this undertaking, and this it is which has inspired the demand for the convention. I think that a convention might at the proper time be a good thing, but the time is not ripe for international consideration. It is better to let fair competition work out its natural results. You cannot well yoke my system to an inferior and unsuccessful imitation. The attempt is to place inferior imitations on terms of equality with the original system."

Parisian News Service by Space Telegraphy.

Some account of the novel projects of the Société des Télégraphes Sans Fil of France has already appeared in this journal. Further details are now given by the Paris correspondent of the Western Electrician:

This company proposes to carry out two different schemes. The first is to establish at Paris a system of wireless telegraphy between a main central station and branch staions, the latter to supply subscribers throughout the city. The stations will have high masts erected on the roofs sufficiently high to avoid obstructions. In this way it is proposed to transmit to the subscribers the news of the day, especially that of the most pressing interest, such as sessions of Parliament, stock quotations, foreign news, races, etc. The company has already established a central station at its headquarters, Place de la Madeleine, and a second station near the Bourse, and the writer had occasion to observe the transmission of the messages between the two stations, which was carried out without difficulty. A third station has also been located in one of the leading newspaper offices. This is the beginning of a system which will no doubt be greatly extended in the near future. The project is headed by Victor Popp, a leading engineer and founder of various enterprises, such as the Popp compressed-air system of Paris; also a large central electrical station which feeds part of the city. The apparatus to be used is that which has been lately designed by Prof. Branly, and contains several improvements, one of which, the use of an oxydized metal coherer, has been lately described. It consists of three rods mounted so as to rest upon a metal plate, and its operation is very successful.

The company expects not only to establish the Paris system within a short time, but is now preparing to erect three aerial telegraphy posts on the French coast, one at the Cape de la Héve, near Havre, another at Courseulles, on the north coast, and a third at Barfleur Point, on the channel. It is intended to communicate between these posts and also with ships. Later on the system is to be extended all along the coast of France, also on the north coast of Africa from Algiers to Tunis, so as to connect the whole coast and signal to ships at 80 miles distance. Such a system has naturally a great importance from a military point of view. The war vessels, some of which now have apparatus on board, will be constantly in communication with the whole of the coast and with Paris.

The Public and the Corporations.

Generally speaking, the public maintains a double standard of morals—one for dealings with corporations, another for transactions with individuals. The man who holds himself bound to govern his relations with a corporation by the same rule of morals and ethics which regulates his relation with the natural instead of the artificial citizen, is fast becoming as extinct as the dodo. Almost the universal attitude is that a corporation is not entitled to receive that strict application of the law of good morals and common honesty which is shown to individuals acting in private capacities. Put into common parlance, the public code in dealing with a corporation seems to be that "A man is entitled to all he can get out of a corporation."—Mason B. Starring on "The Adjustment of Damage Claims"—a paper presented to the American Street Railway Association.

Space Telegraphy Congress at Berlin.

It is now asserted that the international congress to consider space telegraphy called by Germany will be held in Berlin toward the latter part of March next. The purpose of the convention is the discussion of the relations between the space-telegraph stations of different nations. America, Austria, England, France and Italy responded to the initiative of Germany in a most friendly spirit, and a majority of these states have intimated to the Berlin government that they will accept an invitation to such a conference on condition that the programme is fixed beforehand and sent with the invitation. It is not yet quite certain whether it will be possible to draw up a programme before the end of February next.

Successful tests were made recently between the Naval Academy at Annapolis, Md., and the auxiliary cruiser Prairie with the Slaby-Arco system of space telegraphy. The Prairie was 70 miles down the Potomac River. The Slaby-Arco system is said to have given satisfaction as far as the experiments have gone. Tests will be continued until the extreme limits of the system are determined.

Formal Opening of New Power Canal at Sault Ste. Marie.

A celebration covering two days, Friday and Saturday of last week, was held to mark the fruition of the great power project at Sault Ste. Marie, Michigan and Ontario. The fête was the occasion of the formal opening of the new power canal, the waters of which will operate the mammoth electric power plant of the Consolidated Lake Superior Company.

On Friday, October 24th, the school children of the city paid the first tribute to the promoters of this great undertaking by marching in a body from the High School to the plant of the company, where a banquet was tendered them. One estimate places the number in line-of-march at 3,000. In the evening of the same day the company gave the citizens and their visiting friends a reception and ball. The formal opening of the new canal occurred on the morning of Saturday, October 25th, and at noon Miss Helen Clergue, sister of Francis H. Clergue, organizer and general manager of the company, turned a jeweled switch that, for the first time, set the wheels of one of the world's greatest power plants in motion. The first current generated was used to run one of the company's new electric street cars. A civic and military parade marched through the streets during the morning in which, it is said, over 10,000 men took part. In the afternoon an industrial parade was given which showed the different products of the Clergue institutions in the various stages of manufacture, from raw material to finished product. At night the festivities were ended by a banquet given by the company. At this banquet, Mr. Clergue said that the new canal was only the beginning of the development of the "Soo." Speaking of waterpower development in general, he said: "The fall of water between Hamilton and Quebec is equal to 10,000,000 tons of coal a year, and I predict that in 10 years not a ton of coal will be used in Canada between Hamilton and Quebec for manufacturing purposes. In the state of Michigan not a ton of coal will be used for manufacturing purposes. Waterpower will have taken its place."

Of the possibilities of the "Soo" Mr. Clergue said: "There is no limit to he prospects of the 'Soo.' In five years you will see here steel plants beyond your dreams, flour mills to feed the nation, shipyards to build and vessels to carry the products of all these industries to the markets of the world."

Electrical Development in Southeastern Pennsylvania.

York, Pa., October 23.—The organization of several companies of large capitalization for the locating of power plants on the Susquehanna River at points between Havre de Grace, Md., and Wrightsville, York County, and on Muddy Creek, a stream of swift current emptying into the Susquehanna River, has led to much conjecture as to the objects of the companies.

Promoters of some of these companies gave it out from time to time that the object of constructing the plants was to furnish electrical power for establishments that would be attracted to locate in the territory affected. Through statements made by persons in a position to obtain an inside knowledge, the chief purposes of the prospective plants have just been made public here. These are the building of a well-equipped electric railway from Wrightsville, Pa., to Havre de Grace—about 70 miles apart—for passengers, mail and freight traffic; the equipment of the ancient Susquehanna and Tidewater Canal for the running of freight boats by trolley and the equipment of the Maryland and Pennsylvania Railroad for the operating of trains by trolley from York to Delta, Pa., a distance of about 50 miles, and the subsequent converting of the same road from Delta to Baltimore—45 miles farther—into an electric line. A large corps of surveyors has been at work along the towpath of the ancient canal for several months.

The power-plant companies have already set men to work to put their plans in execution, and surveys are being made for the building of several dams across the lower Susquehanna River.

The company having the navigation of the canal for its project has had in its employment for some time mechanical and electrical experts who are perfecting plans which, it is said, will solve the problem of propelling canalboats by means of the trolley system.

The Maryland and Pennsylvania Railroad Company was chartered in 1856. Since the York Traction Company has established a contiguous trolley line from York to Red Lion (in York County, Pa.) with a view of extending it finally to Delta, the steam road has experienced a falling off in its patronage, and for some time the company, which includes a number of shrewd Baltimore capitalists and bankers, has had under consideration the substitution of electricity for steam. Attorney H. C. Niles, counsel for the Maryland and Pennsylvania Railroad, states that there is nothing in the company's charter to prevent it from using electricity as a propelling force. W.

Distributed Lighting.[1]

By Douglass Burnett.

I wish to direct thought to the necessity of determining—not the conditions existing at the prime source of light, but those existing at the illuminated surfaces with which we are constantly concerned in daily life.

No light may ever be used until it impinges upon something, for, unless interrupted, light will continue along a straight line indefinitely. Distributed sources of light and diffusing surfaces are always present in actual lighting. The percentage of time which one spends and of work which one does in direct sunlight in city life is very small; artificial lights should be and are usually so screened or arranged as to take advantage of the diffusion and minimize the glare in one way or another. These results are secured by applying more or less ornamental shades to naked flames, by frosting incandescent lamps or surrounding them with diffusing screens and directing shades and by encloseing arc lamps and gas lamps of high intensity in translucent globes.

These processes are carried to an extreme in cases of "concealed lighting," where all the lamps are hidden from view behind solid cornices or translucent materials. In New York city there are several excellent instances of halls or rooms lighted entirely in this manner, using incandescent lamps.

The indications are that such methods may be applied to a greater extent than heretofore in the event of developments in vacuum-tube or gas-tube lighting. This type of lamp should lend itself particularly to diffused-lighting effects, owing to the greater area of the source of light and its correspondingly decreased intrinsic brilliancy; the result would be a decrease in the spotting effect, which has been difficult to eliminate with incandescent lamps, owing to the brightness of the wall surface in the immediate neighborhood of the lamps. The optical efficiency is also high, being as much as 32 per cent. for Geissler tubes, compared with five per cent. to 10 per cent. for incandescent, and 15 to 25 per cent. for arc lamps.

It would be interesting to compare the intrinsic brilliancy of the light of such tubes with that of other lights; the figures are for an arc crater 6,400 candlepower per square centimeter, for a Nernst glower about 100, for an incandescent filament about 40, and for an Argand gas flame 0.3 candlepower per square centimeter. In connection with these figures it may be said that the arc lamp is much too dazzling for exposed use ordinarily, and even with the incandescent lamp the after-image is quite prominent. It is seen that the development of lights of high intrinsic brilliancy renders increasingly important the study of the distribution and diffusion of their light.

An error, which I think has always been made, is in connection with the plotting of the space intensity curves of incandescent, arc, Nernst and other lamps. The impression they convey would much more nearly accord with what actually occurs if the curves showed—not the intensity of light in the various directions, but the lines along which the lighting is equal at any point. Such curves may be called "isophotals," and while they are of the same general shape as intensity curves, their dimensions are as the square root of the radii.

A theoretical set of such curves has been published by Weber.

The tendency of enclosing an arc, for instance, either in the interior gas globe or more particularly in the outer diffusing globe, is to make such an isophotal curve approach more nearly a circle, which effect is further enhanced by the diffusion from a neighboring ceiling, thus tending toward the desired result of a flat curve, indicating uniform illumination.

Arc lamps for the lighting of country roads should be such as throw their lighting downward; whereas in the lighting of city streets, lined with buildings, such lamps should be used as will throw an amount of light on the walls for diffusion purposes as will not be objectionable to the occupants.

A number of photometers for determining the intensity of sources of light have been devised, while few instruments, notably those of Weber and of Houston and Kennelly, for the measurement of illumination on a surface have been described; and in each of these the lighting was not measured directly, but was adjusted by means of screens or by means of the weakening of visual power, and then compared with a standard amount of illumination. The nearest approach to attempt such a measurement has been made, I believe, by Hutchinson, in connection with the lighting of the Congressional Library at Washington, but in this case a simple photometer with a Bunsen grease-spot disk was used, one side being exposed to the illumination of the room, the other to an adjustable standard of light—in this case a 16-candlepower lamp, but in that case the candlepower was measured and the illumination estimated from the known distance of the groups of lights, no allowance being made for diffusion; and all measurements were made in a single position.

The Bunsen, the Lummer-Brodhum, and other standard photometers operate with varying and indeterminate amounts of lighting on the surfaces to be compared; and any one of them is in essence a luminometer rather than a photometer, since the candlepower is deduced by the application of the mathematical formula instead of measured or compared directly.

The author has devised an instrument arranged so as to expose a standard white surface to the ordinary lighting of a room, the amount of which is not varied. The position of a small incandescent lamp in reference to a similar and adjoining surface is, however, adjusted in order to secure within commercial limits an equal illumination, the position of this standard lamp being indicated on a graduated scale in terms not of distance but directly in terms of the number of luxes. Other observers have stated that the use of small incandescent lamps is quite permissible for such purposes for several hundred consecutive observations. The only precaution necessary in the use of such an instrument would be to shield the eyes from light other than that reflected from the two standard surfaces, and to shield each respectively from the other source of light.

It may be of interest at some future date to plot the space-candlepower curves from a standard open arc without enclosing globe, the space-candlepower curves of an enclosed lamp of the same watt consumption with the diffusing globes used in practice, the isophotals from the latter lamp, the theoretical illumination from the open arc along a horizontal surface without diffusion, and the actual illumination curves from the lamp with the enclosing and diffusing globes in a room under normal operating conditions.

In addition to the case cited, there have been but few instances where the amount of illumination on a surface has been measured or calculated, notable among which may be mentioned a test of the lighting of the streets of Paris.

Our methods of expressing illumination have been in terms of the number of standard lamps, such as those of 16 candlepower, 50 watts per hundred or thousand square feet of surface. Bell has expressed an opinion that five candlepower per square inch is a maximum for interior lighting. Cohn has given 10 meter-candles as the hygienic minimum and 50 meter-candles as the value of daylight; and Wybauw has given 15 to 25 meter-candles as necessary to fluent reading, or one meter-candle for street lighting. Possibly practical requirements may hereafter be more clearly specified by the assistance of some such instrument as has been suggested in this paper.

1. Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, October 24, 1902.

Electric Elevators.[1]

By Charles R. Pratt.

In the early days of elevators the safety of hanging a car on ropes was questioned, and cars were made to climb up the hoistway on racks or screws. The plunger elevator men of to-day make some people believe that a car is only safe on the end of a long pipe. But nearly half a century has proved that accidents caused by the breaking of ropes on passenger cars are almost unheard of.

In the drum elevator the ropes, as you well know, lead from the car to the drum, and are anchored to its helical grooves. A similar set of ropes lead to a counterweight, which usually weighs as much as the car and its average load, and so has no gravity work to do at average load, working against gravity when going up with full load, and coming down with no load, and being driven by gravity when going up with no load and coming down with full load.

Herein lies the difficulty of perfect control. Plain shunt winding keeps the speed within 10 per cent. variation going with or against gravity and gives perfectly safe operation with a practical speed variation of 50 per cent. by field regulation. Compound winding saves the heavy starting currents of shunt-wound motors, but it is necessary to provide means on the controller for preventing the series field windings of the motor opposing the shunt windings when the motor is being driven as a generator.

The operation of the various devices used in the Jones automatic system of electric-elevator control is as follows: On pressing any selected button in the car, or the button at any landing, and provided that all landing doors are closed and that the car is not in use by another, a circuit is established through the "floor relay" coil, corresponding to the selected button. The "floor-relay" magnet is energized, lifts its plunger (core) and establishes a circuit by means of suitable contacts, and through the "floor-limit switch" connected to these contacts, and through the "up" or "down" reversing switch, depending on which "floor-limit switches" are closed. The car then starts for the selected landing. Included in this same circuit is the coil of the "locking magnet," the plunger of which is mechanically connected to the locking bar, which bar is just under the floor-relay magnets. This locking bar operates to hold the floor relay first energized in the "running" position, and all others in the inoperative position, until the car reaches the selected landing and the entrance door has been opened. You will understand that the car cannot be moved from a landing while a person is in the act of getting in or out of the elevator. The opening of the entrance door automatically unlocks all "floor relays" and the controller is again in normal starting condition, after the door has been closed.

The important mechanical features of a drum electric elevator are a solid bed, reliable driving mechanism, a reliable brake, and a reliable limit.

Through error in the specification, or the desire of the elevator builder to cut his price by using too small a motor, 25-horsepower motors are sold to do average work of 10 horsepower, and vice versa, and the elevator condemned for its inefficiency. This is an injustice to the machine as well as to the motor, because 10 horsepower cannot be transmitted efficiently through a 25-horsepower machine, nor can 25 horsepower be transmitted through a 10-horsepower worm gear without undue heating and consequent loss of efficiency. As there is certainly not five per cent. difference in the efficiency of the various makes of motors used on these elevators, the question of difference in efficiency between different makes of worm-gear electric elevators is not worth the trouble that is generally made over it.

The electric elevator as a system, for any kind of service whatever, needs no defense to-day; it is logically and pre-eminently the best. But the demand for safety and reliability in high-speed office-building service will never let it replace the hydraulic until its safety and reliability for that service have been proved beyond all question. It will be a long, hard struggle to accomplish this, as I well know from personal experience. But early prejudice has been overcome, and any attempt to build a high-speed electric elevator for office-building service will receive more encouragement than opposition, and no difficulty will be met with in finding a building to install it. This confidence and encouragement should not be abused by risky experiments; let safety and reliability be preserved in every step of our progress toward this end.

1. Selections from a lecture given before the New York Electrical Society, October 22, 1902.

The Advance in Applied Electricity.

The contractor for the building of the New York rapid-transit subway recently made the somewhat startling statement that, owing to the great developments of the electrical art now going on, a generation of electricity was not now over three years, whereas when he had originally figured on the work it was considered to be at least seven years. The great advance in the design and construction of an electrical equipment for the production and utilization of electric power for tractive purposes has enhanced the cost of equipment to such an extent that, although the contractor in question had engaged the best electrical engineering talent in the preparation of his original estimates, he now finds that the actual cost for the equipment will exceed the estimate by many millions of dollars. This experience, however, is not altogether peculiar to electric-traction equipments, for there is probably no large electric-light or power company in existence, with operations extending back over 15 or 18 years, that has not found it essential to change its entire system two or three times in that period.

The telephone exchanges especially have undergone repeated radical changes in the last 15 years, so much so that an immense quantity of perfectly operative apparatus has been thrown into the junk-heap to make way for improved and generally more economical methods of operation. In one case alone, in the city of New York, telephone apparatus to the value of $400,000 was for this reason deliberately dumped into the junk pile. It is also fresh in the minds of the American investing public how the traction companies of New York, at enormous expense, changed, in a few years, from horsepower to the cable system, and then to the underground electric-traction system.

In addition to the losses which these various changes in the methods of operation have involved, enormous expense has also been incurred in the larger cities by the substitution of the underground in place of the aerial system of conductors. This change in the case of the telephone company operating in New York city entailed a loss equal to three-fifths of the entire net earnings of the company since its organization. The only electrical industry, it may be remarked, that has not suffered in the past 20 or 25 years from radical changes in the methods of operation is the telegraph, the losses of this general nature here having been confined to the change from aerial to underground wires in cities. This fact has given the impression in some quarters that the telegraph companies are not progressive, and loud demands have been made upon those companies to adopt some of the many systems of rapid machine telegraphy whose inventors are clamoring for recognition, the fact being lost sight of, or ignored, that the methods now in vogue in telegraphy are, it may be said, specimens of the survival of the fittest. Machine telegraphy from the earliest days has been tried, and, in numerous respects, found wanting.—Cassier's Magazine.

North Jersey Traction Deal.

The North Jersey traction deal mentioned in a recent issue of the Western Electrician is, according to report, practically consummated. Mr. Frank Gould and the syndicate headed by him are said to be in control of the various electric-railway systems through a pooling arrangement. The deal was to have been closed some time ago, but, owing to the high rates of money in New York, the formal transfer was not made. Uzal H. McCarter of the Fidelity Trust Company of Newark, N. J., is said to be the holding agent of the pool. Fifty-one per cent. of the stock is reported as being manipulated by the syndicate.

An Integrating Photometer for Glow Lamps and Sources of Like Intensity.[1]

By Charles P. Matthews.

In a previous paper I have described an equipment designed for the photometric study of arc lamps. The most valuable feature of this equipment lies in its ability to yield a value of the mean spherical luminous intensity from a single photometer setting. It is the purpose of this paper to describe an apparatus possessing this same valuable feature, and several others worthy of note, when used for the photometry of the incandescent lamp and other sources of the same order of brightness.

Designed especially for incandescent-lamp measurements, the apparatus has several functions and might have been styled a "universal glow-lamp photometer." It is capable of use for all photometric measurements on the glow lamp that do not lie in the province of spectro-photometry. To particularize, it may be used as follows:

(1) As a simple photometer for any unidirectional measurements, such as occur in standardizations, ratings and candlepower distributions.

(2) As an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candlepower.

(3) As an integrating instrument for the direct determination of the spherical reduction factor; that is, the ratio—mean spherical; mean horizontal candlepower.

The fact has long been recognized that the only strictly fair basis for the comparison of incandescent lamps, is that of the total flux of light emitted, a quantity proportional to the mean spherical candlepower. It is possible by altering the configuration of the filament to concentrate luminous flux in particular solid angles at the expense of flux in other angles. Hence, two lamps of equal rated candlepower may yield total light flux in quite different amounts. On the other hand, if two lamps have initially the same mean spherical candlepower, their relative value is determined simply by their power consumption and sustained candlepower. The vexed question of what is the most useful light may well be left to the purchaser, who can select the type of filament best adapted to his own needs. The question is comparable to that which asks: What is the best diet for man?

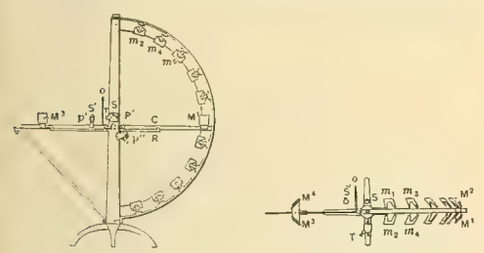


Fig. 1.

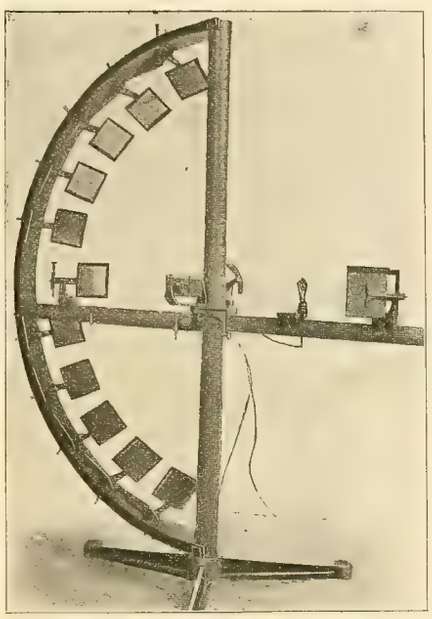


Fig. 2.

INTEGRATING PHOTOMETER FOR GLOW LAMPS.

It would appear that there is need of a photometer capable of giving the mean spherical candlepower of an incandescent lamp with the ease and celerity obtainable in the ordinary photometric measurement. With this need in mind, I have designed and had constructed the apparatus described.

[The theoretical basis of the design is omitted.]

Fig. 1 shows in elevation and plan the essential elements of the apparatus. To the right is seen the mirror system, each pair of mirrors being capable of a certain amount of radial movement for purposes of the initial adjustment of the instrument. (S) is the lamp to be tested, mounted upon a rotator (S′) is a standardized glow lamp. The mirrors (M_3) and (M_4), rigidly connected, may be moved along the bar by means of a rack and pinion, conveniently under control of the observer at the photometer (P). The photometer is fixed, and hence the operation of making a setting is more convenient than that which obtains with the ordinary sliding form. As the design is based upon the approximate equation for the mean spherical intensity, and not upon the integral form, some error arises from this cause. With 11 pairs of mirrors, the error is negligible for all practical purposes.

Fig. 2 shows a photograph of the finished apparatus, with all screens removed, in order that the details of construction may be better seen. This particular instrument is fitted with a Lummer-Brodhun photometer screen. Each mirror bracket is provided with two pins. These pins extend through the frame of the ring radially. By means of this construction each mirror pair may have independent radial adjustment.

We will now consider in detail the different operations to which the instrument readily lends itself.

Operation 1.—Measurement of Mean Horizontal Candlepower.—In this operation the apparatus is used as a simple photometer. Hence, all mirrors except the four horizontal ones, are covered by black screens suitably provided for the purpose. The right pair of mirrors (Fig. 1) is connected at (C) to the sliding rod carrying the rack. The lamp (S) to be tested is mounted in the rotator and driven at a speed of, say, 180 revolutions per minute, and a standardized incandescent lamp, of intensity I_s' is placed in a suitable holder, at (S′). The rod (R) may be moved by the hand for a rough adjustment, and the pinion (P″) used only for the final setting. Since a displacement (d) of the mirror pairs means a change in the light paths of (2d), the moving rod is graduated in divisions one-half the unit (centimeters) in which the light paths are conveniently measured. A reading (R) means that the distance from (S′) to the screen by ways of the mirrors (M_3) (M_4) is (R) centimeters. If now the total photometric distance between the sources is 300 centimeters, we have for the intensity (I) of the light under test.

$$I_s = \left[\frac{300 - R}{R}\right] I_s' \qquad (6)$$

$$= T_1 I_s' \qquad (7)$$

where T_1 is the value of the expression in brackets and stands for "tabulated value corresponding to the reading R." When the apparatus is used with a standard of always the same intensity, it is a simple matter to make the instrument direct-reading.

Obviously, the mean intensity in any north or south polar zone may be found by clamping the arm of the rotator at the proper angle and spinning the lamp, readings being taken as for the mean horizontal measurement. The mean horizontal candlepower of a flame source must be found by taking the horizontal distribution step-wise, since it is impracticable to rotate such a source. Equation (7) is applicable in such measurements.

Operation 2.—Distribution of Candlepower in Vertical Planes.—The distribution of intensity of an incandescent lamp in any vertical plane is obtained with the apparatus arranged as described under Operation 1. The arm of the rotator is merely tilted about a horizontal axis so as to bring any desired aspect of the lamp toward the photometer screen. From equation (7) the different intensities are easily found.

The vertical distribution of candlepower from a flame source cannot be obtained by tilting the arm of the support. The following method is available in such cases: Mount the burner vertically at (S). Disconnect the mirrors (M_1) (M_2) from the movable rod and push them to their place at the extreme right (Fig. 1). Now, with a standard of the same order of brightness as the source to be tested, make a setting. The horizontal intensity is given by

$$I_h = \left[\frac{200}{R}\right]^2 I_s' \qquad (8)$$

$$= T_2 I_s' \qquad (9)$$

where T_2 is the tabulated value of the expression in brackets corresponding to the reading (R).

To obtain the intensity of the source in a direction of θ_0 to the vertical, the horizontal and θ mirrors should both be used. This prevents the limit of the bar being reached by mirrors (M_3) (M_4). The intensity is given by

$$I_\Theta = \frac{T_2 I_s' - I_h}{\sin \theta} \qquad (10)$$

where I_0 is the intensity found in the horizontal measurement.

Operation 3.—Standardization of Glow Lamps.—For this operation the lamp (S) is removed and a horizontal circular plate mounted in place of the lamp. This plate is ruled with concentric circles which facilitate the centering on the amyl-acetate lamp or other primary standard. The lamp to be standardized is mounted at (S′). With all mirrors screened except the horizontal ones, and with (M_1) (M_2) attached to the bar, settings are made as usual. The value of (S′) is given by

$$I_s' = \frac{1}{T_1} \qquad (11)$$

if the standard is unity.

Operation 4.—Measurement of Mean Spherical Intensity.—(a) Glow Lamp.—The lamp to be tested is mounted in the rotator and driven at a speed of about 180 revolutions per minute. Mirrors (M_1) (M_2) are detached from the movable rod and pushed to the extreme right, in which position they may be considered a part of the system of 11 mirror pairs. With a standardized lamp at (S′), a setting is made in the manner already described. If (R) is the reading, we have

$$I_{ms} = T_3 I_s' \qquad (12)$$

where T_3 is a tabulated value corresponding to the setting (R) and I_s' the intensity of the standard as heretofore. Thus the operation has all the simplicity of any photometric measurement.

The intensity of the standard used should be approximately that of the lamp to be tested. For example, if a 16-candlepower lamp is to be tested, a standard of not less than 16 candlepower is best. With such a standard, the range of possible measurements depends upon the limit of travel of the mirrors (M_3) (M_4). A 16-candlepower lamp will serve as a standard for the measurement of mean spherical intensities ranging from two to about 25 candlepower when the limit of travel is about one meter. It is best to substitute a 32-candlepower standard for intensities much greater than 16 candlepower.

(b) Flames.—To obtain the mean spherical intensity of a flame or of any source that cannot be rotated, it is necessary to repeat Operation 4, at equal angular intervals on the horizontal circle. The mean of the results may then be taken.

Operation 5.—Direct Measurement of the Spherical Reduction Factor.—If the standard (S′) and the opaque screen (O) be removed, it is clear from the figure that the left side of the photometer screen will be illumined by the horizontal rays of the lamp (S). In fact, if (S) be rotated, we will have on the right side of the photometer screen an illumination proportional to the mean spherical intensity of (S), and on the left side of the screen an illumination proportional to the mean horizontal intensity of the same source. Under these conditions the photometer setting yields the spherical-reduction factor. In other words, the mean spherical intensity is measured against the mean horizontal intensity, as a standard. The reduction factor is given by

$$f = T_3 \qquad (13)$$

As the removal of the standard (S′) lengthens the distance from source to screen, it is necessary to add a constant to the reading. This is provided for by a second reading point marked RF. All readings for Operation 5 must be taken at this reference mark.

Operation 6.—To Check the Horizontal Mirror Constants.—As before stated, it is essential that the four mirrors attached to the movable bar should have the same constant. To ascertain if this condition exists, remove the opaque screen and the lamp (S′), as in Operation 5. Connect the horizontal mirrors to the moving rod and, screening all other mirrors, take reversed photometer readings on a rotating lamp (S). If the mirror coefficients are equal, the mean reading will be 150, indicating equal light paths on each side of the photometer screen. Here again the RF reading mark must be used.

Operation 7.—To Check the Adjustment of the Circular-mirror System.—In case of any doubt as to the accuracy of the initial adjustment of the photometer, or, in case of the substitution of a new screen, it may be necessary to readjust the mirrors of the half ring. This operation is best performed as follows: Mount at (S) a 32 nominal candlepower lamp, and at (S′) an eight-candlepower lamp, the latter being in circuit with a rheostat capable of continuous variation. With mirrors (M_1) and (M_2) free from the moving rod, and with all other mirrors on the half-ring screened set (R) equal to 100 centimeters. Now, while maintaining the 32-candlepower lamp at constant voltage, vary the voltage impressed on the eight-candlepower lamp until the photometer shows equal illumination. Note voltage on eight-candlepower lamp. Repeat measurements with reversed photometer. The lamp should finally be maintained at the mean voltage so found. Under these conditions the two lamps have a candlepower ratio of 4:1. Next tilt the lamp holder to an angle of 15°. Uncover the corresponding mirrors ($\theta = 75°$ or $\theta = 105°$) and cover the horizontal ones. Under these conditions we have the same aspect of the lamp toward the photometer, but with the light incident at 15°. Set the bar at

$$R_{15} = \frac{R_0}{\sqrt{\cos 15°}} \qquad (14)$$

Adjust the 15° mirrors radially until an equality of illumination is obtained, then secure them by means of the set screw. This operation may be repeated untill all the mirrors have been adjusted.

In conclusion, I would acknowledge my indebtedness to Messrs. D. M. Lynch and E. D. Fristoe for their painstaking labor in constructing a preliminary form of this apparatus. I am also indebted to Mr. C. R. Dooley, assistant in electrical engineering at Purdue University, for assistance.

1. Abstract of a paper read at the meeting of the American Institute of Electrical Engineers, New York, October 24, 1902. The author is professor of electrical engineering in Purdue University and is regarded as an authority on photometry.

DEVELOPMENT OF THE TELEPHONE FIELD.

Important Telephone Change.

Cleveland, Ohio, October 27.—At a meeting of the directors of the Federal Telephone Company and the Cuyahoga Telephone Company in the Electric Building to-day, Henry A. Everett resigned as president of both companies. Frederick S. Dickson of New York was then chosen to fill the position. Mr. Dickson is a representative of the Roebling Company of New Jersey, and some take this to mean that the Roeblings see a good thing in the business the company has started, and will take it up. However this may be, the indications now are that the Federal Telephone Company will at once be rejuvenated and plenty of money will be furnished to put all the plants now owned into good condition.

Mr. Dickson said that some of the plants might be sold if the proper price is offered, but that it will be his aim to put all the properties into good condition, so that they will become money-makers. He will move to Cleveland, and will have his office in the Electric Building, where the Federal company now has its headquarters.

This is all the change that has been announced. The old board of directors has been retained and all the other officers. It is understood that there will be nothing further done along this line and that all those who have been heavily interested in the company will retain their stock and bonds.

It is asserted that it is the intention of the officers to spend about $1,000,000 in the improvement of the properties and extensions of some of the plants that are not now large enough to meet the demands made upon them. Quite a large portion of this will be spent on the plant of the Cuyahoga Telephone Company, which will have the capacity made very much larger than at present. O. M. C.

International Telephone Company.

Much comment was occasioned in financial circles last week by the mortgaging to the Trust Company of the Republic in New York of all the property of the recently organized International Telephone Company of America. The mortgage was for a sum of $100,000,000, it is reported. It is said to be the plan of the telephone company to construct lines in all parts of the country, both in cities and eventually in the country districts, and to furnish telephone service at a flat rate of two cents a call. The company was incorporated in Delaware. The officers of the International company are: President, S. B. Rinehart of Waynesborough, Pa., president of the Frick Company and Citizens' National Bank of Waynesborough; vice-president, Charles W. Mackay of New York; treasurer, William B. Ehlen of Baltimore. The company will manufacture its own apparatus.

Michigan Telephone Reorganization.

Two reorganization plans have been proposed to bondholders and stockholders of the Michigan Telephone Company (Bell). The first plan is to scale the bonds and eliminate the minority stockholders, and the second plan is to assess the stockholders. The first involves the formation of a new company to acquire all the assets, or substantially all of the present corporation, which is to be capitalized with $7,500,000 stock and the same amount of bonds. The alternate plan for minority stockholders includes a voluntary assessment of $55 per share, giving $1,000,000 for new improvements, and $1,000,000 for the protective committee's expenses, a new company to be formed with the same capitalization as above. The gross earnings of the Michigan Telephone Company last year were $1,300,000.

The Telephone System of Berlin.

The Berlin telephone system is said to be one of the largest in the world. The number of subscribers and connections amounts to 60,683, the branch-line connections alone numbering 15,000. The principal exchange has 10,482 subscribers, the smallest having no less than 4,622, while the number of exchanges in the German Empire totals 3,303. The longest line, over which an average of 30 calls takes place daily, is between Berlin and Paris, a distance of 736½ miles; the line between Berlin and Budapest, 608½ miles, is used about 26 times daily, and 79 people telephone over the 588¾ miles between the German capital and Memel every day. The 573 miles of connection from Berlin to Basle are used about 17 times a day.

Harry Lemon, head lineman of the Lewistown and Great Falls (Mont.) Telephone Company, has returned to Great Falls, after having been absent since last spring engaged in the construction of new lines and rebuilding old lines for his company. The line from Neihart to Mann and from Great Falls to Armington was entirely rebuilt, and a new line constructed from Stockett to Sand Coulee. Altogether, about 65 miles of line was built during the summer by the company. Mr. Lemon will at once begin placing the telephone apparatus in the comapny's new building on Main Street in Great Falls.

Telegraph and Telephone Advancement in Japan.

The advancement of modern science in Japan is well shown in the telegraph and telephone fields. Telegraph and telephone instruments are now to be found in all parts of the country and the development along these lines has been exceptionally rapid during the last five or six years. The official report for the year 1900-1901 shows the total length of telegraph lines to be approximately 15,095 miles. The total number of messages dispatched during the year was 16,737,150. This was at the rate of about 35 messages to every 100 inhabitants. During the year 1895-1896 the total number of messages was 9,097,102, and the total length of telegraph lines was, in round numbers, 9,700 miles. In addition to the land lines there is a considerable length of submarine cables, not included in the above figures.

Telephone advancement has taken place at even a greater rate than that of the telegraph. In 1900-1901 the number of telephone employes was 1,529, and of subscribers 18,668, while in 1896-1897 the number of employes was 311, and of subscribers 3,232. This impressive development is the result of government plans, which have been carried on for the last four years and which will be finished shortly.

A second plan for the development of the telegraph and telephone, to cover a period of five years in working out, is to be submitted to the Diet for consideration. It involves the expenditure, above the ordinary government appropriation, of 5,000,000 yen for telephones and the establishment of five new exchanges and 35 telephone call-offices. The plan also includes the laying of a number of new cables between the different islands of the Japanese group, and between the important ports on the island of Japan proper, the importance of these ports being considered mainly from a military and naval point of view.

How to Use the Telephone.

The accompanying illustrations show very clearly the right way and the wrong way to talk into the telephone. Many persons are careless in this respect and blame the telephone company for poor service when the fault is their own. Readers of the Western Electrician hardly need be told to place the lips within half an inch of the transmitter, to speak in a moderate tone of voice, to enunciate distinctly and to hold the receiver closely pressed to the ear. The pictures show the right way in Figs. 1 and 3 and the wrong way in Figs. 2 and 4. The Western Electrician is indebted for them to Frederick C. Toepleman, the general superintendent of the Carolina and Virginia Telephone Company, with headquarters at Henderson, N. C.

Fig. 1. The Right Way.

Fig. 2. The Wrong Way.

Fig. 3. The Right Way.

Fig. 4. The Wrong Way.

HOW TO USE THE TELEPHONE.

NEW COMPANIES.

The Norfolk and Carolina Telegraph and Telephone Company of Elizabeth City, N. C., has been chartered with a capital of $50,000. C. R. Johnson of Portsmouth, Va., is the largest stockholder. M. L. Guirkin of Elizabeth City is also interested.

The People's Independent Telephone Company has been organized in New Iberia, La., with a capital stock of $50,000. The officers are: President, R. F. Hogsett; vice-president, E. S. Broussard; secretary, H. D. Giles. Headquarters of the concern will be in New Iberia.

Indiana Telephone Items.

The Citizens' Telephone Company of Fairmount filed articles of incorporation with the secretary of state on October 23d. The company's original capital stock is $10,000. This will be increased. The company proposes to establish a telephone system in Grant, Wabash, Madison, Howard, Blackford and Delaware Counties. The main office will be at Fairmount. The board of directors is headed by Charles T. Parker, John Kesey, W. A. Beasley and Charles Small.

The newly organized Co-operative Telephone Company of Crawfordsville held a meeting during the past week, with about 25 representatives present. The committee which was appointed to solicit members reported that nearly all the subscribers of the old co-operative company had agreed to come into the new one. Another committee was appointed to seek members from the business men, and they will report at a subsequent meeting. Officers will be elected and articles of incorporation filed this week.

By the breaking of a 90-foot pole from which he was removing telephone wires William Berry, an employe of the Cumberland Telephone Company of Evansville was hurled to the earth, crushed and mangled, but, remarkable as it may seem, he is still living and may recover.

The Evansville telephone situation grows more interesting. The Cumberland Telephone Company continues to advertise for bids for the erection of a telephone-exchange building. On the other hand, Mayor Covert says sufficient stock has almost been subscribed for the municipal telephone plant; that work will begin in early spring, and that the wires and poles of the Cumberland company will be removed from the streets.

The New Telephone Company of Indianapolis, at a recent meeting of its board of directors, declared a quarterly dividend of 1½ per cent., payable on the first day of November, to stockholders of record on the 25th of October. This is the company's first dividend, and the board of directors has issued a statement that, in its judgment, the company will continuously pay a dividend of 1½ per cent. quarterly, payable on the first days of November, February, May and August.

Important litigation between the Richmond Street and Interurban Railway Company and the New Long-distance Telephone Company was compromised and amicably settled, on Tuesday, the 22d inst. The telephone line was on the road first, and the trolley company so constructed its lines as to interfere with the use of the telephone. The telephone company applied for a temporary restraining order, which was granted. The company next applied for a temporary injunction, and, after a hearing by the Circuit Court, this was also granted. At this stage the parties got together and discussed what a trial of the case on its merits meant, with a possible appeal to a higher court, and the railway company paid the expenses of moving the telephone line to the opposite side of the highway, and all proceedings were dismissed. F.

Ohio Telephone Notes.

Although the first plan arranged between the Everett-Moore syndicate and Barber & Brailey of Wauseon, by which the latter were to acquire a controlling interest in the United States Telephone Company, failed, another plan has been formulated, and it is said that it will be consummated within a short time. Under the new arrangement, Mr. Barber and his associates are to take $400,000 of the stock at $25 per share, which will amount to $100,000 in cash. In addition, there will be $250,000 additional bonds issued, and Mr. Barber will take his pro rata share of this issue. This money will be sufficient to pay the July interest and the January interest and give the company a working capital of about $200,000. The control of the United States company will be in the hands of three trustees, so far as the voting power is concerned. R. A. Harmon and J. R. Nutt will represent the Cleveland interests, while Mr. Barber is to name a man to represent his syndicate.

The stockholders of the Millersburg, Wooster and Orrville Telephone Company of Millersburg met a few days ago and elected directors and officers for the ensuing year. The officers are as follows: President, George Adams; vice-president, Frank L. Beam, manager of the Columbus company; secretary, B. C. Sill; treasurer, John E. Koch; general manager, M. M. Herron.

The health authorities of Cleveland have ordered that all telephone instruments in public stations be examined for smallpox germs. There have been many cases of the disease in the city the last few months and the officers feel that it may possibly spread from the use of the telephone, to some extent at least. O. M. C.

Telephone News from the Northwest.

The Redwood County Rural Telephone Company will build its lines from Wabasha, Minn., to Morgan, and will establish a local exchange at the latter place.

The Interurban Telephone Company of Holmes City, Minn., will install a local exchange for Alexandria, Minn. It will be a central-energy system.

The Independent telephone company at Sioux Falls, S. D., will erect an exchange building.

The People's Telephone Company of Superior, Wis., has induced the Consolidated Telephone Company to give Superior one of the two through circuits from the Twin Cities to the Head of the Lakes. Connection is now made direct with Minneapolis.

The Rural Telephone Company of Centerville, S. D., has been incorporated with a capital stock of $5,000.

The Northeastern Telephone Company of Rush City, Minn., has been transferred to the Minnesota Mutual Telephone Company. The line will be put in first-class condition at once.

The Wisconsin Telephone Company has begun the construction of a toll line from La Crosse, Wis., to Holman, Galesville, Fountain City and Alma, where connection will be made with Eau Claire and the northern part of the state.

The Iowa Telephone Company has raised the wages of employes at Marshalltown, Iowa. Those receiving $2 a day, now receive $2.50. At Oskaloosa a similar increase in wages was given.

The Rocky Mountain Bell Telephone Company has asked a new franchise at Butte, Mont., before complying with an ordinance requiring telephone wires to be placed underground. The company asks a 50-year franchise.

It is understood that a municipal telephone system is projected at Fort William and Port Arthur, Ont.

The Hawkeye Telephone Company of Des Moines has taken a contract for stringing 200 miles of copper wire for the exclusive use of the grain firm P. B. Weare & Co. of Chicago. This line will cover nearly all the principal towns reached by the Hawkeye system.

H. S. Olds of Ralston, Iowa, has invented a device to ring telephones by means of a button. It has greater ringing power than the old system and is available to ring almost any number of bells.

The Michigan Telephone Company is making improvements to the local exchange at Menominee, Mich., to cost about $7,000. R.

Colorado and Wyoming.

Denver, October 24.—There is more competition in sight for the Bell Telephone Company in this city, if the plans of the promoters of what is known as the local company are carried out. The new concern filed articles of incorporation on October 19th, the capital stock being placed at $500,000. The objects, as set forth, are to construct and operate telephone lines in Denver and throughout Colorado. The directors are S. H. Clough, W. H. Hake, T. M. Brady, J. D. Malcolm and J. H. Hagerman. Their plan meets the approval of Denverites, as the new company promises to cover all mining camps throughout Colorado of a population of 500 or more which are now without telephonic connection with the outside world.

The business men, agriculturalists and stockmen of Morgan County, Colo., are displaying considerable enterprise by the organization and building of an Independent telephone system, which is growing rapidly, over 300 telephones now being in use. The stock is owned entirely by members greatly interested in the success of the undertaking, and the association will not cease its labors until connection has been made with all counties in the district. The first dividend has already been declared and was made at the rate of 14 per cent. per annum.

During the past two years the construction of new telephone lines in Wyoming by the Bell Telephone Company has been of wonderful growth, no less than 260 miles having been erected during the past summer. These new lines are as follows: Douglas to Casper, 50 miles; Casper to Thermopolis, 140 miles, and Round Hill to Lander, 70 miles. Last year 325 miles was constructed, making a total of 585 miles in two years. Last year's work was as follows: Cheyenne to Douglas, 135 miles; Encampment to Pearl, 31 miles; Battle to Baggs, 45 miles; Evanston to Kemerer, 65 miles; Carter to Lone Tree, 35 miles; Kemerer to Opal, 14 miles. G.

Traction or Mine Telephone.

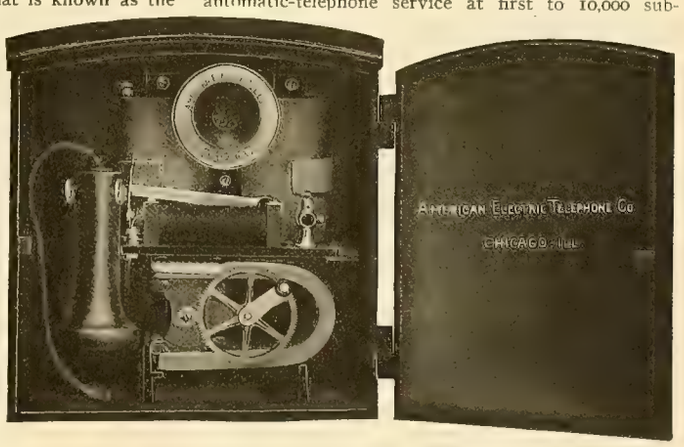
The accompanying illustration shows an iron box traction or mine telephone manufactured by the American Electric Telephone Company of Chicago. This piece of telephone apparatus is fitted with a front covering-plate of iron (not shown in the cut) fitted with a rubber gasket, which covers all the working parts, leaving exposed when the front door is open only the transmitter, receiver and generator crank. This type of telephone is particularly adapted to traction or mine work, on account of its being entirely moisture-proof.

The transmitter and receiver, which are the only vulnerable parts of the mechanism exposed, are so constructed as to be likewise weatherproof. The telephone is fitted with its own generator and can be mounted with ringer coils if desired. The outer case, provided with a door, as shown, is built so as to be easily attached to a pole by means of lag screws from within, and the door is fitted with a suitable and substantial lock.

Chicago Telephone Tunnels Inspected.

Chicago was visited last week by a large party of eastern capitalists, who have invested their money in the great opposition-telephone enterprise of the Illinois Telephone and Telegraph Company. The party, under the guidance of Mr. J. B. Russell, reached this city on Friday morning of last week and registered at the Auditorium Annex, after which carriages were taken and a trip was made to the large factory of the Automatic Electric Company, which is manufacturing the automatic-telephone equipment for the new Chicago exchange. Here the visitors were taken in hand by Vice-president Joseph Harris and his associates and conducted through the factory from basement to top floor, witnessing the practical operation of the automatic switchboard and acquainting themselves with the manner in which the apparatus is made. Many of the visitors were men who had long been identified with the large manufacturing interests of the East, and these gentlemen took a keen interest in the modern equipment of the factory.

After leaving the factory, the party, in the hands of Mr. A. G. Wheeler and Mr. J. B. Russell, visited the telephone tunnels of the Illinois Telephone and Telegraph Company, 12 miles of which have been completed at a depth of 25 to 40 feet below the streets of Chicago. Expressions of surprise were heard on every hand as Messrs. Wheeler, Russell and Mr. George W. Jackson, the chief engineer, who had joined them, explained to the party the methods which had been employed in performing this gigantic task and the difficulties which had been met and overcome. For miles the visitors walked, far below the streets of Chicago, not hearing a sound from the upper world. Mr. Wheeler explained that preparations were almost completed for beginning the placing of the cables in the tunnels which will give automatic-telephone service at first to 10,000 subscribers in the commercial heart of Chicago, and that the extensions of the system would be rapidly pushed.



TRACTION OR MINE TELEPHONE.

In the evening, in the green room of the Annex, the visitors were given a dinner, at which Mr. Wheeler presided. On Saturday morning the party was driven about the city and shown some of its interesting features. At 2 p. m. the depot was reached and a little later two Pullman cars were flying eastward, bearing an enthusiastic body of men who have shown their faith in the future of Chicago by investing their money in this great Independent telephone movement.

The following-named gentlemen were of the party: J. B. Russell, J. W. Hollenbeck, P. A. Meixell, George N. Reichard, Isaac M. Thomas, C. E. Stegmaier, Lidden Flick, R. J. Flick, George H. Flannagan, P. R. Bevan, Samuel E. Innes, F. C. Johnson, C. D. Foster and L. S. Ryman of Wilkesbarre, Pa.; Dr. L. L. Sprague and Professor W. L. Dean of Kingston, Pa.; M. W. O'Boyle, J. H. Foy, John A. Law and W. S. Staley of Pittston, Pa.; E. R. Payne of Williamsport, Pa.; Thomas H. Phillips of Philadelphia, Pa.; Colonel H. M. Boies, Clarence D. Simpson, Byron Winton, Thomas E. Jones, Thomas Sprague, Grant Pelton, A. B. Eynon and Charles H. Welles of Scranton, Pa.; H. B. Russell and Homer Green of Honesdale, Pa.; Robert A. Jadwin of Carbondale, Pa.; G. C. W. Lowrey, Clinton W. Wisner and C. B. Eddy of New York city.

The Kellogg Switchboard and Supply Company of Chicago has issued a booklet entitled "The 'Express' and Some of Its Stopping Places." The publication contains a large number of testimonial letters from telephone companies stating their satisfaction with the Kellogg Express switchboards, which have been especially designed to meet the demands of small exchanges.

Place of Correspondence Schools in Electrical Education.[1]

By Harris C. Trow.

The correspondence school was originated to meet the growing demand for technical education by the great rank and file of men who have neither the time nor the means to devote to taking a course in a resident school. It is not to be supposed that the correspondence school can or ever will be able to take the place of a resident college or school of technology, and we advise all who can to avail themselves of the unsurpassed opportunities and advantages offered by the many excellent resident schools of engineering which we have in this country. But the fortunate men who can avail themselves of this opportunity are very few as compared to those who cannot, and to this latter class the correspondence school offers a method of obtaining an education along engineering lines at a moderate expense, and without loss of time from the student's regular occupations. Another barrier besides lack of time and funds prevents the average man from attending a school of technology, in that the requirements for admission to these schools are such that with only a common-school education it would be impossible to pass the entrance examinations, without, perhaps, an undue loss of time in preparation. The correspondence school meets this difficulty at the very beginning, as no previous training is required for preparation before commencing the course.

No argument is needed to show that there is a great demand to-day for a school within the reach of the ordinary workman. The conditions are such as to make better training a necessity, not a luxury, and the workingman realizes this as well as the superintendent. The former is beginning to take an increased interest in his own welfare and to realize that his success depends directly upon his training. Moreover, in the last few years there has been an influx of technically trained men into all industries, beginning first with the superintendents and gradually working down, so that the untrained man is becoming a mere machine in the routine of his work. Furthermore, progressive manufacturers in all branches are coming to realize that trained men in their employment are an industrial economy, so that, consequently, a knowledge of the theoretical as well as the practical is imperative to the workman who hopes to advance or even to hold his own in the struggle.

Heretofore the study of engineering has been regarded as for the highly educated only—to be obtained through the medium of the college and school of technology; and unless a man had sufficient preparation and could avail himself of the privilege of this training, he must be content to do without an education; but the correspondence school takes a man for what he is worth, and allows him to start where he is at the present moment and keep on from that point.

Students differ very widely as to preparation for the study of engineering, and the courses must be so planned as not to debar those who have been the least fortunate in this respect, beginning with the most elementary principles of engineering, namely, arithmetic and a knowledge of mathematics in general. To those who do not need this preliminary training a brief special examination is offered.

It may be interesting at this point to note briefly the history of the American School of Correspondence. Its beginnings were laid a number of years ago in New York, when a consulting engineer of some prominence was engaged by a technical society to act as adviser in answering questions which were submitted to it by its subscribers. These subscribers had the privilege of submitting any and all questions which came up in their work to the society, and these were answered by the consulting engineer in as complete a manner as possible. A little later on it was found that it was difficult to explain these questions fully in many cases because of the fact that those who asked them frequently had little or no knowledge of the use of formulæ, or of even the simplest forms of algebra and higher mathematics. Hence in connection with this work instruction papers were issued on arithmetic and elementary algebra, which were of great assistance. The question then naturally arose, why, if so much good could be done by the instruction papers in elementary subjects, it would not be feasible to introduce instruction also upon the more advanced subjects. This was accordingly done, and the school has continued to increase its scope and the amount of ground covered in its courses, and also to increase the number of courses.

The methods of instruction in our school differ quite radically from those commonly used in the resident school or college. In the first place, the textbooks, upon which the success of the instruction depends very largely, differ from the ordinary textbook in that they have been designed especially for this particular purpose by men who not only understood the subjects upon which the books treat, but also the requirements of textbooks to be used for correspondence purposes. Inasmuch as the student does not have his instructor at hand to refer to personally, the textbooks must, as far as possible, supply this want, and this is done by making everything unusually clear and plain, and by taking up each step in the work so that the student is advanced progressively from the simpler to the more complex parts without difficulty. Moreover, the instruction papers are condensed to the extent of leaving out all superfluous matter in order that the student will not have to wade through a lot of unnecessary text, which he feels is not going to be of any assistance to him in his work. Throughout the course the ultimate results desired are borne in mind, and even in the arithmetic and algebra courses we introduce many of the factors and constants of mechanical and electrical engineering which will appear later, so that the student may feel familiar with them when he meets them, and altogether an atmosphere of engineering exists throughout the course, whether it be in arithmetic or drawing.

The classes of men reached by correspondence instruction represent the widest extremes, from the man who, perhaps, had almost no schooling when a boy, and has had no opportunity to attend school since, to the college graduate. The ranks are recruited very largely from the first class—those who have had but little opportunity for attending school—and who must necessarily start at the very beginning and work up. They are, however, in most cases, men of mature years and judgment, and do not require the impetus given by the constant supervision of a teacher to watch over them and keep their interest from flagging, as is frequently the case with the college student whose tuition is paid by a wealthy parent. Hence they go in with the determination to get the greatest possible good out of their course. The class of college men who enroll in courses are as a rule either men who graduated some time ago and are taking up the work to refresh their memory and keep them in touch with advancement in engineering in the line in which they have prepared themselves or else they are men who in their college work took up one branch of study, and have enrolled to take up some other line.

There is also a vast difference in the occupations of the correspondence students, and almost every walk in life is represented. The man to whom the correspondence-school work is best fitted is the man who every day is putting into practice in the station or dynamo room the principles which he is studying, so that the two lines of theory and practice are carried along symmetrically side by side. As has been proven by the resident school, the fullest development can be obtained only by a well-planned course of study of both the theoretical and practical side. In college the theoretical training is obtained from lectures and textbooks and the practical is obtained in the laboratory. With the correspondence school the theoretical side is taken up in the study of the instruction papers and in the corrections and advice from the instructors, while the laboratory work is furnished by the constant contact with the various machines which are met with in the student's daily work.

In our electrical course, after the preliminary studies, the purely electrical subjects are taken up. Magnetism, which forms a good foundation for a starting point, and upon the principles of which so much of the study of electrical engineering depends, is chosen to commence with. Static electricity, which the student is well prepared to understand after he has mastered the principles of magnetism, comes next. From static electricity the student passes to the principles of dynamic electricity, which the preceding work has prepared him to understand. Then voltaic electricity is taken up, and the subject of currents and their magnetic effects, together with the production of currents by induction and its application to the telephone and telegraph. The above is covered in the first instruction paper in the electrical course. The next instruction paper commences with the matter of resistance, and discusses this subject thoroughly—how it is affected by length, cross-section, material and temperature of the substance. Next comes up that extremely important and fundamental law of Ohm $\left(I = \frac{E}{R}\right)$, upon which so many of the calculations in electrical work depend. This preliminary work in electricity has led the student up to a point where he is able to take up the subject of dynamo-electric machinery.

The next subject is that of electric lighting, which presents many important and interesting problems. In addition to this are treated the subjects of electric railways and electrical measurements, and also alternating-current machinery. A treatise on central stations and power transmission and another on design of direct-current generators complete the course.

Discussion.

Some of the questions asked by members of the association and answered by Mr. Trow were as follows:

What did correspondence schools set out to do?

To help the wage-earner help himself, and to fill a long-needed place in our educational system. To enable the wage-earner to become familiar with the theory of his trade and understand the principles involved in his work.

How can you do any thorough work along the electrical line when pupils vary so widely in the extent of their (perhaps) scant preparation?

Our school requires no previous training, other than that the student understands reading and writing. His work begins with the simplest and advances a step at a time into the more technical branches of engineering. The student who has had previous training, sufficient to enable him to take up the advanced part of his engineering course, can do so by passing a special examination, or by taking the elementary work as a review, which we believe is the wiser plan. Thus, even the advanced student becomes familiar with the latest methods, which are ofttimes much shorter, more accurate and better than his previous training has given him. After completing the mathematical work or our general studies, the student takes up the electrical part of his course. Thus, the student is advanced a step at a time, covering the work so thoroughly that, on completion of the course, he understands each step, from the most simple work to the most advanced in his course.

Can you "enthuse" the pupil enough by correspondence to get him to build apparatus and make experiments himself?

The best proof of the interest awakened in the student to experiment for himself is the fact that many students who are holding clerical positions or doing some line of work other than engineering while taking an engineering course desire at once to get positions, even at much smaller pay, in some good plant where they can help in building the apparatus which they are studying, or, if unable to do this, in many cases have fixed up shops in their own homes, where they have put in their own telephones, or have secured small lathes for their own use in building machinery or obtaining knowledge of the actual use of the machine necessary in building.

Does the correspondence work tend to whet the pupil's appetite for regular technical engineering, or does it take him to the point where he feels satisfied with the idea of being fully educated along this more particular line?

This would, of course, depend somewhat upon the character of the man, whether his nature was of the superficial or the thorough sort. It is true, with us, as with the technical colleges, that occasionally a man when he completes a course and obtains a diploma feels that he has gone about as far as it is possible to go, but such men as these are the exception and not the rule.

Does your new combination with the Armour Institute mean that you have found just how far you can go with the correspondence work and just where the pupil's attendance becomes necessary; and, if so, what proportion of the engineering course do you find readily covered by correspondence work?

The co-operation of the faculty of the Armour Institute of Technology with our school is, we feel, a great benefit to our students. A man, to be able to teach the best shop and laboratory practice, must be in close touch with both. In other words, to enable our students to receive every benefit possible by correspondence study in their profession it is necessary that their instructors have at their disposal facilities for making special tests and doing special experimental work. It further makes it possible for our students to have their work count toward resident work and a degree, as all work done under the supervision of the instructors in the Armour Institute of Technology will receive proper credit when resident instruction at the Armour Institute is desired. We know that a large number of our students will later on complete their education at a good resident school. Our students are under the examination and guidance of the members of the faculty; therefore, when they seek to obtain a degree at the Armour Institute of Technology they will be treated precisely as correspondence students in other branches are treated by universities offering correspondence courses.

1. Abstract of paper read before the Chicago Electrical Association on October 17, 1902. Mr. Trow is instructor in electrical engineering in the American School of Armour Institute of Technology, Chicago.

Cable Code for General Public.

Every foreign tourist will appreciate what a cable code to meet the requirements of every-day life would mean. The excessive cable rates in foreign countries make the use of the cable very expensive when one merely wishes to communicate to his friends at home the state of his health or his future whereabouts. The business man, by means of elaborate codes, is enabled to send long messages at a minimum expense. An example of the degree to which this may be carried out is seen when it is said that, by the aid of a commercial code, one may telegraph from the farthest part of Australia to London at a cost which, when the word total of the decoded message is taken into account, represents not more than two cents a word.

The absence of a system which would place persons wishing to discuss other than business topics on a footing of equality with commercial men has long been regarded as a hardship. To meet this situation a code said to combine simplicity, efficiency and cheapness, has been arranged by Robert Atkinson of London. Mr. Atkinson says that his new code will be placed at the disposal of the public free of charge. The code contains about 17,000 words and phrases, and is said to meet every emergency likely to arise in telegraphic correspondence. It will be issued in book form and sent to telegraph and cable offices in every part of the world, so that a traveler, if he does not have a copy of the code himself, will still be able to take advantage of the system.

The Aurora, DeKalb and Rockford Traction Company of Aurora, Ill., certifies to an increase of capital stock from $100,000 to $1,500,000.

New Works of the B. F. Sturtevant Company at Hyde Park, Mass.

The new works of the B. F. Sturtevant Company, now nearing completion at Hyde Park, Mass., present an excellent opportunity to study the factors that control in the location and design of the modern manufacturing plant. The present plant at Jamaica Plain, Mass., is limited in its opportunity for growth; its capacity has long been strained to the utmost, and, as a consequence, the question of removal has continued to present itself with ever-increasing force. The fire which occurred last year forced an immediate solution, and a new site was selected after the most careful consideration. Aside from the general character of the lot itself, the principal factors considered in reaching a decision were proximity to raw materials and to an abundance of skilled labor, adequate shipping facilities, ample water

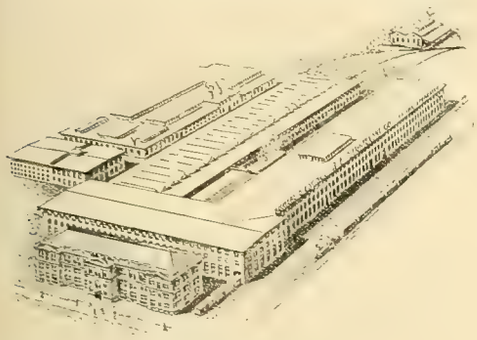


FIG. 1. BIRDSEYE VIEW OF NEW WORKS OF THE B. F. STURTEVANT COMPANY.

supply and space for ready disposal of waste material. The best combination of advantages was presented by a lot of nearly 20 acres of land in the town of Hyde Park, Mass. Here was presented a population of particularly skilled workmen which could readily be supplemented by present employes of the company, the new location being only six miles from the old plant. The lot selected has a frontage of about 1,300 feet upon the freight yard of the New York, New Haven and Hartford Railroad at Readville Station, the distributing point for all freight passing over either the Midland or Providence divisions of that road. One side of the lot is bounded by a plentiful stream known as Mother Brook, and the adjacent shore is at a level of nearly 10 feet below that of the yard and buildings, thus providing sufficient space for dumping waste material for years to come.

The site having been selected, most careful consideration was given to the size and character of the buildings; the head of each department was consulted, his recommendations reduced to writing, and frequent conferences held as to the requirements of the individual departments. With these data at hand, the individual and aggregate areas were determined and the plans started with the idea of providing a total floor space slightly more than double that of the present plant. Consideration was first given to the question of the number of floors to be provided in the various buildings. The lay of the land and its available area being somewhat against a group of one-story buildings, and a simple calculation showing that the actual cost of the power expended in a single year for lifting the entire product of the works through a distance of 20 feet figured only a little over a dollar, determined the company upon the building of multi-storied buildings. The character of the products of this company readily lent itself to such a design, and it was believed that the fixed charges on elevating machinery would be more than offset by a reduction in the horizontal distances necessary to be traversed.

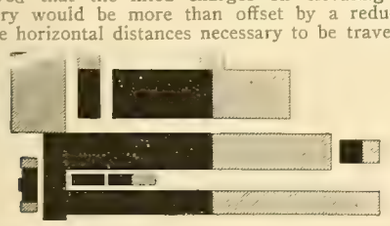


FIG. 2. NEW WORKS OF THE B. F. STURTEVANT COMPANY. (POSSIBLE ADDITIONS ARE SHOWN BY SHADED AREAS.)

The arrangement of the buildings was determined by the provision to be made for growth. One arrangement of a series of parallel buildings permitted increase only by multiplication of buildings, but provided an excellent opportunity for the carrying of switch tracks across both ends of each building. The other arrangement provided for a group of buildings parallel to the railroad tracks, with accommodation for switch tracks between buildings, and for their entrance at the ends of the building, with an opportunity for growth by extension in length. After a careful working out of many schemes and a comparison of the advantages and disadvantages the latter arrangement was adopted. The small plan which is presented herewith (Fig. 2) shows by the shaded portions the opportunity for increase of size in each of the buildings.

The construction of the buildings next received consideration. The latest development of all-steel and concrete construction with large window areas did not appear to meet the requirements of a group of buildings as permanent and substantial in their character as these. All-steel buildings, with brick walls and concrete fireproof floors, presented disadvantages in the way of discomfort to workmen, inconvenience in attaching machines on hangers, and excessive expense, which did not appear to be offset by advantages to be secured in the way of absolutely fireproof construction. The type finally selected is composite in its character, consisting of steel interior columns and main steel girders, with heavy brick walls, wood timbered floors and plank roofs. In the case of the one-story foundry, the roof is supported by steel trusses; in the other buildings open timbering with wooden columns in the upper floor is employed. The main floor in the machine shop is of tar concrete, with spruce and maple flooring. The upper floors are carried upon wooden beams spanning the spaces between the steel girders, which follow a unit system of 20 feet on centers through the building. All roofs are of three-inch plank with tar and gravel top.

The question of power was early decided to the extent that the entire plant would be electrically driven from a central power house; that the engines would run condensing; that the exhaust steam derived from engines under test, which is considerable, would be utilized for heating, with supplementary amount of live steam admitted at reduced pressure as might be required. The final decision regarding the power house placed it sufficiently far from the ends of the buildings to permit sufficient extension of each and near enough to the water supply to reduce to a minimum the expense of conveying condensing and other water.

In the accompanying illustration (Fig. 3) is presented a block plan of this plant, showing that in its design the most careful consideration has been given to the transfer of materials through the various buildings to the point of storage or shipment.

The pattern building provides at one end a two-story portion, 80 feet square, for carpenters and flask makers on the first floor, and for pattern makers

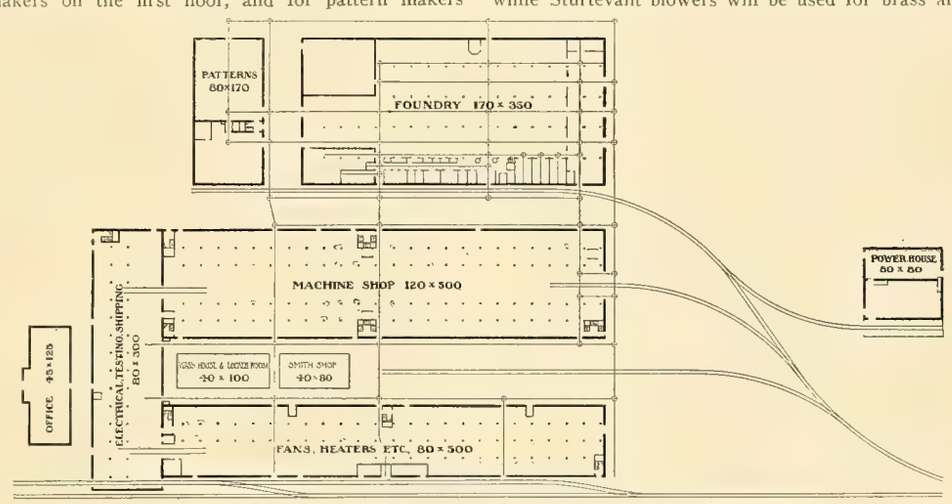


FIG. 3. BLOCK PLAN OF NEW WORKS OF THE B. F. STURTEVANT COMPANY.

on the second floor. The balance of the building, which is devoted to pattern storage, is provided with intermediate floors, making four in all, separated from the other portion of the building by double fire walls and automatic fire-closing doors. The close proximity of this building to the foundry facilitates rapid intercourse.

The foundry, 170 by 350 feet in ground dimensions, is designed with the idea of distributing iron upon a track system, and is to be equipped with narrow-gauge railways, bedded in concrete, making runways between the molding floors. Two craneways run lengthwise of the building through the greater part of its length, and the tracks extend beneath the crosswise traveling crane in the cleaning room at the end of the building. The brass foundry is located in one corner; a wash room is in the adjacent corner, and a core room is between the two. The last-named has ample opportunity for growth toward the center of the foundry, while the foundry itself can be extended to practically double its length. Storage for supplies is provided upon one side adjacent to the railroad switch. From the bins thus provided the iron and fuel charges will be carried directly to the charging floor.

From the foundry the castings will pass to the rear of either the machine shop or the fan shop. The former is of the familiar gallery type, 500 feet long, with wings 40 feet wide, and central runway of the same width for a crane of 20-ton capacity. The lighting will be principally by a series of saw-toothed skylights running crosswise of the roof, with glass facing due north. The crane will serve the entire floor and transport heavy castings from the machine tools to the erecting floor, where the completed engine or generator may be lifted upon a transfer car, passing through the testing building, and there picked up by another 20-ton crane, which will drop it upon the testing plate and subsequently carry it forward to the steam-railway track which passes through the end of the building and provides space for the loading of two cars at a time. The upper floor of this building, together with portions of the adjoining buildings, is devoted to the electrical department and provided with individual small traveling cranes.

The building devoted to the manufacture of fans, heaters, etc., is 80 feet in width, of the same length as the machine shop; it is three stories in height, of typical mill construction, provided with all conveniences for handling material and arranged so that shipment can be made from numerous points along one side, while supplies are brought in from the court between it and the machine shop.

The smith shop, 40 feet by 80 feet, serves both buildings with equal facility, while the wash house and locker room, measuring 40 feet by 100 feet and three stories in height, is so located as to reduce to a minimum the distance to be traversed by the individual workman. The third floor will be used as a lunchroom.

The standard first-floor height in the main building is 17 feet; that of the second and third stories is 15 feet. The windows are large and numerous.

The office is to be a model structure of its kind, and is to serve as headquarters for the entire business. It will contain the correspondence, designing and drafting offices, the superintendent's quarters and the cost department, the advertising bureau and a printing office, which will be located in the basement. It will be three stories in height, with a finished attic to provide additional drafting-room space.

The equipment of this plant will be largely "Sturtevant" in its character. Beginning with the power plant, the mechanical-draft apparatus, the engines and generators and the exhaust head will be of Sturtevant make. The buildings will be heated by the Sturtevant system, the shafting and individual machines driven by motors of the same make, the refuse from the woodworking machinery, the dust from the cleaning room of the foundry, the ventilation of the offices, toilet rooms and wash house, and the removal of smoke from the smith shop will be accomplished by Sturtevant exhaust fans, while Sturtevant blowers will be used for brass and iron foundry, forge-shop blast, and the like, and Sturtevant steam traps will be employed upon the steam driers.

The accompanying birdseye view (Fig. 1) presents a clear idea of the general arrangement and appearance of these buildings.

Steamboat Connection with Interurban Road.

[From the Seattle (Wash.) Trade Register.]

The commercial effect on Seattle of the interurban line is already beginning to be felt, not alone by the communities adjacent to the road, but indirectly by those of the whole upper sound. As the result of the opening of the road a steamer is to be put on the Tacoma-Shelton run to connect with the interurban electric line for Seattle. Shelton has long felt the needs of a service that could be depended on to bring it in closer touch with Seattle, which the new line will do. This is only an illustration of one place that is directly benefited by the interurban road and which indirectly brings travel and traffic to Seattle. Others must naturally follow and get in touch with the main artery of commerce that leads to Seattle. The success of the interurban line is already more than meeting the expectations of its promoters, and its promised success should prove a strong incentive to the parties who not long ago surveyed a line north of Seattle to Everett to go ahead and push the work to early completion. The northern coast sections of both King and Snohomish Counties are full of rich, enterprising communities, eagerly anxious to be brought in closer touch with Seattle, and which would rapidly develop into larger and more thrifty settlements, if given the advantages of rapid transit.

The organization of the Sparta Electric Light and Power Company of Sparta, Tenn., was recently completed by the election of Dr. W. V. Young to the presidency.

Hot-water Heating from a Central Station.[1]

By E. H. McKnight.

Owners of electric-light plants have long desired to increase the earning capacities of their properties without appreciable additional expense. This has led to an investigation of the utilization of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric-light plant it has proven its salvation, especially where competition has been keen and profits small.

The purpose of this paper is to give a general idea of the equipment and operation of such an enterprise.

Details of Construction.

Pumps and condensers, or heaters, an expansion tank and a catch-all constitute the equipment of the station.

Large duplex pumps are used to circulate the water about the system. They are operated at a low pressure during moderate weather, but in extreme cold weather the pressure is increased.

An open tank of sufficient capacity is placed at an elevated position, and used as an expansion tank for the system. Any good condenser or open heater into which the exhaust steam from the engines is turned can be used. The condensation formed is conducted back to the boiler by means of a small automatic pump, furnishing a quantity of heated water free from impurities, the oil having been extracted by means of the catch-all. The water for the heating system is pumped under pressure into the condensers or heaters, and becomes heated, passing out of the condensers or heaters and continuing its travel about the circuit. The condenser should be of ample size to heat sufficient water to care for the amount of radiation installed. A continuous and uninterrupted service during the heating season is assured by having all station equipment in duplicate.

The Mains.

Upon leaving the station from eight to 12-inch pipe is used, this depending upon the capacity of the system. The size of the pipe is reduced at intervals, until the end of the line is reached. The two-pipe system has many advantages, in my opinion, over a single-pipe system. One pipe is used for the supply and the other for the return. With this arrangement water is brought directly into each building from the heating apparatus, not having passed through any other building.

The insulation of the mains is a matter which necessitates much care and attention. The material which has been found to be the most efficient and inexpensive consists of hemlock boxes built with double air-tight compartments, in which the mains are laid, the space remaining about the pipes being well filled with process shavings or mineral wool. The outside of the boxing is protected by a prepared building paper. Where this kind of insulation has been used, the loss of heat on the line amounts to not more than 15 to 20 degrees; that is to say, when water is sent out at 180 degrees it will return to the plant at 160 degrees. Thus, when this water is raised from 160 degrees to 180 degrees, it is ready to send out again. Care should also be taken in anchoring the mains, and providing for expansion.

Cost of Operation

The expense of operating the heating plant under ordinary conditions is not great, the principal expense being in the amount of live steam used to operate the circulating pumps, which at no time is any great amount, the total for the entire heating season being a comparatively small item. No extra labor is needed at the plant, since what little attention the heating plant may require can be given by the same force of men heretofore employed at the electric-light plant.

In order to realize fully upon the investment at the earliest possible time, it is most desirable to secure the services of one who is thoroughly conversant with the details of the business and familiar with the method of figuring for the purpose of making contracts for the heating of every available building located upon the pipe line.

As soon as the capacity of the pipe line has been reached, this additional expense can be dispensed with.

Method of Figuring.

The rules used are the same as those given by the highest authorities on the subject of heating, and are the same as those which have been in general use for a number of years.

In determining the amount of heat a given building will consume, measurements are taken of the cubic contents of each room, it being assumed that the atmosphere of a room changes once and must be reheated. The square feet of exposed glass surface is also measured, the loss of heat through one square foot of glass being 75 times as much as the heat consumed by one cubic foot of air. Next the square feet of exposed wall surface is taken, it being estimated that 10 square feet of wall surface, in the average well-built house, will use as much heat as one square foot of glass surface.

By this means we arrive at the total number of feet of radiating surface to heat a given building, allowing one square foot of radiating surface for every hundred feet of cubic contents or its equivalent. An erroneous impression has gone forth to the effect that the heat is charged for according to the number of feet of radiation used, whether this be much or little; but in reality the cost per year is governed by the amount of heat the building will consume, and is not based entirely upon the number of feet of radiation contained in it.

Advantages.

It is a well established fact that hot water as a heating medium is far superior to all other known methods of heating. Among the numerous advantages to be had from this particular method is the fact that during the fall and spring months, when a moderate amount of heat is desired, this need can be supplied by circulating the water at a low degree of temperature.

The heat from such a system is supplied to the consumer 24 hours a day, and every day upon which heat is needed; the service being continuous and uninterrupted, it gives the consumer the least concern.

A crowning feature of this system of heating is obtained by the use of heat regulators, one or more being placed in each building. This insures an even, regular temperature through the house at all times.

Discussion.

E. F. Gwynn of the Delaware Electric Light and Power Company followed, and gave a detailed description of his method of installing the heating system. In the discussion following Mr. Gwynn stated that his company had, during the last winter, and covering the 12 months then ended, paid a coal bill of $6,800 and sold heat to the amount of $7,800, with an increased operating expense in coal bill over the previous year when the system was not in use or installed of something like $1,000. In the heating plant proper there was represented an investment of some $32,000. There must also be considered interest on this investment of some $1,600. The average horsepower last winter was 190 for the day; horsepower up to 425 was installed.

Mr. Hayler of Van Wert reported that his company was selling heat, and had to use live steam at times last year simply because they had no day load. The coal bill for five months from the 25th of November until close of the season was increased not quite 50 per cent. If they could operate the lighting plant continuously for 24 hours, they could afford to sell their current at a sufficiently low price to pay for fuel; then the gross returns from heating would be net profit.

L. B. Hoit of Cleveland held that where it is possible to secure water for condensing, and particularly in plants where they have no day load, a better revenue could be secured than by attempting to use exhaust steam for heating purposes. If it is possible to maintain a day load on the plant equal to a light load, so that the plant will be in operation for 20 hours out of the 24, the advantage gained by using the exhaust steam for heating is about the advantage gained in condensing. However, the cost of the investment on installation for heating purposes must be considered as a matter of expense to be charged against the heating system as compared with a condensing plant.

1. A paper read before the Ohio Electric Light Association at Columbus, Ohio, October 15, 1902. Mr. McKnight is president of the Middletown (Ohio) Electric Light and Power Company.

How to Oppose Municipal-ownership Agitation.

[From an address by Acting President E. H. McKnight of Middletown, Ohio, at convention of Ohio Electric Light Association at Columbus on October 14th.]

What the electric-lighting fraternity should do, in my opinion, is to draft a fair and reasonable bill, come out openly, present and push home the facts, show the public that the business has been either wilfully misrepresented or ignorantly explained; that the people who have been doing the loudest talking do not know of what they talk; and keep everlastingly at it until we have a commission appointed, just as in the case of the Railroad Commission, or secure the passage of laws modeled after those of the state of Massachusetts. Give to electric-light and gas companies a lease of life as long as they do a fair and reasonable business legitimately. Give them some protection from the blackmailer and the bribetaker, and we will not hear so much of blackmail and bribery connected with our business in the future.

Edison's New Storage Battery in Europe.

Arrangements for the establishment of European factories to manufacture the new Edison storage battery are said to be on foot in London. England, Germany, France, Belgium and Austria are chosen as possible factory locations. The aim of the promoters is to have a number of the factories in operation during the next year. Patents have been secured throughout Europe, and the only delay now is the finishing of a number of tests to which Mr. Edison is subjecting his invention. Among those who have expressed an interest in the new battery is Mr. Balfour, the British premier, who is an ardent automobilist and an interested student of electric traction.

The People's Traction Company of Galesburg Ill., certifies to an increase in capital stock from $100,000 to $150,000.

Electric Parcel Delivery in England.

Not alone in the United States is the electric package-delivery system attracting attention. Last week the Western Electrician published an article by George W. Parker on the service of this nature in and about Detroit. But it appears that considerable development has been made in England in this direction also. The London Mail says that one of the most successful parcels-carrying schemes at present in operation in connection with electric tramways is that which has been started in North Staffordshire—the Potteries Electric Parcels Express. Nine months ago the system was started as an experiment. Two hundred parcels was the weekly average for the first month, and now it has reached about 5,000, while the business is developing at the rate of 300 or 400 parcels a week.

The electric railway at present includes about 30 miles of track, and connects Hanley, Stoke-on-Trent, Newcastle-under-Lyme, Burslem, and a host of smaller towns and villages; but though the track is confined to this locality the company caters for parcels traffic to all parts of the world, and has agents in London, Manchester, Liverpool and the principal towns in England as well as in America and on the Continent. It will deliver a parcel weighing 11 pounds in any part of London for 2d., which is just half the amount charged by the North Staffordshire Railway—the only line available to North Staffordshire people. Within a mile of its own depot it will deliver parcels not exceeding seven pounds for 2d., 14 pounds 3d., 28 pounds 4d., and 56 pounds 6d. It will deliver a parcel of four pounds in Manchester for 3d.; its competitor, the railway company, charges 6d.

The system is conducted in such a way that it does not interfere with the passenger traffic. If a number of small parcels are to be delivered, a boy accompanies the car, which has a receptacle for the parcels. When the car does not pass the place of delivery the parcels are taken round in small handcarts or on tricycles by the boys.

Each morning trailer cars, for the use of which a special permit hedged around with many conditions had to be obtained from the Board of Trade, are sent to the railway station for the baskets of parcels for delivery from large towns, and on their way to the central depot these are sorted by two clerks.

The farmer desiring to send his milk to the town dairyman takes his cans each morning to a station on the line of route of the electric railway and forwards them in the trailer car. A local newspaper firm, which issues a Saturday night sporting edition, employs a trailer car, which delivers the parcels to all the agents along a route of eight miles within 55 minutes.

Another instance of a successful electric-railway parcels-dispatch system is that of the Burnley (municipal) Corporation. Its charges are similar to those of the Potteries company, but its scope is confined to Nelson, Burnley and Padiham. Along this seven miles of railway something like 50,000 parcels are dealt with annually.

Alfred Vanderbilt's Electric Plant.

Alfred Gwynne Vanderbilt has a private electric-light and power plant at his summer home, Oakland Farm, located at Portsmouth, R. I. The installation will furnish power to several buildings on the grounds.

The power house is located about 300 feet from the residence, all cables between the different buildings being laid underground. It is 38 feet by 20 feet outside, and being built of brick presents an attractive appearance. The floor inside is of cement, and rooms are partitioned off for the storage battery, workshop, etc. In the main room are installed the engine, generating apparatus and the switchboard, with instruments for the control of the entire plant.

The prime mover is a Hornsby-Akroyd 16-horsepower, single-cylinder kerosene engine, made by the De La Vergne Refrigerating Machine Company of New York. The engine runs at 225 revolutions per minute, and is belted to a Westinghouse compound-wound, multipolar, direct-current generator, running at 800 revolutions per minute, and capable of furnishing 75 amperes at 110 to 175 volts pressure. Ample foundation is provided, and the exhaust from the engine is led through apparatus especially designed by the contractors, so that even when the engine is running at full load there is practically no vibration and the slight noise of the exhaust is indistinguishable a few feet away.

The principal feature of the plant is the storage battery, of the Chloride accumulator type, built and installed by the Electric Storage Battery Company of Philadelphia. This battery is composed of 63 cells and is capable of carrying a load of 60 amperes for a period of eight hours. The engine and generator are only run for a short time each day, long enough to charge the battery, and then the load is thrown upon the battery. The plant is complete in itself and as economical as if it had been built on a much larger scale.

The feasibility of running electric cars over steam railroads between the regular trains, is being tested in Saxony. It is said that the experiment promises to become a financial success.

CORRESPONDENCE.

New York Notes.

New York, October 25.—Report says that Jacob W. Greatsinger, president of the Brooklyn Rapid Transit Company, presented his resignation to the directors three weeks ago and that it has been accepted, but that formal announcement will not be made before the first of the year. S. C. Calderwood, assistant president of the company, and D. S. Smith, general manager, however, deny that Mr. Greatsinger has resigned. These denials are disregarded in view of the general belief in financial and railroad circles that Mr. Greatsinger will not continue as president after the end of this year.

The rapid-transit commissioners are at present much interested in a settlement with the controllers of the Astor property at the corner of Broadway and Forty-second Street. The subway is temporarily held up, and yet the city does not want to proceed with the condemnation proceedings, as it is probable that a better arrangement can be reached out of the courts.

Justice O'Gorman recently ruled that the Rapid Transit Commission must pay for the electric-wire ducts being installed in the tunnel, since they were, by court decision, a part of the road equipment and not a part of the tunnel construction proper. A sum of $1,200,000 is involved.

Work on the New Jersey end of the old North River tunnel at the foot of Fifteenth Street was resumed on Monday. The existing part of this tunnel was commenced 26 years ago, but the tunnel was never finished.

Among the clubs which will take a prominent part in the coming Federation Festival of Women's Clubs to be held at the Waldorf-Astoria on November 6th, 7th and 8th for the benefit of the Trade School for Girls, is the Minerva Club of this city. The Minerva Club will preside over the electrical booth. A unique and elaborate electrical display has been arranged. Every style of electric light will be used in some manner to beautify the booth.

An involuntary petition in bankruptcy was filed during last week against the Falcon Electric Manufacturing Company of New York city, with factory at Ampere, N. J. Theodore M. Taft was appointed temporary receiver for the bankrupt company. The action was brought on by the company's recently having issued a mortgage for $12,832 to the American Union Electrical Company on all its machinery and tools.

The following incorporations occurred during the week:

Electrical Reflector Company, New York; capital, $10,000; directors, W. A. Schiffer, E. A. Kerbs and C. L. Gaus, New York.

American Device Manufacturing Company, New York; railway and electric supplies; capital, $100,000; directors, Nelson Stafford, A. N. Stafford and Edgar Beckman.

The Eickemeyer Electric Pump Company, Hoboken, N. J.; capital stock, $50,000. Registered office, 185 Montgomery Street, Jersey City. The incorporators are Carl Eickemeyer, John W. Avery and S. R. Bullock. O.

New England News.

Boston, Mass., October 25.—The Pettingell-Andrews Company, dealer in electrical supplies, has moved from Winthrop Square to more commodious quarters at the corner of Pearl Street and Atlantic Avenue.

A newspaper dispatch from Atlanta, Ga., gives information of the proposed organization of a company to purchase the electric railways in all the important southern cities. The reputed head of the trust is the United States Security Company of Boston. The company is unknown in this city. Boston people who are interested in southern electric railways profess entire ignorance regarding any such combination.

The Willimantic Traction Company has decided to locate its power house at South Windham, Conn. It will be operated by steam.

General Manager J. E. Sewell of the Connecticut Railway and Lighting Company says that the company's electric railway between Cheshire and Mount Carmel, Conn., will be in operation before snow flies. The road is about seven miles long. It will connect with the Fair Haven and Westville system at Mount Carmel.

The J. & M. Manufacturing Company, organized at Portland, Maine, has filed its certificate of organization with the Maine secretary of state. It proposes to manufacture and deal in electrical apparatus and has a capital of $1,000,000; $15 paid in. Fletcher W. Jewell of Boston, Mass., is president, and William F. Miller of Boston, Mass., is treasurer.

The Massachusetts railroad commissioners have rendered a report on the accident to President Roosevelt's carriage at Pittsfield, Mass., on September 3d. The board blames the management of the Pittsfield street railway for having no "go-slow" rule for the dangerous place where its track crossed the highway at grade, and blames Motorman Madden for not using reasonable care, but finds extenuating circumstances in the facts that his car was in a way exempt from the general arrangement for stopping cars that morning, and that among the passengers interested in having him make high speed was a leading officer of the railway company. The finding emphasizes the need for the general regulation of the speed of electric cars. In its finding the board calls attention to the dangerous nature of that particular crossing, and says: "Such locations are always a menace to travel unless cars pass over them very slowly. If they are unavoidable, the rate of speed over them should be secured by regulation, and not left to the discretion of motormen. The statements of onlookers as to the speed of the car are conflicting, but it is speaking within bounds to say that the car was making at least 15 miles an hour. The impropriety of undertaking to pass these carriages is apparent, but aside from that, the pace at which it was attempted, was a reckless one. The immediate responsibility for the movement of the car rests with the motorman. He evidently thought that by keeping up a high speed he would pass in front of the carriage, and assumed that the sound of his gong would warn everyone that the car was coming and that they must keep out of the way. This was all wrong. A street car should always be under such control as to enable the motorman to meet any event which he has reason to believe is likely to happen. This rule prohibits high speed at a place like this, where a motorman is bound to know that a car has no right-of-way over a carriage, that there is always a chance that a driver may not seasonably hear the gong or notice the approach of the car, may not estimate distances accurately, or may not be in command of his horses at the critical moment. A motorman has no right, when crossing a street, to assume that, at the sound of his gong, all other travel will surrender the right-of-way to him, On the other hand, a driver, on approaching a street-railway track, should not forget that a car may appear at any time, with limitations upon the power to guide it and sometimes upon the power to control it. The driver of this carriage did not hear the gong and turned his horses to cross the railway, without looking back to see that no car was coming. Upon an ordinary occasion, a driver in charge of a single carriage should have taken no such risk. It is to be borne in mind, however, that it was a matter of common knowledge that this carriage contained those to whom the entire community would be expected to show deference; that the carriage was followed by other carriages, one containing those especially charged with the personal safety of the president, and by mounted men on guard duty. Under such circumstances it was not strange that the driver should give entire attention to his four horses. The regulation of speed upon street railways is expressly left, by statute, to the companies and to boards of aldermen and of selectmen. The frequent occurrence of accidents caused by excessive speed upon the highways, leads us to again call attention to the need of regulation."

The Boston Suburban Company has bought an additional 80,000 feet of land in Waltham, Mass. The company will build a large central power house as a feeder for its system of street railways and a general repair shop on this land. B.

Southern Developments.

Charlotte, N. C., October 25.—Captain Seaton Grantland is planning to establish an electric plant at High Falls, near Griffin, Ga., where he proposes to develop between 30,000 and 40,000 horsepower, the plant to cost, according to estimate $200,000.

The directors of the Macon (Ga.) and Indian Spring, and the Consolidated Car Companies have recently held a meeting to perfect arrangements for consolidating the two interests. W. W. Mackall and others are interested. The Consolidated company is preparing to build a number of connecting lines. T. J. Carling is president and manager.

The Nashville (Tenn.) Railway Company announces that it will expend $1,000,000 in improvements, according to an agreement entered into by the city and the receivers of the railways. The city will relinquish all claims upon the franchises and abandon a suit seeking to recover the same.

The electric lines in Montgomery, Ala., are causing considerable trouble on account of the fact that three tracks are being laid on one street. No decisive action has been taken to prevent the move.

It is reported that waterpower on Kinchafoonee and Muckalee Creeks, near Albany, Ga., will be developed. A hydraulic engineer is now on the ground.

The Savannah Electric Company of Savannah, Ga., has just begun the work of placing new rails and other equipment on several streets. L.

Texas and Old Mexico.

Austin, Texas, October 24.—It is learned that the effort which is being made to organize a company to build an electric railway between Austin and San Antonio, a distance of 81 miles, is meeting with success. Harry Landa, a wealthy manufacturer of New Braumfels, Texas, is interested in the enterprise.

After many hitches and delays, the big project of organizing a company for building an extensive system of electric street railway in the city of Monterey, Mexico, has been consummated and the actual work of constructing the new lines has been begun. The company has a capital stock of $1,500,000, gold, and its financial backer is the firm of Sperry, Jones & Co. of Baltimore, Md. R. B. Sperry, the senior member of the firm, is in active charge of the new enterprise, and is now in Mexico superintending the preliminary work. He will return to the United States in a few days and place orders for construction material, equipment, etc.

A number of millionaire Henequin planters, who make their home in the city of Merida, Mexico, have organized a company to build an extensive system of urban and suburban electric lines.

Harold J. Rossi, a nephew of Archbishop Gillow of the City of Mexico, has begun the construction of a large electric power-transmission plant, situated near the town of San Martin Texmelucan, in the state of Puebla, Mexico. It is estimated that sufficient energy will thus be generated to run the various cotton mills and other large manufactories of that section.

At a meeting of the citizens of the town of McKinney, Texas, held at the instance of a representative of the Union Traction Company of Cleveland, Ohio, the sum of $10,000 was subscribed as a bonus for the proposed interurban electric road which that company is to build between McKinney and Blue Ridge.

It is announced that J. H. Broocks of Beaumont, Texas, who owns a controlling interest in the Gulf and Interstate Railroad, which line originally ran between Beaumont and Port Bolivar, opposite Galveston, a distance of about 60 miles, is organizing a company with a capital stock of $8,000,000, which has for its object the rebuilding of the road and converting it into an electric line. It is also planned to establish extensive terminal and port facilities at Port Bolivar. More than 30 miles of this road was washed away by the great Galveston storm of two years ago, and only 30 miles of it has been in operation since then. H.

From the Buckeye State.

Cleveland, Ohio, October 25.—The city authorities of Defiance are making an investigation of the fall of the Maumee and Auglaize Rivers at that point, with the idea of establishing a waterpower plant. It is said that the Auglaize shows a fall sufficient to give 2,700 horsepower and that the Maumee is even better, although no measurements have been made on it. In case the plan is carried out, an electric-light plant will be operated by it, and power will be sold for other purposes.

The Erie Railroad has made arrangements to enter Springfield over the Dayton, Springfield and Urbana electric line. A coach similar to the steam-railroad coaches will be used, and the passengers will be transferred to this car at Durbin. The line will meet every train, and there will be no waits.

The Cleveland, Akron and Southern Fast Line Railway Company of Akron has been incorporated with a capital stock of $10,000 to build a line between Cleveland and Akron, with branches to Canton and Massillon. Thomas L. Childs, George W. Sieber, C. R. Grant and other Akron men are interested in the new company.

The Cleveland and Sharon Traction Company will shortly increase its capital stock from $10,000 to $1,500,000. A contract will be let to the Morgan Mining and Engineering Company for the construction of six miles of track from Middlefield east. It is thought the remainder of the line will be completed by June 1st.

Luther H. Allen, J. W. Holcomb and other Cleveland men are interested in a new railway that is proposed from Buffalo to Dunkirk, N. Y. The company will be known as the Buffalo, Dunkirk and Western, and it is stated that it will be constructed as soon as possible. In connection with this, it is also said that the Buffalo and Point Gratiot (N. Y.) Street Railway Company will be reorganized soon and a consolidation with several other companies is anticipated. Activity in electric-railway building in Southwestern New York is assuming an interesting aspect, and the fact that there is a probability of a connection between these roads and the Ohio lines in the northeastern portion of this state is of importance to Ohio men.

When the line of the Western Ohio Railway Company from Sidney to Piqua is completed, the company will have 59 miles of track in operation. This section will be in operation by December 1st. The portion between Lima and Findlay, 32 miles, will be constructed this fall and winter and will be in operation some time the latter part of the coming year. A. E. Aikens is president of the road. O. M. C.

Detroit, Mich.

Detroit, October 25.—The Standard Electric Company of Detroit has filed articles of incorporation. The capital stock is $10,000, with $6,000 paid in. The incorporators are Fred. W. Haines, John Broad and John R. Haines.

The new Detroit electric road to Forest Lawn and Mt. Olivet Cemeteries was completed this week and dedicated by a spread and speeches at Mt. Olivet Cemetery. A party of owners and friends took the first trip over the new line, which was constructed at a cost of $25,000.

A special election has been called at Trenton Mich., to vote on the question of issuing $7,500 electric-light plant bonds.

The supervisors of Big Rapids, Mich., have granted a franchise for three steel or stone dams across the Muskegon River, to Erwin & Co., who are backed by Boston capital, and will develop, possibly, 30,000 horsepower. Electric current will be supplied to Grand Rapids, Muskegon and other nearby points for factories, lighting and trolley roads.

The United States Geological Survey is studying various Michigan streams for the purpose of advising development of waterpower. C. G. W.

Information from Indiana.

Indianapolis, October 27.—The city of Alexandria is complaining of the Union Traction Company and says that for the sixth time in 18 months a water pipe under the company's tracks has been replaced owing to electrolysis having eaten holes in it. The city insists on the company paying for the damages and taking some steps toward preventing further injury. Litigation over the matter is not improbable.

Surveys were completed during the week for the Evansville, Suburban and Newburg line to Rockport, a distance of 23 miles. The 10 miles of the line which is in operation is operated by dummy engines, but when the extension is finished, electricity will be used. The road is highly regarded, as Rockport, the county seat of Spencer County, has no direct railway communication with Evansville.

President Fauvre of the Indianapolis and Eastern Traction Company, said last week that the extension of its line from Knightstown to Dublin was proving a hard proposition from an engineering point of view. "Only three routes are open, and each have their difficulties," said he. The Blue River-Scoval-farm route is likely to be adopted, and the only thing that can prevent the immediate completion of this necessary connecting link is unfavorable weather. When completed Mr. Fauvre said the line from Indianapolis to Richmond, connecting and operating in conjunction with the Cincinnati, Columbus and Cleveland lines with through sleeping-car service, etc., would be the greatest interurban line in the country.

Muncie boasts that five electric-traction lines are now building and positively assured for that city, which, added to the Union Traction Company, now operating between Muncie and Indianapolis, makes six roads to be operating within a year. This will make Muncie the second largest traction center in the state.

The Merchants' Heat and Light Company, which recently secured a franchise to construct and operate a plant in Indianapolis, has encountered difficulties and is threatened with injunction proceedings if it attempts to lay its conduits in the downtown alleys. These alleys are already burdened with seven or eight underground constructions, and none of them will permit the new company to lay conduits close to its property. F.

Northwestern Notations.

Minneapolis, October 25.—The Fargo and Moorhead Street Railway Company has directed Civil Engineer George E. Moffatt to make all preparations for starting construction on the line at Fargo, N. D., without delay.

It is rumored at Sault Ste. Marie, Mich., that an electric railroad will be constructed to St. Ignace, the power to be secured from the waterpower at Sault Ste. Marie.

The street-railway system at Sheboygan, Wis., has been transferred to an eastern syndicate. The line to Sheboygan Falls will be extended to Plymouth and possibly to Elkhart Lake.

City Engineer Coleman of Winona, Minn., is preparing plans and specifications for a municipal electric-lighting plant.

C. H. Causey of Fort Benton, Mont., has been granted a franchise at Havre, Mont., for the installation of an electric-light and waterworks system.

The Electrical Commission of Duluth plans to have all overhead wires down in the business section of Duluth in another year; in the business district of the West End within three years, and in West Duluth in five years. The electric companies are to construct conduit systems and the city will reserve the right to use a portion of the space for its own wires. A meeting will be called soon of the representatives of the various electric companies and the Electrical Commission to talk over the matter and to consider plans.

Ex-Mayor Johnson and James Kennedy of Fargo have been granted a franchise at Williston, N. D., for the establishment of an electric-lighting plant there. It is estimated that the plant will cost about $40,000.

The North American Telegraph Company is arranging to extend its wires north to Winnipeg, Man., connecting with the system of the Canadian Pacific Railway. The line from the Twin Cities will connect by way of Fargo and Grand Forks, N. D.

The city of Mankato, Minn., is taking bids until November 7th for furnishing street lighting for a period of one, three and five years, with arc or incandescent electric lights, with gas, gasoline or oil lights.

The Public Service Company of St. Cloud, Minn., is gradually consolidating the two systems of lighting there into one, since the merger of the companies, and is also placing the poles in the alleys and removing them from the streets.

The electric-light company of Hastings, Minn., has made a proposition to the council of Hastings, Minn., to sell the plant to the city at $300 a month for a period of eight years. R.

Among the Rockies.

Salt Lake City, October 23.—It has been definitely decided that the Truckee River Company will supply electric power to Carson, Nevada. The material for extending the line has been ordered and a sub-station will be erected at Carson. The power will be transmitted at a potential of 24,000 volts.

The Utah Light and Power Company has been making a number of additions to its equipment, and Frederick Sargent of Chicago, consulting engineer for the Utah company, arrived here this week to look over the situation and assist in making plans for the future development of the company's interests.

There has been a delay in getting the electrical apparatus in connection with the new Alvarado fountain, recently placed in position at Albuquerque, New Mexico, in the plaza, but on Monday evening a score of jets rising in golden streams over the powerful lights of many lamps arranged at the base of the basin, was turned on and the water fell in iridescent sprays. The display attracted a host of admiring visitors from surrounding towns. The fountain was designed by Architect Whittelsey of Albuquerque and was constructed by local firms.

The Intermountain Electric Railway Company has obtained a franchise from Boise, Idaho, for operating a street-railway system over certain streets.

Mr. Betts, a Michigan capitalist, backed by eastern money, has asked the City Council of Spokane, Wash., for a franchise to operate a line for passenger and freight traffic from Spokane to Cœur D'Alene City, a distance of 30 miles. The power is to be furnished by the Washington Water Power Company.

It is expected the gentlemen will have no trouble in securing a franchise for the line, which will cost about half a million dollars, and it is proposed to make the run with passengers in one hour, cars to be run hourly, while at night freight will be hauled to and from the mountain city. G.

PERSONAL.

King Victor Emanuel of Italy recently appointed William Marconi a chevalier of the Order of Industrial Merit.

Reginald A. Fessenden, the space-telegraph inventor, is at present at Fort Monroe, Va., superintending the installation of a station for further experimental purposes.

A. H. Kreitler of the Consumers' Incandescent Lamp Company of Owensboro, Ky., visited Chicago last week for the purpose of securing additional machinery for the manufacture of lamps. Mr. Kreitler reports that the company's business is "booming."

Colonel Abner B. Packard of Quincy, Mass., a director of the Quincy Light and Power Company, died suddenly of heart trouble, last week. He was born November 21, 1821, was a veteran of the Civil War, being colonel of the celebrated Sixth Massachusetts Regiment when it went to the front, and was engaged in the business of supplying stereotyping and linotype metal to New England and New York newspapers. He left a wife and two sons.

Eugene N. Foss, manager of the B. F. Sturtevant Company and largely interested in the Old Colony Street Railway Company of Boston, is the prime mover in the organization of the New England Reciprocity League, which proposes to further the commercial and industrial needs of New England. Mr. Foss is the Republican nominee in the new Eleventh Massachusetts Congressional District, and his platform calls for Canadian reciprocity and free iron, coal and hides.

At the meeting of the New York Electrical Society on October 22d the following-named members were elected: A. H. Ackerman, Frank F. Thompson, Orosco C. Woolson, E. W. Hazazer, C. R. Newman, John H. Dale, Charles H. Sinnett, Olin Beecher Greene, A. F. Stanley, George L. Patterson, Brice A. Frey, Berry Riphael, Gustave A. Brackly, John L. Streever, R. Halliday Nexsen, George Greenwood, Henry A. Sheuplein, G. T. Luckett, Severn D. Sprong, William T. Dempsey, F. Moreton Jack, E. A. Harley.

Colonel Allan C. Bakewell, who was recently elected president of the Sprague Electric Company, has long been identified with the electrical industry, and has won many friends by his executive ability and honorable business methods. He was vice-president and general manager of the old Interior Conduit and Insulation Company, which was absorbed by the Sprague company some years ago. Previous to his acceptance of the presidency he was for three years second vice-president and general manager of the Sprague company. D. Clarence Durland, who has been elected second vice-president of the Sprague Electric Company had been assistant general manager of the company for the last three years. Mr. Durland is well known in the electrical field and combines engineering and executive abilities in a marked degree.

ELECTRIC LIGHTING.

Emporia, Kan., has sold the $20,000 bonds voted to build an electric-light plant, and work on the plant will commence soon.

The large power house of the Helena Light and Power Company of Helena, Mont., was destroyed by fire on October 21st. The loss is placed at $50,000.

The Clendenin Electric Light Company has sold the Gallipolis (Ohio) plant for $12,500. The purchasers take the plant on November 1st. The town has made a contract with the new owners whereby an almost complete new installation will be needed.

The Marksville (Iowa) Electric Light and Power Company has organized with W. F. Couvillion as president. An electric-light plant will be erected at once.

Huntsville, Ala., has employed Mr. Jackson, an engineer of Nashville, Tenn., to prepare plans for installing a new electric-light plant. Bids are invited.

Reedsburg, Wis., will receive bids until November 5th on the furnishing of 25 enclosed-arc lamps and transformers. A. H. Clark, city clerk, may be addressed.

The Saugerties (N. Y.) Light, Heat and Power Company has been incorporated with a capital stock of $50,000. The incorporators are H. B. Hord, R. C. McCormic and C. W. Eichells.

The Gladys Electric Light, Water and Power Company of Huron, S. D., has been incorporated with a capital of $100,000. The incorporators are L. F. Reuckenstein, F. Taylor and M. Hoke.

The Edison Illuminating Company of Detroit, Mich., is reported to have been sold to a syndicate of New York and Boston capitalists. It is said the new company will more than double the capacity of the present plant, expending some $2,000,000 within the next two years. The syndicate offers to take all the stock of the old company at $60 a share—par value $25—and is said to have obtained over 90 per cent. of it already. W. F. White and C. W. Wetmore of the North American Company of Boston are managing the deal.

ELECTRIC RAILWAYS.

The Hoquiam (Wash.) and Aberdeen Street Railway Company has issued bonds for $125,000, the proceeds derived from the sale of which are to be used in building an electric railway between the two places.

The York (Pa.) Street Railway Company has decided to expend about $25,000 in needed improvements on its lines. All of the principal streets through which the system extends will be double-tracked.

A mortgage for $300,000, covering the Wabash River Traction Company's rolling stock, right-of-way, etc., has been filed. The mortgage is executed in favor of an eastern construction company and is part of a plan to finance the Wabash company's new road from Logansport, Ind., to Peru, Ind.

The Brockport, Niagara and Rochester Railway Company of Brockport, N. Y., has been incorporated to construct an electric railway 44 miles long from Brockport to Medina. The capital stock is $500,000. Frederick Beck, W. S. Shields and S. J. Spencer compose the first board of directors.

The Twin City Rapid Transit Company of Minneapolis and St. Paul, Minn., is said to have purchased a 22-acre tract of land in Kittsondale. The price paid for the land was $21,676. The company intends to erect large barns on the land, it is reported, and eventually to build additional shops.

The Yerkes-Morgan "tube" controversy in London, England, has taken a decided turn in favor of Mr. Yerkes. Mr. Morgan's plan, submitted to Parliament and which would have greatly interfered with the financial success of the Yerkes roads, has been blocked, at least for the present, for it is possible that a reconsideration may occur. The Pall Mall Gazette comments on the action of Parliament in a very deprecating manner and infers that Mr. Morgan's plan was not given a fair hearing.

The statement of the earnings of the Aurora, Elgin and Chicago Railway Company for the month of September shows the following: Gross receipts $21,450.86; operating expenses, $10,420.06; net earnings, $11,030.80. This statement covers the operation of what is practically only one-half of the mileage over which the company will operate when the property is completed. From the fact that the Elgin branch is not yet ready for operation, the company is now serving only one-half of the population tributary to the entire line.

A proposition submitted by A. B. Colvin, president of the Hudson Valley Railway Company, on the night of October 20th, to the striking employes of the company and accepted by them suddenly and unexpectedly failed on the following day. The result is that the strike, inaugurated on August 30th still continues. The proposition was that the existing troubles be settled by arbitration. The board was to be made up of three men, one chosen by each side and the two so chosen to select a third. At the first meeting of two appointed arbitrars, a disagreement occurred and the strikers' appointee withdrew.

POWER TRANSMISSION.

A deal has been closed whereby the waterpower of Koochiching Falls, on the Rainy River, will be developed. This river is the boundary line between Minnesota and Ontario, and considerable difficulty was experienced in negotiating with the Canadian government. By the present agreement, Canada is to get the use of 3,500 horsepower under any circumstances, and if this be less than 50 per cent. of

that developed, she is to get enough more to make up one-half. The estimated developable horsepower is 8,000.

The Golden State Power Company of San Francisco, Cal., has been incorporated with a capital stock of $10,000,000. The directors are C. L. Morrill, H. L. Lange and T. Getty. The company proposes to develop electric power from the Feather River. The first power house is to be established about 186 miles from San Francisco. At this plant it is said about 60,000 horsepower will be developed.

SOCIETIES AND SCHOOLS.

Plans for a new heat and light plant for the University of Pennsylvania, located at Philadelphia, Pa., have been drawn. The building will be much larger than the present one and will cost $500,000.

The International Correspondence Schools of Scranton, Pa., is anxious not to be confounded with the Correspondence Institute of America of the same city. The former is the great collection of correspondence schools that has won an international reputation by its phenomenal success. As to the latter, the Scranton Tribune says that the four principal officers of the Alt. F. Clark Company, which conducts the Correspondence Institute of America, were arrested on October 15th on a warrant charging them with using the mails to defraud.

PUBLICATIONS.

The engines and induced-draft apparatus of the Buffalo Forge Company of Buffalo, N. Y., are well known. Two new booklets issued by the company named illustrate these excellent types of machinery clearly. The publications are neatly executed.

The Sterling Electrical Manufacturing Company of Warren, Ohio, is sending out a striking and beautiful souvenir in the form of a well-executed chemigraph in bas-relief of Makart's "Diana's Chase." The picture is mounted on heavy cardboard and is about 15 by seven inches in size. Below the picture is the name of the firm, a representation of the Sterling "Special" lamp and the phrase: "The lamp that makes Warren famous."

SPACE TELEGRAPHY.

A newspaper paragraph states that it has been decided to establish Marconi space-telegraphy apparatus at all stations and on all passenger trains on Italian railroads.

A report from London is to the effect that the Western Telegraph Company has equipped its cable ships with a new system of space telegraphy, designed by J. E. Maskelyne, Jr. The ships are to be used in an auxiliary cable service for inter-island service or any other short stretches where tides and rocks unduly shorten the life of cables. Mr. Maskelyne's system utilizes a closed metallic circuit for both the sending and receiving stations, and a new form of coherer, dispensing with metal filings. It is asserted that its action is delicate and reliable.

The London Telegraph of October 7th says: "The steamship Minnehaha of the Atlantic Transport Line, from New York, passed the North Foreland on Monday afternoon, and should have docked at Tilbury early in the evening, but was detained by a fog in the Thames above Southend. The owners wished to ascertain her whereabouts, and communicated with the Marconi company, who instructed its Chelmsford station to "call her up," as this ship, among several others of the Atlantic Transport Company's fleet, is fitted with the Marconi system of wireless telegraphy. This was done and the ship's position was discovered."

MISCELLANEOUS.

James O. Lyman of Waterbury, Conn., superintendent of the Standard Electric Time Company, has invented a new electric clock which is intended for the operation of bells and signals in factories, schools, etc.

Charles Whitney Carman, the inventor of the Carman (electrical) opaque projector, has been engaged by the directors of the Coliseum, who have charge of the Pure Food Show, to give daily exhibitions of his invention during the progress of the show, which will take place this month. The Carman projector was fully described in the Western Electrician of February 22d last. The apparatus promises to be valuable in the study of botany, insect and lower animal life.

The Philippine Commission has passed a bill providing for the construction of a standard-gauge electric railway in Manila and for a lighting and power plant. Advertisements for tenders will be inserted in Chicago, New York and Washington papers, and the specifications will be exhibited in Manila and Washington. The bids will be opened in Manila on March 5th.

TRADE NEWS.

The Stanley Electric Manufacturing Company has recently opened a sales office in Atlanta, Ga. The office is in the Empire Building and is in charge of George P. Hardy.

The Cincinnati (Ohio) Electrical Tool Company has been incorporated with a capital of $15,000. The incorporators are J. W. Zimmerman, George A. Appel and Charles A. Appel.

The Champion Trolley Harp Company at Philadelphia, Pa., has been incorporated with a capital stock of $130,000. The company proposes to manufacture improved trolley harps.

The Chicago agency for the Triumph Electric Company of Cincinnati is now at 1426 and 1427 Marquette Building. R. J. Randolph, well known in electrical circles, has been appointed manager for the Chicago district.

The O'Brien Electric Light Letter Company of Sacramento, Cal., has been incorporated with a capital stock of $50,000, subscribed in full. The principal place of business of the company will be San Francisco. The first board of directors is made up of the following: D. J. O'Brien, M. J. Sullivan, L. Zeh and E. J. Maloney.

The H. P. Cameron Electrical Manufacturing Company of Ansonia, Conn., has been incorporated with a capital stock of $50,000. The company proposes to deal in electrical apparatus and appliances used by street-car and power companies. The incorporators are Irving Whiting, John T. Kent, John Elliot, Jr., and C. E. Tullar.

An injunction was issued against J. F. Buchanan of Philadelphia on October 14th in a suit filed by the General Electric Company on the Tournier patent, No. 559,232, issued April 28, 1896, the particular infringement alleged being the sale by Mr. Buchanan of certain lamp sockets manufactured by the New England Electric Manufacturing Company of Boston, Mass.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until November 25, 1902, for the installation of a conduit and electric-wiring system for the United States public building at Boise, Idaho, in accordance with the drawings and specification, copies of which may be obtained at the office in Washington or at the office of the superintendent of construction in Boise. James Knox Taylor is the supervising architect.

In its "Copper Gossip" circular of October 15th the National Conduit and Cable Company says: "Copper has displayed considerably more life within the last few days, and the tone of the market reflects a more optimistic feeling than for weeks previous. The prospect of a speedy settlement of the prolonged coal strike will undoubtedly go far toward removing the policy of hesitation which copper buyers have pursued in the recent weeks, and there are indications already that consumers are taking more interest in the market. A large business has been done during the last few days, and we know of at least 8,000,000 pounds of electrolytic sold at 11.60. There is a firmer tone to copper now discernible, with electrolytic quoting at 11.60 and Lake 11.75. The course of the market has favored buyers for a long time, but it looks now as if the end of the decline had been reached, at least for the present."

The Bryan-Marsh Company, manufacturer of the Bryan-Marsh incandescent lamp, offers an interesting example of commercial expansion in its true sense. The Bryan-Marsh lamp is manufactured in Marlboro, Mass., and the operation of the company at the beginning was confined chiefly to the East. It was about six years ago that the local office was established in Chicago, and two years later a northwestern district office was located in Minneapolis. The company continued to expand, and in September, 1900, the Chicago office was made a district center under the management of George C. Keech, who then represented the Bryan-Marsh Company in the Michigan territory. Under Mr. Keech's jurisdiction salesmen were gradually added until the seven states allotted to the management of the Chicago office were fully covered. At the opening of business in the fall of 1902 the large amount of business sent in to the New York home office from the various western branches of the company was of such quantity as to make it necessary that a main office be established in Chicago, through which all business west of Pittsburg will henceforth be transacted. Under this arrangement the northwestern district office previously established at Minneapolis, and the new Cincinnati office, will be tributary to Chicago, and the entire western department will be under the management of Mr. Keech. Incidentally, it may be said that Mr. Keech has had extended experience in the incandescent-lamp field. For several years he did business throughout the West for the Sawyer-Man Company, and, in addition to this work, his successful career with the Bryan-Marsh Company would seem to indicate that his company has made a wise choice in his selection as manager of the western half of its business. The Bryan-Marsh Company has just moved into a fine, large suite of offices at 510 Fisher Building, Chicago, where it will be thoroughly equipped to carry on the increasing business. One of the most interesting points to lamp buyers relative to the new sales organization of the Bryan-Marsh Company lies in the fact, that the company will carry a stock of about 585,000 lamps in Chicago, 260,000 in Minneapolis and 60,000 in Cincinnati. As many as 12 salesmen are now traveling from the Chicago office and its branches. The present most excellent condition of the Bryan-Marsh business in the West is largely due to Mr. Keech's indefatigable efforts in behalf of this institution.

BUSINESS.

The Central Electric Company of Chicago wishes to call attention to Columbia lamps. Any buyer of incandescent lamps will be sent, upon request, an attractive pamphlet entitled "That Question of Light."

Through changes in the equipment of Power House No. 1 of the Lindell Railway Company at St. Louis, the Whitehead Machinery Company of Davenport, Iowa, has secured 10 72-inch by 18-foot tubular boilers of 125 pounds' pressure each, with all accessories, that it has for sale and ready for immediate shipment.

The L. B. Allen Company, 1334 Columbia Avenue, Chicago, manufacturer of the well-known Allen soldering stick and other electrical specialties, is receiving orders in gratifying size and volume. The Allen products have been on the market for a long time and have stood the most severe tests. The company will mail a sample soldering stick and further particulars upon application.

The Great Western Smelting and Refining Company of Chicago, which pays highest market prices for scrap copper, brass, platinum, incandescent-lamp bases, etc., states that it is doing a greatly increased business over that of last year. The company has on its books many of the largest electric-light and street-railway companies in the United States and is anxious to hear from other concerns that wish to realize on scrap material.

The Commercial Electrical Supply Company of St. Louis, Mo., reports continued success in the sales of the Nernst lamp. In St. Louis Boehmer & Co., Nelson Morris, Scarritt & Comstock and John T. Milliken & Co. use the lamps. A large order of the lamps for shipment to Nicaragua, Central America, has been booked. There is a steady demand from central stations throughout the United States, and the outlook for the lamp is very favorable.

Eugene Munsell & Co., who are pioneers in everything connected with the mica business, have recently begun the manufacture of a mica chimney for incandescent gas burners which is superior in many respects to anything heretofore offered in that line. It is known as Warren's folding interlocking mica chimney, and application has been made for a patent on its unique and yet simple style of construction. The chimney is packed and sold flat, like a sheet of paper, and it can be formed into a cylinder as easily as a sheet of paper can be rolled up, the edges interlocking, as implied by the name. This makes it possible to clean the chimney, when necessary, easily and thoroughly, which cannot be done with the ordinary mica chimney. The shipping weight of these chimneys is one-fifth less than that of others, and they take up little space on shelf or in storeroom.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, October 21, 1902.

711,481. Storage-battery Plate. Nathan T. Daboll, New London, Conn. Application filed February 19, 1902.

The plate consists of wire gauze coated with finely divided carbon and this in turn covered with white lead.

711,488. Supporting and Lifting Mechanism for Secondary-battery Plates. Louis H. Flanders, Wilkinsburg, Pa., assignor to the Westinghouse Machine Company, Pittsburg, Pa. Application filed February 24, 1902.

This patent seems to indicate that the Westinghouse interests purpose to enter the storage-battery field. The lifting frame comprises a longitudinal beam having an eyebolt adapted for engagement by a lifting hook and two transverse beams provided with depending hooks and having a locking but readily separable connection with the longitudinal beam.

711,520. Electric Motor for Vehicles. Harry G. Osburn, Hoboken, N. J. Application filed May 6, 1901. Renewed March 17, 1902.

The field magnet is supported upon the frame of the vehicle. The armature coils are supported on the vehicle wheel and arranged to rotate about the exterior of the field magnet, and a commutator rotates upon the interior of the annular field magnet. (See cut on next page.)

711,532. Incandescent Electric Lamp. John J. Rooney, Scarsdale, N. Y. Application filed November 14, 1901.

The base is provided with two external contact pieces. There are two filaments in the lamp, with a common electric connection between the filaments and one of the contact pieces. Wires from the opposite end of each filament lead out of the base and protrude from it near the other of the contact pieces.

711,537. Storage Battery. Frederick Sedgwick, Chicago, Ill., assignor to the International Battery

Company, Chicago, Ill. Application filed August 2, 1902.

An electrode for storage batteries composed of juxtaposed film-like layers of lead foil, each layer having minute, closely comminuted perforations therein sufficiently numerous and minute to produce in the assembled whole a cellular mass capable of capillary action.

711,543. Fuse Box. John C. Stewart and Walter Horn, Newark, Ohio. Application filed April 28, 1902.

A removable block or plug is provided on the under side of the fuse box, with a pole connection or socket to receive a pole end whereby the plug or block may be readily inserted and removed to replace the fuse.

711,545. Art of Blasting. George Thomson, Elizabeth, N. J. Application filed May 28, 1902.

By this "improved mode of blasting" an electric furnace is introduced within the blast hole. By passing a suitable current through the furnace great heat is generated. This heat is continued until the surrounding rock is heated to a high temperature, whereby its expansion exerts a disruptive effect against the outer mass of rock. (See cut.)

711,556. Telephone Switchboard Plug. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed April 13, 1901.

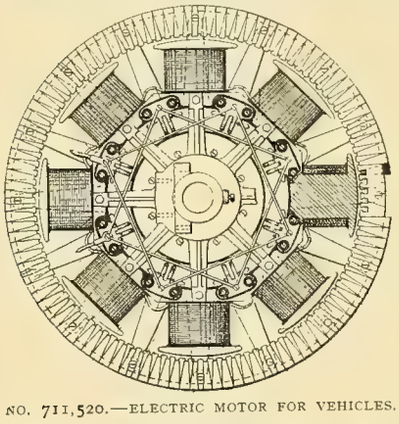
An improved switch plug is described.

711,567. Carbon Holder for Electric Arc Lamps. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Philadelphia, Pa. Application filed March 12, 1902.

Details of an improved carbon holder are described.

711,568. Electric Alarm Clock. Thomas E. Heeter, St. Louis, Mo. Application filed September 11, 1901.

In combination with a clock-train there is a normally stationary contact arm, with means for actuating the arm from the clock-train at predetermined intervals, a plurality of contact pins in the path of the arm, an electric bell in circuit with the contact arm and pins, whereby an intermittent alarm is sounded at predetermined intervals.



NO. 711,520.—ELECTRIC MOTOR FOR VEHICLES.

711,588. Inclosure for Telephones. Albert J. Parke, Boston, Mass. Application filed May 23, 1901.

This patent covers an inclosure for a telephone consisting of a hood or awning closed at the top and sides and open at the bottom, with a transparent section in the hood.

711,589. Inclosure for Telephones. Albert J. Parke, Boston, Mass. Application filed July 13, 1901.

This inclosure is made of a screen of a pliable material, with provision for light and ventilation.

711,610. Showcase Bracket. George C. Wright, Cleveland, Ohio. Application filed May 10, 1902.

This invention relates to show-case lighting. A bracket for an incandescent lamp and wiring connections are provided.

711,614. Gas Battery. Oscar Britzke, St. Petersburg, Russia. Application filed January 17, 1901.

A gas battery for generating electric current comprising a number of battery cells, each having parallel channels or chambers for the passage of a hot, easily oxidized gas and of a hot gas containing oxygen. A metal plate impregnated with an electrolyte separate the channels from each other, and metal electrodes separate the cells from each other.

711,615. Mouthpiece for Telephone Transmitters or Speaking Tubes. Joseph W. Brown, Philadelphia, Pa., assignor to Joseph G. Brown, Odessa, Del. Application filed January 9, 1902.

Details are described.

711,621. Desk Bracket. Alan R. Fergusson, New York, N. Y. Application filed December 19, 1901.

One of the features of this office-desk attachment is an adjustable carrier arm open throughout for a flexible electrical conductor so that the arm may be moved while the electrical device carried thereby is in operation.

711,622. Desk Lamp. Alan R. Fergusson, New York, N. Y. Application filed February 14, 1902.

For a desk the combination with a flexible staff of an electric translating device carried by the staff, with a plurality of telescopic members, a clamping means upon one of the members, a plate to which another member is attached, a bracket upon the plate provided with a perforation, the flexible shaft being firmly secured in this perforation.

711,624. Candle Holder. Moritz Hammerstein, Berlin, Germany, assignor to Max Blau, Berlin, Germany. Application filed October 25, 1901.

This is an electric dark lantern. It contains a battery and a small incandescent lamp. There is a spring-opened cover over the lamp, operated by the handle of the lantern. Opening the cover causes the lamp to project through the opening, at the same time automatically making connection with the battery circuit. (See cut.)

711,629. Insulator. Clayton Hobert, Philadelphia, Pa., assignor of seven-tenths to W. Storm Miller and Edward S. Kerper, Reading, Pa. Application filed March 6, 1902.

An insulator furnished upon its side or sides with a slot adapted to receive a wire, the bottom of the slot being furnished with a groove of less width than the diameter of the wire.

711,635. Revolution Indicator. Erwin Lavens and Edward J. Lavens, Brooklyn, N. Y. Application filed February 8, 1902.

To record the revolutions of a shaft there are described, in combination, a moving part carrying a bridge device, a series of electrical contacts, means for closing the circuit through the indicating mechanism of such device, a motor device in circuit with the contacts, and means energized by the motor device for indicating the passing of the bridge device over the contacts.

711,640. Telephone Receiver. Willard M. Miner, Plainfield, N. J., assignor to the Sun Electric Manufacturing Company, Camden, N. J. Application filed March 7, 1901.

The cap of insulating material over the diaphragm is flattened and smooth externally, and centrally pierced with a group of small apertures, whereby sound waves may pass but accidental contact with the diaphragm is prevented.

711,649. Secondary Electric Clock. James J. Stockall, Sr., London, England. Application filed February 26, 1901.

An electric escapement mechanism has, among other features, a magnet, a pivoted armature, and a rocking arm operated by the armature and engaging a projecting arm.

711,660. Machine for Producing Perforated Telegraph Paper. George H. Hackett, North Sydney, Canada, assignor to other residents of Nova Scotia, Canada. Application filed June 12, 1901.

This invention relates to mechanical means for perforating paper for rapid telegraphy.

711,667. Means for Regulating Electric Motors. Robert Lundell, New York, N. Y. Application filed May 10, 1902.

In an electrically propelled vehicle the combination with an electric motor and two or more groups of batteries arranged to be connected in parallel or in series to the motor by a speed-regulating controller, of means for causing the field strength of the motor to become practically independent of the armature current when the batteries are connected in parallel, but responsive to variations in the armature current when the batteries are connected in series.

711,695. Induction Coil. Monroe S. Clawson, New York, N. Y. Application filed December 24, 1901.

Features of this coil are an armature plate suspended on wires, a spring vibrator fixed to the plate, a revoluble drum to receive one end of the wires, means to rotate the drum, and screws bearing against the plate.

711,710. Storage Battery. Daniel E. Wiseman, Chicago, Ill., assignor of two-thirds to W. W. Vance, Ottumwa, Iowa, and Charles V. Aspinwall, Chicago, Ill. Application filed March 12, 1901.

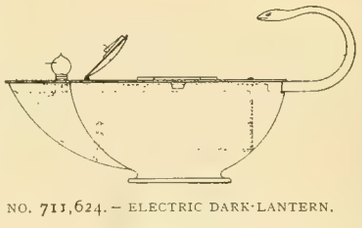
The electrodes are supported upon rods fixed in the cell, and are composed of a conducting strip or ribbon bent back and forth upon itself in serpentine form, and having a series of depressions produced therein to receive the active material.

711,718. Signal Installation for Fire Engines. Jerome H. Deters, Cincinnati, Ohio, assignor of four-fifths to the American Fire Hose Signal Company, Cincinnati, Ohio. Application filed April 28, 1902.

In the operation of a hose line attached to a fire engine there are a valve-controlled discharge nozzle, a cylinder in open communication therewith and a piston held therein to a normal position and against a certain water pressure by a spring. An electrical bell signal and electrical appurtenances are carried by the engine. Normally open contact pieces are in circuit with this electrical outfit, and a projection on the piston is adapted to close these contact pieces to operate the bell signal when the piston is caused to move by reason of increase in valve pressure due to manipulation of the valve in the discharge nozzle.

711,743. Telautomotor. Harry Shoemaker, Philadelphia, Pa., assignor to Gustave P. Gehring and Marie V. Gehring, Philadelphia, Pa. Application filed April 12, 1901.

In a wireless telegraph system a receiving station consisting of the air and ground plates, a coherer, a decoherer, a circuit, a relay in the circuit, means operated when the relay is energized, a shaft adapted to be stopped by these means, a series of collector rings, and a commutator mounted on the shaft. A circuit is operated when the relay is de-energized to allow the shaft to revolve a space at a time at each impulse that is received. This receiving station is designed to be carried by a torpedo or boat to operate the torpedo or boat's different mechanism. (See cut.)



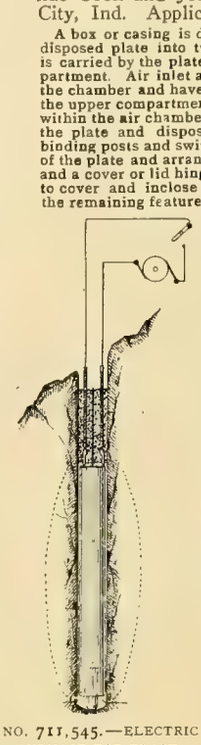
NO. 711,624.—ELECTRIC DARK-LANTERN.

711,790. Automatic Electric Circuit Controller. Joseph Sachs, Hartford, Conn. Application filed October 5, 1900.

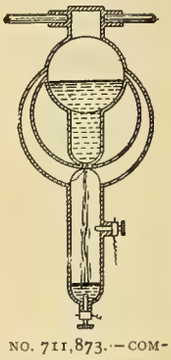
Features of this circuit controller are a plurality of fuses, an arm adapted to bear successively upon the terminals of the fuses to complete the circuit, mechanical devices released electrically by the blowing of a fuse, whereby the arm is set in motion. The motion is stopped when the arm makes contact with the next fuse in an appreciable period. Means for regulating the period are also provided.

711,827. Electrical Heater for Dental Purpose. Julius Cook and Joseph M. Pumerville, Michigan City, Ind. Application filed July 15, 1901.

A box or casing is divided by a removable horizontally disposed plate into two compartments. An air-chamber is carried by the plate and situated within the lower compartment. Air inlet and outlet nipples are connected to the chamber and have their upper ends extending within the upper compartment. An incandescent lamp is located within the air chamber, while a resistance coil carried by the plate and disposed within the lower compartment, binding posts and switching devices on the upper surface of the plate and arranged within the upper compartment, and a cover or lid hinged to a box or casing and adapted to cover and inclose the upper compartment, constitute the remaining features of the device.



NO. 711,545.—ELECTRIC FURNACE FOR BLASTING.



NO. 711,873.—COMMUTATOR WITH QUICKSILVER.

711,867. Portable Electrically Illuminated Sign. Henry S. Kemp, Richmond, Va., assignor to the Reversible Electric Car Sign Company, Richmond, Va. Application filed February 25, 1902.

Contact plates are provided, so that the sign is removable and may be operated at various places.

711,868. Illuminated Sign. Henry S. Kemp, Richmond, Va., assignor to the Reversible Electric Car Sign Company, Richmond, Va. Application filed February 25, 1902.

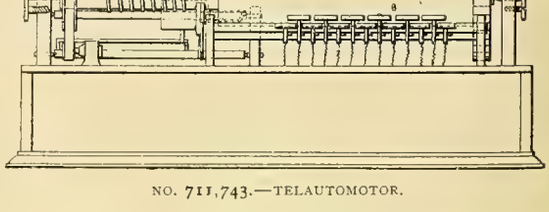
A concaved shell adapted to receive an electric lamp and provided with a translucent plate and also having a vertical stem adapted to be slipped into the sign casing from below is provided. The vertical stem is furnished with contacts adapted to co-operate with the respective contacts in the casing, and a pivoted latch is adapted to uphold the stem.

711,873. Electric Commutator. Wilhelm Loewen, Breslau, Germany. Application filed March 22, 1902.

In an electric commutator the combination of a chamber containing quicksilver with a contact chamber, a channel of small diameter connecting the chambers, one or more side channels of larger diameter between the chambers, and means for closing the circuit. (See cut.)

711,893. Electric Signaling Apparatus. Albert F. Hauss, Baltimore, Md., assignor of one-half to Charles F. Hauss, Baltimore, Md. Application filed January 30, 1902.

Invention is allowed for the combination of transmitting mechanism, receiving mechanism, a supply circuit provided with terminals, a switch-arm adapted to make and break contact with these terminals, and means which will automatically move the switch arm into contact with the terminals while the transmitting mechanism is shifting from one signal to another, and which will also automatically move the switch arm out of such contact as soon as the signal has been given.



NO. 711,743.—TELAUTOMOTOR.

711,917. Storage-battery Plate. Edward H. Winkes, Buffalo, N. Y., assignor of one-half to the American Motor Carriage Company, Cleveland, Ohio. Application filed April 25, 1902.

An integral section of thin lead forms the active portion of the plate. The lead is corrugated and cut or scored in the direction of the corrugations to present numerous closely spaced strips readily accessible to the electrolyte.

711,921. Fuse. Frank B. Cook, Chicago, Ill. Original application filed July 29, 1896. Divided and this application filed May 21, 1902.

The combination of an insulator, a line wire secured to it, a fuse protector having its upper end clamped upon the line wire at a point outside of the insulator, and a conductor secured to the lower end of the protector and adapted to connect with the instruments to be protected.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, NOVEMBER 8, 1902. No. 19

Milan-Gallarate Electric Railway.

By A. DeCourcy.

An electric railway of considerable importance has been built in Northern Italy within the last year and is now in successful operation. It was decided some time ago to adopt the electric system upon the railroad lines extending from Milan to Gallarate, Porto Ceresio, Laveno and Arona, representing a total distance of 80 miles. These lines not only serve the region of the Italian lakes, which are visited by a great number of tourists, but are also the principal outlet from Milan toward a populous and industrial region. As hydraulic power is used, the cost of running is much less than that of the steam trains, and a frequent and rapid service can be assured, especially during the summer and autumn, when there is a great affluence of tourists. The installation of the road has been carried out by the Thomson-Houston International Electric Company, and at present one of the lines, that of Milan-Gallarate-Porto Ceresio, is in operation. The other two branches are to be constructed later. The map on the next page (Fig. 2) shows the system. The dotted lines indicate the high-tension transmission lines from the Tornavento generating station to the five sub-stations which feed the road. Regular trains are made up of one motor car and one trailer, both of special construction, and containing seats for 63 passengers, with 12 and 27 standing places, respectively. In times of heavy traffic a train is made up of several motor cars and trailers, the motor cars being placed at the ends of the train.

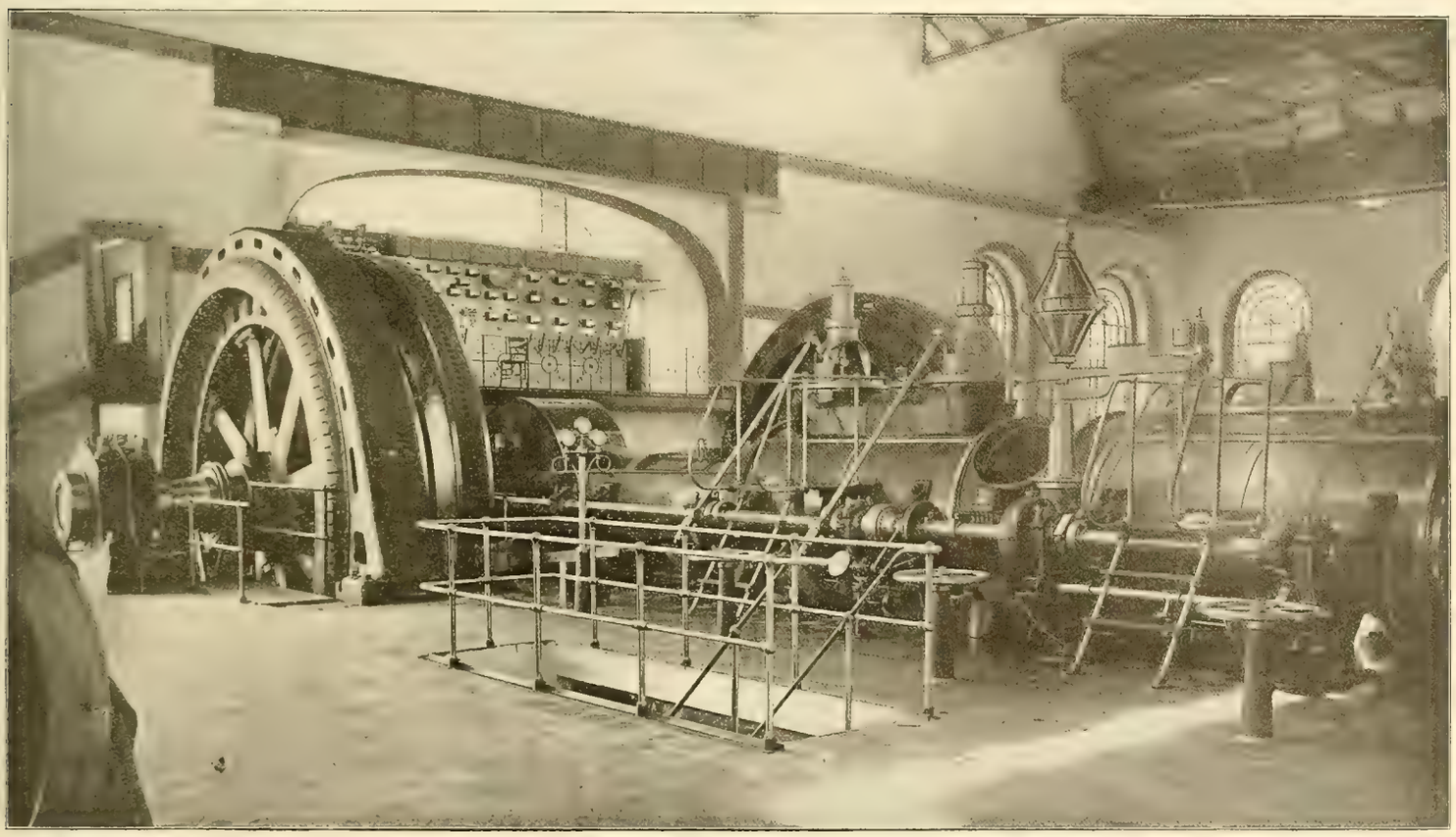


FIG. 1. MILAN-GALLARATE ELECTRIC RAILWAY.—GENERATING PLANT AT TORNAVENTO.

The central-station plant is established at Tornavento, on the banks of the Tessin, and comprises two separate buildings. One contains a hydraulic station and the other a steam plant. The hydraulic plant, which is now under construction, will contain eight units, consisting of 750-kilowatt alternators direct-coupled to 1,200-horsepower turbines. The voltage is 13,000. The steam plant, which is now supplying the road, will be later used as a reserve in case of accident or when otherwise needed. Its appearance will be noticed in Fig. 1. It includes three horizontal Corliss engines, tandem-compound, each of 1,410 horsepower. Steam is furnished by eight tubular boilers, working at 12 atmospheres. To each engine is direct-coupled a three-phase alternator with revolving field, having 750 kilowatts capacity and working at 94 revolutions and 25 cycles. These machines give current at 13,000 volts directly. For the exciters, two six-pole dynamos of 75 kilowatts each are used, coupled to 85-horsepower, vertical engines. The excitation is at 125 volts. The switchboard is composed of nine panels, of which one is used for the two exciters, three for the alternators, one for the meters and the remaining four for the line (two panels for each of the double transmission lines which proceed toward Gallarate and Parabiago).

Referring again to Fig. 2, the system of high-tension transmission lines will be readily understood. The energy produced at 13,000 volts at the Tornavento power house is transmitted on the one hand to Gallarate and Bisuschio and on the other to Parabiago and Musocco by double lines, composed of six copper wires, varying from 0.16 to 0.36 inch in diameter, supported by insulators upon wood poles. The sub-stations, of which there are five, are spaced about 10 miles apart and feed the line directly. In the sub-stations at Gallarate, Parabiago and Musocco, as shown in Fig. 3, the potential is reduced from 12,000 to 420 volts by seven transformers (seen on the left), provided with mechanical ventilators. These have a capacity of 180 kilowatts each. The current from the secondaries passes to rotary converters and is transformed to continuous current at 650 volts. Each of these three sub-stations contains two rotary converters; one alone will suffice for ordinary cases, and the second is used for heavy loads and also as a reserve. These machines are of the six-pole type with a capacity of 500 kilowatts. Each is connected separately to a bank of transformers. The sub-stations of Gazzada and Bisuschio have the same general arrangement, but contain a single rotary converter of 250 kilowatts. As the load of these two sub-stations is intermittent and variable, their plant includes a storage battery of 275 ampere-hours and a booster operated by an electric motor.

Twenty motor cars and 20 trailers constitute the rolling stock, in addition to a heavy electric locomotive. Fig. 4 depicts a light train made up of a motor car and trailer, both of which are built on the same model. The cars are divided into compartments which connect by sliding doors, and they have an entry and vestibule at each end. The car body is supported on two double-axle trucks, the axles being directly operated by the motor. The electric equipment of each motor car includes four motors of the GE55 type, and these give sufficient power to maintain the high speed of 50 miles an hour which the trains have to make over the greater part of the Milan-Gallarate section, this being 25 miles long, and also to provide for a rapid starting, which is necessary, owing to the frequent stops. The motor cars have two series-parallel controllers, each of which can operate the four motors. Air brakes, operated by a motor compressor of four horsepower, are used. The lamps for lighting the cars are placed in series on the main circuit. The contact shoes for collecting the current from the third rail are supported as shown in the drawing (Fig. 5), by an iron brace fixed to the end of the axle box. The motor cars have a contact shoe at each end to assure a constant contact, even should the rail be interrupted for a short distance. For the freight trains an electric locomotive is used weighing about 35 tons. It is equipped with four motors of 160 horsepower.

Fig. 6 shows the position of the third rail, which runs parallel to the tracks. The contact rail is protected in most places by a hood. The rail is supported every 12 feet by insulators of "artificial granite" which were especially designed for this plant. This type has remarkable qualities of solidity and insulation, which have been shown in the tests and in the regular running. The rail is mounted (see Fig. 5) on the iron covering of the insulator, so as to slide back and forth to provide for expansion and contraction. The rails are connected by flexible copper bonds of 0.35 square-inch section. On the Milan-Gallarate portion, where the track is double, the two contact rails are cross-connected every 300 feet by cables of one-half inch diameter. At switches or road passages (one of the latter will be observed in Fig. 6) the connection is assured by an armored cable of 0.7 square-inch section. To distribute the current to the line, feeders are not employed, as the sub-stations feed the line directly. The latter is broken at each sub-station, and the connection is made at each end of the interruption by the corresponding switchboard panel. The sub-stations thus work in parallel, both on the alternating and the direct-current side.

The first part of the line to be completed extends from Milan to Gallarate, a distance of 25 miles, this

being a double-track section, and thence it continues over a single track to Varese. The part from Varese to Porto Ceresio, the terminus, has only been finished recently. The total length now in operation from Milan to the terminus is 44 miles. At first seven electric trains were run each way along with the regular steam trains, but as the system was found to work successfully, the latter were removed, and now the whole road is operated electrically. At first it was intended to use a short train composed of a motor car and trailer, but it was soon found that a heavier train was needed at certain hours, and these were made up of four cars and four trailers. It was also found that the freight and baggage service would be of considerable importance, and the postal service was also to be provided for. Here the electric locomotive was brought into use to draw a train of baggage and postal cars. The locomotive can draw a load of 150 tons at a speed of 30 miles an hour. Several new locomotives are to be built to meet the increasing demands; they are to draw 300-ton trains at 20 miles an hour.

FIG. 2. MAP OF MILAN-GALLARATE ELECTRIC RAILWAY.

FIG. 3. MILAN-GALLARATE ELECTRIC RAILWAY.—SUB STATION AT PARABIAGO.

At last accounts there were 32 trains running each way from Milan to Gallarate. Of these, seven are high-speed express trains which take only 53 minutes to make the trip from Milan to Varese, a distance of 36 miles, with but one intermediate stop. There are also 10 regular express trains which are somewhat slower and make two stops. The operation of the road has proved quite successful and no difficulty has been found with the contact rail at these speeds, even during the winter months, when hardened snow formed on the track. In this case the contact shoe acted effectively as a scraper.

FIG. 4. MILAN-GALLARATE ELECTRIC RAILWAY.—MOTOR CAR AND TRAILER.

The strike of the employes of the Hudson Valley Railway Company has finally been settled, the company agreeing to the scale of wages presented by the men and also recognizing the union. Work was resumed last Monday morning at 7 o'clock.

The Coal Battery.[1]

By Hugo Jone.

It will be remembered that in the summer of last year I patented a battery for the production of electricity from coal. The device was capable of considerable improvement, and for that reason I did not intend to put it on the market until it was thoroughly perfected. The improvements are now complete. I now have a battery ready to be used in practice, to run street cars, light the streets, propel ships, and turn the wheels of large factories.

The new device is a gas battery. The electricity is produced from gas. The gas can be made from coal, but differs from the ordinary illuminating gas. The yield is 62.5 per cent. of the energy of the gas used in the battery. This is about 2½ times as much as is obtained from the best engines hitherto in use. The ordinary gas engine yields 25 per cent. The best gas engines of latest construction yield 28 per cent. of the energy of the gas used up. The efficiency of steam engines is still lower, since they produce only about 10 per cent. of the energy of the coal which they consume. The comparison is best made with the gas engines, since they consume gas the same as the new patent battery. Forty per cent. of the energy of the coal is equal to about 62.5 per cent. of the energy of the gas.

The new battery is of practical and convenient form and easy to work. It is difficult to see how the invention, if introduced into the city's lighting plants and pumping stations, can fail to save the city $300,000 annually for coal.

It is expected that the new device will supplant the steam engine and the gas engine in factories, on railroads, and on ships, as it furnishes 2½ times as much energy as the gas engine and four times as much as the steam engine, from a given amount of coal.

The invention was my private, personal enterprise until it was published last summer; then the city took it up. City Electrician Ellicott became interested in it. He offered to have a model made, if I would exempt the city from royalty on all my batteries. I did not believe in putting the first primitive device on the market, for although it could have been worked with advantage, it would have been displaced by a better battery which I had devised during the two years between the completion and the publication of the first battery. Evidently, then, there was no use in putting the first battery on the market. I, therefore, informed City Electrician Ellicott that I had a new battery, better than the first. He, naturally, preferred the better one of the two batteries.

I signed an agreement, whereby the city is exempt from royalty on any of my batteries. This was on October 1, 1901. A few weeks afterward the city electrician decided to get a model made in order to see if the device was satisfactory, with a view to introducing it in the city's pumping and lighting stations. This model was ordered in November, 1901, but was not completed until August last. Although the great importance of the invention prompted me to work hard, spending the larger part of my leisure time on the invention, the large amount of work in designing the details of the model, working the model and attending to patent matters naturally retarded progress. When, finally, in August of this year, I set the model working, the experiments proved the invention to be all that it was designed to be. The model has about five times the capacity of the small cell worked by Mr. Ellicott. The next step is to make a large battery and to set it working. It is anticipated that, with a large cell, the loss of heat will not cause a reduction of the yield. The large battery is to be built chiefly to get absolute certainty about this point.

I am positive that the device is a success. If it were not sure of success, I should not claim it. I did not claim success for the first device.

Mr. Ellicott has been acquainted with the new device since November, last year. He has failed to find a defect in it, or anything that would render the device impracticable. He has seen the principal experiments, measuring the yield with his own hands, but could not find the time to complete his investigation of the new device. Though he cannot guarantee success, he can form a conclusion that the invention is a success beyond a reasonable doubt. My own experiments demonstrate success beyond the slightest doubt. Mr. Ellicott has decided to try the invention on a large scale.

The new device is a great improvement on the first battery described last summer. It resembles the first battery but little. Neither lead nor sulphuric acid are used. All the chemicals used in the battery are recovered, with the exception of the gas and the oxygen of the air. This battery, like the first battery, may be likened to a furnace consuming gas, but giving out electricity in place of heat. I am willing to have the invention put to the test in actual practice on a large scale.

The supplanting of steam roads by electric roads will be hastened by the new invention. Locomotives are doomed. Stationary generators will be used, giving four to five times as much power from a ton of coal as a locomotive. On ships the battery will be provided with a special appliance which increases

1. In its issue of July 13, 1901, the Western Electrician published an article on "Jone's Method of Producing Electricity Direct from Coal." Since then Mr. Jone, who is the city chemist of Chicago, has given much time to the improvement of his battery, and although he is not yet ready to give a technical description of it, he has prepared the present article at the request of the Western Electrician. Mr. Jone's work has attracted much attention. If it shall be crowned with success, its great importance is of course obvious.—Ed.

the current strength, so that a strong current can be obtained from a small cell. As a result, all the cells needed to propel a ship will occupy a comparatively small space on the ship. As the battery produces four times as much power from a ton of coal as a steam engine, the ships equipped with it will be able to travel four times as far without taking in coal. For factories, lighting plants and pumping stations the current obtained is acknowledged to be strong enough, even without the special appliance for increasing the current strength. The superiority of the battery over the steam engine in factories is apparent.

Mr. Ellicott recognized from the start that both inventions were based on sound principles, and not fake inventions, which could not lead to anything good. It takes an expert to distinguish a fake invention from a real invention. Mr. Ellicott has done this, in spite of the fact that he has his hands full with routine work. A thorough investigation of the merits or demerits of the device should be made at once.

Overhead Wiring in Chicago.

City Electrician Ellicott thinks that there is opportunity for improvement in the overhead wiring in the city of Chicago in the outlying districts, where overhead wires are permitted. He has been paying some attention to the subject of late, and to a representative of the Western Electrician, who asked him for his views, he said:

"There is no city ordinance, and never has been one, governing the placing of high and low-tension wires on poles in the outlying districts of the city. Of course, the downtown districts are protected by underground-wiring regulations and practically no trouble occurs there. It is this lack of system that is chiefly responsible for accidents that have happened. Had the city drawn up rules by which the different electric companies must have abided in the placing of their wires relative to those of other companies, much trouble might have been avoided. Another point which is almost of equal importance is the necessity of employing careful and experienced linemen. A great majority of the accidents reported are to the linemen themselves. The companies must attend to this part of the problem for themselves, although a proper city ordinance would be of assistance.

"I am going to submit the matter to the council and request that a committee be appointed to act in conjunction with representatives from the different electric companies in the drawing up of a proper ordinance. It would be an impossibility for any one man to draft such an ordinance or for a committee to do so properly without first consulting the different companies involved. The conditions are different in different sections of the city where lines cross one another, and each company should be asked to submit its views on this important subject.

"Nothing, however, that either the city or the companies can do will ever protect the lineman until he learns to protect himself. He must accustom himself to looking upon every wire as 'live' until, by one way or another, he has determined to the contrary. When stringing wires he knows are not 'live,' a lineman often becomes careless. Sometimes the wire being strung is tied to the cross-arm of a pole while some other wire is being removed or some minor operation attended to. This wire sags and perhaps comes in contact with a high-tension wire over which it passes. It is immediately charged to the high voltage, and when the lineman again picks it up—well, if he awakes, he tells the old story of 'I didn't know it was loaded.'"

Marconi in Nova Scotia.

William Marconi, aboard the Italian warship Carlo Alberto, arrived at Glace Bay, N. S., on October 31st. He was accompanied by the Marquis Solari.

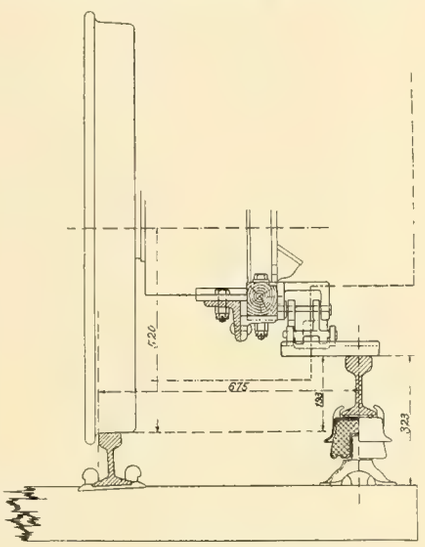


FIG. 5. MILAN-GALLARATE ELECTRIC RAILWAY. — DIAGRAM OF THIRD RAIL AND CONTACT SHOE.

Sixteen boxes of space telegraphic apparatus were landed after some little trouble with the customs officials.

Mr. Marconi will remain at Glace Bay for some time and will supervise the installation of the new apparatus. It is expected that successful attempts will soon be made to communicate between the Nova Scotia station and the English station at Poldhu. In regard to his experiment on the Carlo Alberto and his future plans Mr. Marconi said:

"For 200 miles from Poldhu I transmitted messages on my last trip and I received messages at a distance of 500 miles from Poldhu. As soon as the machinery is all installed in the Table Head station I will commence to experiment. I will first place the Carlo Alberto a short distance from shore and experiment between her and Table Head, and when I am satisfied that everything is going properly, I will send a message across to Poldhu. It will probably be a week, anyway, before I have a statement to make regarding my communication between Poldhu and Table Head."

Major Flood Page of London, England, and Mr. Kemp, chief electrician of the Marconi Company, accompanied Mr. Marconi on board the Carlo Alberto which was four days overdue. Major Page will remain at Glace Bay until after the transatlantic tests are made.

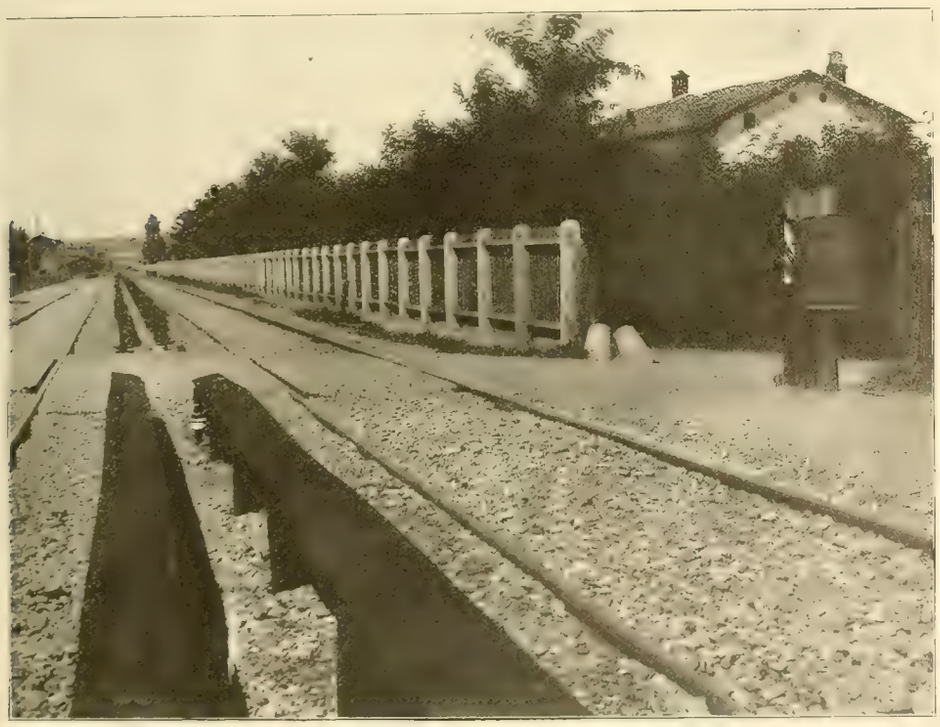


FIG. 6. MILAN-GALLARATE ELECTRIC RAILWAY. THIRD RAIL PROTECTED BY HOOD.

Units for Electrochemical Calculations.

At the recent convention of the American Electrochemical Society held at Niagara Falls, N. Y., Alfred H. Cowles of Cleveland, Ohio, read a paper entitled "A Unit of Quantity of Electricity for Use in Electrochemical Calculations." The subject of the paper related to the rather remarkable fact that an even 500-ampere current for one mean solar day liberates in the electrolysis of water one pound avoirdupois of hydrogen, lacking 0.59 of one per cent., and a 100-ampere current, in one sidereal day, liberates just one cubic meter of hydrogen under standard conditions. These agreements are so close that they should be of great practical value in rendering it easy for students to master the table of electrochemical equivalents.

The atomic weight of hydrogen being taken as one, then that of silver is 107.11. Lord Rayleigh's determination of the electrochemical equivalent of silver is 0.001118 gram per coulomb. This would make the electrochemical equivalent of hydrogen 0.00001043786. Under these premises, 100 international amperes during one sidereal day (the kilocrithcol) liberate 1.00071 cubic meters of hydrogen under standard conditions of pressure and temperature.

The meter is not exactly one ten-millionth part of the quadrant of the earth from the pole to the equator. The most reliable data, as to the distance from the pole to the equator is the determination made by Clarke in 1880, based upon all the arcs of the earth that had been measured up to that time. He found the distance from the pole to the equator to be 10,001,868 meters. Were we to correct the length of the meter in the light of this more reliable data, the cubic meter would then become a trifle larger, and the 100-ampere current would then give 1.00015 cubic meters of hydrogen at 0° Centigrade at the pressure of the atmosphere at the sea level and at 45° latitude in one sidereal day. The sidereal day is 86,164,091 mean-solar seconds, and measures the true revolution of the earth on its axis. This agreement is so close that it is well within the limits of error of the determinations of the various constants, and it naturally raises the very important question as to whether the agreement is absolute or not. Taken in connection with the law of Avogadro and the valencies of the elements, this agreement reaches to every element in chemistry. Hence, if this connecting link could be proven fundamental, the periodic law, the law of gravitation, and Coulomb's law of attraction between electrically charged bodies, could all probably be brought within the scope of some broader generalization.

The generalization spoken of might lead to the formation of a whole system of new units. For instance, a table of "apparent relative atomic capacities for electricity," similar to the table of atomic weights, could be made. From such a table thermal reactions or energy transformations would be read with the same ease that one now reads and traces the shifting of mass in chemical reactions. It is this relation—that 100 amperes in one sidereal day free 1.00015 cubic meters of hydrogen—for which Mr. Cowles is endeavoring to find a physical reason. It is evident that this must be an extremely complicated matter, as here very different units of physical science are interlinked.

American Machinery in Brazil.

The following is extracted from a letter written by Harry Nuding, an American constructing engineer now in Brazil: "I have had four years' experience in the north of Brazil as a constructing engineer, and I have found that it requires unusual skill and thorough knowledge to handle machinery successfully in the tropics. German, English, French and Belgian machinery, including locomotives, ice machines, stationary engines, electrical goods, etc., have been experimented with here and have given poor results when they have not been absolute failures. The supremacy of American machinery is thoroughly established, and if properly placed on this market an immense quantity of it can be sold, to the practical exclusion of foreign machinery and machinery tools. I also introduced American return tubular boilers, fire bricks and fire clay, all of which gave perfect satisfaction. The old locomotive boilers here have been entirely superseded by the American return tubular boilers, as with the intense and continuous heat of this climate, added to the boiler heat (from old-style boilers), the fireman could only stand four-hour shifts; whereas today, with the new American boilers, they are able to run their regular day's shift. We use wood fuel owing to the excessive cost of coal, which, at the present rate of exchange, amounts to $15 to $17 per ton. Several French electrical machines were bought by the state, and I was employed to mount them. They ran for a short time, but it was soon found necessary to send them to the United States to be remodeled and repaired. American electrical machines, since erected here, are found to require less fuel and attention and to give far better satisfaction in every way than the European ones."

Steinmetz Polyphase Induction Regulator.

Where multiphase systems of electrical distribution are used for both lighting and power purposes, a serious difficulty which is encountered is that of unequal variations of electromotive force across different mains of the system, commonly known as "unbalancing," and caused in general by unequal distribution of load between different mains of the system. In some cases, however—as, for instance, in interconnected two-phase systems—if the loads are reactive or the transmission lines contain reactance the electromotive forces across the two sides of the system become unequal, even if loads on the two sides of the system are equal.

The necessity for some means for bringing multiphase systems of distribution into balance is therefore apparent, and for this purpose Charles P. Steinmetz has devised an arrangement for simultaneously

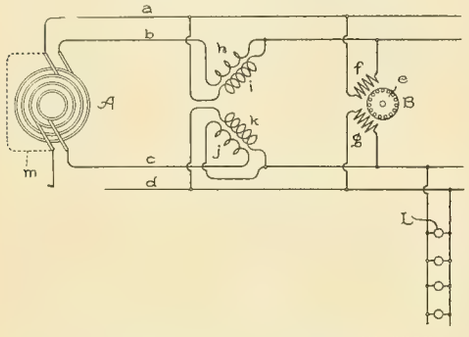


FIG. 1. STEINMETZ POLYPHASE INDUCTION REGULATOR.—DIAGRAM OF CONNECTIONS.

operating upon the electromotive forces between two sides of a multiphase system, the action being such as to produce an opposite variation in the electromotive forces, either raising one and simultaneously lowering the other, or the reverse.

His invention is more particularly applicable to two-phase systems of electric distribution; but it is not in any sense limited thereto, but may be applied to any two alternating-current circuits in which it is desired to produce simultaneously an opposite variation of electromotive forces.

Fig. 1 illustrates diagrammatically the application of the invention to a two-phase system of electrical distribution. Fig. 2 shows a physical embodiment of the invention. Referring to Fig. 1, (A) represents a source of two-phase currents of any appropriate character—such, for example, as a two-phase generator. In this case current of one phase is conducted over mains (a) (b), while current of the other phase is conducted over independent mains

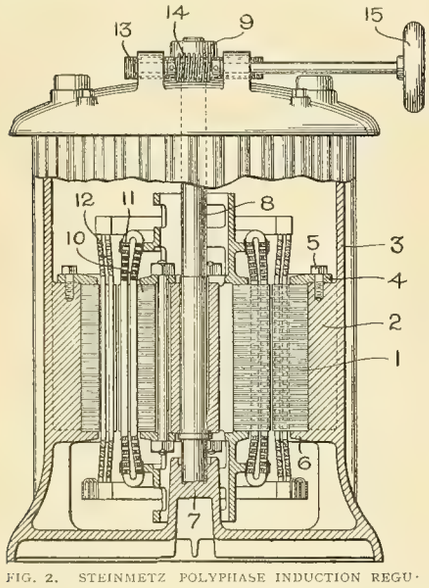


FIG. 2. STEINMETZ POLYPHASE INDUCTION REGULATOR.—SECTION OF REGULATOR.

(c) (d). From these mains connections are made to translating devices in the usual way. At (B) is illustrated a two-phase motor having an induced member (e), acted upon by currents in the coils (f) (g) of the inducing member, one coil, as (f), being supplied with current of one phase from the mains (a) (b), while the other coil (g) is supplied with current of the other phase from the mains (c) (d). Lamps (L) are shown as connected across the mains (c) (d).

The means which Mr. Steinmetz has devised for bringing the electromotive forces on the two sides of the system to an equality when they become unbalanced consists of two co-operatively arranged induction regulators, one of which is applied to each side of the system. Each induction regulator consists of a winding in series with one of the mains and a shunt winding connected across the corresponding mains. As here shown, the winding (h) of one regulator is connected in series with the main (b), while its corresponding shunt winding (i) is connected across the mains (a) (b). In a similar manner the winding (j) of the other regulator is connected in series with one of the mains (c) of the other side of the system, while its shunt winding (k) is connected across the mains (c) (d).

Where desirable, each of these regulators may be made self-contained and connected together mechanically, so as to be simultaneously operated; but in most cases the preferred method is to place all of the windings of both regulators in a single structure having two relatively movable members. This structure is similar to an ordinary induction motor and consists of a suitably constructed toothed ring of laminated magnetic material, within which a similarly toothed cylinder of laminated magnetic material is mounted so as to be partially rotatable. Over one member both of the series coils are mounted, while on the other member both of the shunt coils are similarly mounted. The coils are so arranged that in one position of the regulator the lines of force produced by each shunt coil will all pass through or tend to pass through the corresponding series coil. The electromotive force induced in each series coil by the action of its corresponding shunt coil will thus be a maximum and will accordingly add to or cut down the electromotive force of the line in a maximum amount, depending upon the direction in which the coils are connected into circuit. For the purpose of the present invention the coils operating upon one circuit are so connected as to have an effect opposite from that of the coils which act upon the other circuit. This reverse connection of the coils may be made in different ways, one manner of accomplishing the same being shown in Fig. 1.

With the connections of the regulator thus described and with the coils in the relative position to each other above mentioned it will be seen that one set of coils acts to raise the electromotive force of one circuit a maximum and to depress that of the other a maximum in the opposite direction. If now the shunt coils be rotated or moved away from the corresponding series coils, the mutual induction between the coils becomes less, thus decreasing the boosting effect on one circuit and the lowering effect on the other. A continued relative movement of the coils finally results in bringing them into a neutral position, where no effect is produced on either circuit. A continued movement beyond this position causes a reverse action to take place, lowering the electromotive force of that circuit whose electromotive force had previously been raised and raising the electromotive force on that circuit whose electromotive force had been lowered.

"It will thus be seen," says Mr. Steinmetz, "that my improved regulating device simultaneously raises one electromotive force and lowers another, thus providing a means for producing any desired relation between two electromotive forces without changing their mean value. It will be further observed that the action of my device is not dependent upon the current flowing in the two branches of the system and that it does not have as its object the equalization of current thus flowing, thus differing essentially from many devices for balancing multiphase systems, which depend for their operation upon unequality of current in the system."

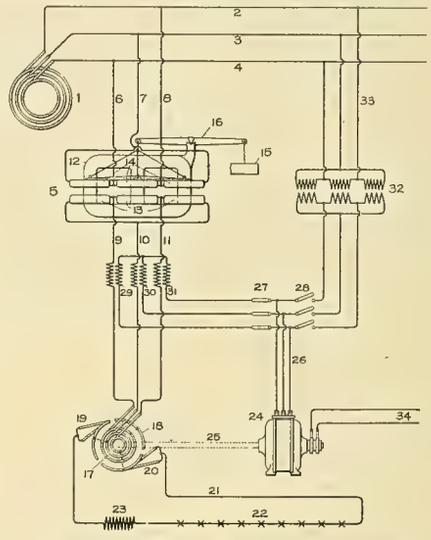
A convenient form of apparatus in which the invention may be embodied is shown in Fig. 2, the same being indicated partially in section. An annular structure (1), of laminated magnetic material, is here shown as carried by projections (2), formed integral with a suitable protecting casing (3). A clamping plate (4), secured by bolts (5), serves to press the laminated structure (1) against the projecting ledge (6). A boss (7) projects up from the bottom of the casing (3) and supports the lower end of a shaft (8), the upper end of which has a bearing in the cover plate (9) of the casing (3). A laminated structure (10) of cylindrical form is carried by the shaft (8) and is similar to the rotating member of an inductor motor. Each of the members (1) (10) is provided with teeth, and in the slots between the teeth the coils of the respective members are carried. For convenience the shunt coils are placed upon the rotatable member (10), while the series coils are placed on the fixed member (1). The shunt coils are indicated in section at (11) and comprise a bundle of comparatively small conductors, while the series windings are shown in section at (2) and consist of wire or rod of large cross-section. The winding of the coils in the slots is similar to that of the ordinary induction regulator now well known in the art, and will be readily understood.

Any desired means may be provided for securing relative rotation between the two members of the regulator, such as a worm-wheel (13), secured to the end of the shaft (8), with the worm (14) coacting therewith. Rotation of the worm (14) may be produced by means of the hand-wheel (15), attached to the shaft. Mr. Steinmetz's invention is treated in two patents, Nos. 712,013 and 712,463, issued last week and assigned to the General Electric Company. The application was filed on February 27, 1899.

The Macon (Ga.) Consolidated Street Railway Company and the Macon Electric Light and Railway Company have consolidated, with J. Claring as president of the new company. The merger involves a capitalization of $1,000,000. The board of directors authorized an immediate expenditure of $164,000 for new machinery.

Synchronous-motor Distribution System.

A system of electrical distribution for alternating currents, comprising certain improvements in the operation of synchronous dynamo-electric machines—such, for example, as synchronous motors, has been devised by Charles P. Steinmetz of Schenectady, N. Y., and is covered by two patents, Nos. 712,104 and 712,464, issued last week. Although not limited to use in any particular relation, the invention is of especial value in connection with rectifier systems in which alternating current is changed to a unidirectional current by means of a rectifying commutator driven by a synchronous motor. In such systems it is usual to obtain the constant current by transformation from a constant-potential source. It is thus possible to drive the synchronous motor by current either from the constant-potential source or by the constant current itself but it has been found in practice that the latter is preferable because better commutation is secured due to the shifting backward or forward of the rotating member of the synchronous motor and the rectifying commutator driven thereby in response to the corresponding shifting in phase of the constant-alternating current. The points of commutation are thus adjusted to a considerable extent automatically without shifting the commutator brushes. There are, however, certain attendant difficulties. The constant current being limited in value is frequently insufficient for sup-



SYNCHRONOUS MOTOR DISTRIBUTION SYSTEM.

plying the requisite starting current for the synchronous motor. Mr. Steinmetz has overcome this difficulty by starting the synchronous motor from the constant-potential mains, from which an ample supply of current is obtainable. After being brought into synchronism the motor may then be switched over to the constant-current circuit or to a circuit derived inductively therefrom.

The drawing represents a system of distribution embodying the invention. A source of alternating current is indicated conventionally at (1). It may be of any number of phases, but, by way of example, is here shown as three phase. Transmission lines (2) (3) (4) extend therefrom and supply energy to suitable consumption circuits. A rectifier system is shown as supplied with energy from these mains. The arrangement illustrated by way of example comprises a three-phase constant-current transformer (5), having primary leads (6) (7) (8) and secondary leads (9) (10) (11). It may consist of a three-branched core (12), having three secondary coils (13) and the same number of primary coils (14). Either set of coils may be fixed while the other is movable, or in some instances both sets of coils may move. The secondary coils (13) are shown as fixed and the primary coils (14) partially counterbalanced by a weight (15), operating through the lever (16).

The secondary leads (9) (10) (11) pass to a rectifying device consisting, in the instance shown, of collector rings (17), to which the secondary leads are connected and which in turn are connected to appropriate segments of a rectifying commutator (indicated at 18). Sets of brushes (19) and (20) bear upon the segments of the commutating device and conduct the rectified current to a consumption circuit (21), containing in series translating devices—such, for example, as arc lamps—indicated conventionally by the crosses (22). To improve the commutation, an inductance coil (23) may be included in series with this circuit. This will have the additional effect of smoothing out the

current in this circuit and rendering it more uniform.

The rectifying device is driven by means of a suitable mechanical connection with a synchronous dynamo-electric machine—such, for example, as a synchronous motor (24). As illustrated, the rectifying commutator is mounted on the same shaft with the rotating member of the motor, this mechanical connection being indicated by means of the dotted lines (25). The rectifving commutator and brushes are shown in the drawing merely in diagram, but it is of course to be understood that they are to be mounted in suitable mechanical relation to the synchronous motor and not in the displaced position shown for convenience in illustration.

The leads of the synchronous motor are indicated at (26) and are connected with two sets of switches, (27) and (28), respectively. The switches (27) operate to connect the synchronous motor leads to the secondary terminals of three series transformers (29), (30) and (31), the primaries of which are placed, respectively, in series with the secondary leads (9) (10) (11) of the alternating constant-current circuit fed from the constant-current transformer (5). The switches (28) serve to connect the leads of the synchronous motor to the terminals of a source of constant potential—such, for example, as the secondary windings of a step-down transformer (32)—the primary windings of which are connected through leads (33) across the main supply system (2) (3) (4).

When the rectifier is to be started up, the switches (27) are opened, while the switches (28) are closed, thereby connecting the synchronous motor across the constant-potential alternating circuit. The comparatively large starting current required by the motor is supplied thereto without difficulty, thereby causing the motor to start up and accelerate until it reaches synchronism, at which time the current required is much less than at starting and of a value such as may be supplied from the constant-current circuit. The change over from the constant-potential circuit to the constant-current circuit may then be effected by opening the switches (28) and closing the switches (27), the resulting arrangement of circuits being as indicated in the drawing. Instead, however, of normally supplying the motor from the secondary of the constant-current transformer it is obvious that it may be supplied from the primary circuit.

Steam Turbines in Europe.

During an address on "Steam Turbines" at University College, Liverpool, England, Professor Hele-Shaw said that the total turbine power of marine vessels completed or nearly completed was about 83,000 horsepower, including torpedo-boat destroyers, yachts, and passenger vessels. Although no Atlantic liners, cruisers or battleships had yet been built with turbine engines, their application to such ships would be attended with even greater advantage than to smaller vessels. In seconding a vote of thanks to the professor, Mr. Shield, formerly chairman of the Walker Engineering Laboratories committee, said he had only just returned from the Continent, where steam turbines excited deep and universal attention. There was scarcely a steam-engine maker who was not seriously considering that question, and what had brought about that state of things was the fact that in all recent tenders of any importance for electrical plant steam-turbine makers had not only tendered below the price of the best makers of reciprocating engines, but had guaranteed an economy which the makers of reciprocating engines could not possibly do. In Paris wonderful results were being achieved, and the makers were working in a way which he thought would render the adoption of turbines easier than at present, because, by the expedient of having each a separate ring of guide blades and vanes encased in a separate chamber, less accuracy of fitting was necessary, as the steam was compelled, after escaping into its own chamber, to pass into the next chamber, and there do the work. This, he thought, would greatly reduce the cost of turbines and possibly bring about their universal adoption.

London "Tube" Controversy.

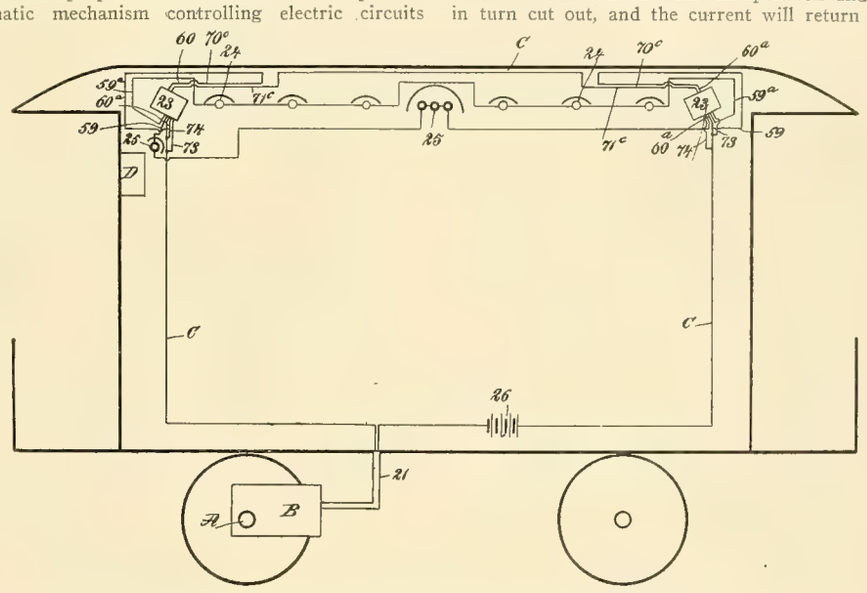
The London "tube" controversy has taken an acrimonious turn. The principals being unable, for the time being, to obtain any further action by Parliament, are amusing themselves and the general public by causing to appear in the London papers long articles on what the other fellow said, which was "entirely incorrect" and what he did, which was "unfair." As the matter stands, the Morgan syndicate can do nothing for at least a year, when Parliament can again take up the matter. Just at present and for some little time, it would be a grave breach of parliamentary procedure were the Morgan bill again brought up for discussion.

It is asserted in parliamentary and financial circles that the Morgan syndicate has been the victim of a breach of faith, necessitating a delay, but not the abandonment of its projects. This breach of faith was committed by the promoters of the West London part of the scheme and not by the Yerkes group. The latter simply bought up part of the enterprise for paralleling their district railway, paying therefor an enormous price, and then temporarily killing the whole enterprise. Popular sentiment seems to favor the Morgan plan, and it is probable that that syndicate will, sooner or later, have an underground-railway system in London.

Automatic Photographic Detector for Passenger Cars.

Frederick W. Brooks of Brooklyn, N. Y., is the inventor of a novel and ingenious if not entirely practicable apparatus for use on street cars. The purpose of the invention is to provide an automatic mechanism for recording the "number and class of passengers, the distance ridden by each, the approximate time and place of ingress and egress of each passenger, identifying the conductor, the car, the trip, the day or night, the hour and minute of the day or night, and the approximate location of the car in order to obtain a true automatic register or record of the trip and the number of passengers carried independently of the co-operation and beyond the control of the conductor or faretaker in order that the truth or falsity of the conductor's returns shall be shown and passenger-mileage reckoned, the records being taken in such manner that they may be used as lantern slides, whereby the records may be enlarged and projected on a screen."

A further purpose of the invention is to provide automatic mechanism controlling electric circuits and connections to operate a photographic camera or cameras to be operated electrically and automatically at such intervals or distances apart as may be desired by and in consequence of the revolution of the car wheels and governed by the number of such revolutions and to arrange the mechanism in such manner that the intervals may be changed or adjusted at will, the camera or cameras being so situated as to photograph the interior or part of the interior of the car, the platform or platforms and side running boards, and any and all passengers that may come within its field, and, further, so to connect the camera or cameras with the electric appliances of the car as properly to light the field of the camera and to cut off objectionable or conflicting lights, also to protect the devices and their connections from malicious tampering.



AUTOMATIC PHOTOGRAPHIC DETECTOR FOR PASSENGER CARS.

The parts of the invention may be briefly summed up as follows: First, a device connected with and operated by the revolution of a wheel or axle of the car and an electrical connection by which the operations of the camera and registers and the distance between such operations are actuated and controlled; second, an electric current from any available source, preferably a battery, either primary or storage, situated in such part of the car as may be deemed most convenient and connected by conductors with the above device, by which the circuit or circuits are opened or closed, the opening and closing of the electric currents being arranged to operate the camera or cameras, the registers, and the lighting and de-lighting of the car; third, a method for automatically lighting the car in such portions as are desired and means for shutting off conflicting or objectionable lights.

The accompanying illustration is a diagrammatic view of a car, showing the system of wiring. The car shown may be an electric car or a horse tramcar, open or closed, operated by overhead trolley, third rail, storage battery, underground rail, or other power. In such car one or more electrically controlled compound cameras (23) are placed in overhead position, one near each end of the car, in such position that the camera near the front end of the car will have for its field the rear portion of the car, including the platform, and in an open car the side running-boards, also, if desired, the register, the clock or calendar-clock, and such other data as may be desired to be automatically recorded, the camera at the rear end of the car operating in like manner to photograph the front portion of the car. The register (D), including a clock, if a colck is employed, is located, preferably, at one end only of a car.

The usual incandescent electric lights (24) employed for ordinary lighting purposes may be placed wherever desired, and these lights (24), though usually kept in circuit when the car is running at night, may be cut out of circuit when the shutters of the camera are opened by the automatic action of a switch.

In addition to the ordinary lights (24) additional incandescent lights (25) are placed in such position as may be deemed best to light the portions of the car being photographed, each camera light (25) being so screened as to prevent the light therefrom falling directly into the camera operating therewith, and a current therefor is arranged in such manner that the going out of the lights (24) will shunt the current through the camera-lights (25) to be used for such camera while in operation and to be in turn cut out, and the current will return to the lights (24) when the shutter of the camera is again closed.

An electric primary or storage battery (26) is placed in any desirable position in the car and is connected to and from the cameras, registers, lighting apparatus, and actuating devices by any desirable method of wiring. The wiring in exposed places is to be carried in a conduit similar to the conduit (21), the conduit being led as required by the conditions of construction of the car.

In general the operation of the mechanism may be described as follows: The revolution of the axle of the car connects the current of electricity which opens the shutter of the camera, at the same time turning off the general or usual lights in the car and turning on the lights which are especially devised and placed to light those portions of the car to be photographed, and simultaneously moves the distance-tape, at which the camera or cameras take the record of the car number, the conductor's number, photographing the conductor, the number of fares rung up by the conductor on the register, the locality, the year, the month, the day, the hour, and the minute of taking the record, the number and class of passengers in the car, distinguishing thereby such officials as are entitled by law to ride free, including employes of the road in uniform, and children. These records may be arranged to be taken as frequently or as infrequently or at such distance apart as may be desirable by altering the number of spurs on the car-axle (A).

At such time and places as may be desired the film-spools containing a record may be taken out (inclosed in a dark box) and developed and printed in any suitable way and by any suitable process, and may be fitted for enlargement on a screen—for example, by a magic lantern, a stereopticon, or a light adapted for the purpose.

Mr. Brooks' curious invention is covered by a United States patent (No. 711,935) issued on October 28th.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Milan-Gallarate Electric Railway. By A. De Courcy. Illustrated	323, 324, 325
The Coal Battery. By Hugo Jone	324, 325
Overhead Wiring in Chicago	325
Marconi in Nova Scotia	325
Units for Electrochemical Calculations	325
American Machinery in Brazil	325
Steinmetz Polyphase Induction Regulator. Illustrated	326
Synchronous-motor Distribution System. Illustrated	326, 327
Steam Turbines in Europe	327
London "Tube" Controversy	327
Automatic Photographic Detector for Passenger Cars. Illustrated	327
Editorial	328
White River Development by Snoqualmie Falls Company	329
Magnitude of the Niagara Power Developments	329
Electrical Exports for September	329
British Pacific Cable Laid	329
Proposed Developments of the Institute. By Charles F. Scott. (American Institute of Electrical Engineers.)	330, 331
Remarkable Blasting Accident	331
Chattanooga Hustling for Street-railway Convention	331
Development of the Telephone Field. Illustrated	332, 333
New Telephone Patents. Illustrated	332
Interstate Independent Telephone Association	332
Telephone News from the Northwest	332
Ohio Telephone Notes	332, 333
Southern Telephone Developments	333
Indiana Telephone Items	333
Rocky Mountain Region	333
Michigan Telephone Company's Affairs	333
Kentucky and Southern Indiana Telephone Convention	333
General Telephone News	333
Engineering in Argentina	333, 334
Motor-driven Gardner Grinder. Illustrated	334
Swedish Government Considering Big Electric-railway Project	334
Ionization of Gases. By George F. Stradling. (Franklin Institute.)	334
More about the Osmium Lamp	334
World's Production of Coal in 1901	334
A New Miniature-lamp Company. Portraits	335
The Technolexicon	335, 336
The Field for Electric Railways	336
A Railway Franchise in Jamestown, N. Y.	336
Book Table.—"Forest Reserves"	336

DEPARTMENTS.

Correspondence	336, 337, 338
New York Notes	336
Canadian Intelligence	336
New England News	336
Southern Developments	336, 337
From the Buckeye State	337
Detroit, Mich	337
Information from Indiana	337
Northwestern Notations	337
Among the Rockies	337
On the Pacific Slope	337, 338
Personal	338
Electric Lighting	338
Electric Railways	338
Power Transmission	338
Societies and Schools	338
Telegraph	338
Publications	338, 339
Miscellaneous	339
Trade News	339
Business	339
Illustrated Electrical Patent Record	339, 340

DATES AHEAD.

Interstate Independent Telephone Association, Auditorium Hotel, Chicago, December 9th, 10th and 11th.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

WHAT is needed in the plant of the Rochester (Ind.) Electric Light Company, evidently, is an ohm-sifter. In describing a recent mishap the Rochester Daily Republican says that "the feed wire from the armature to the collector rings, on the incandescent dynamo, broke in two somewhere between the electric equipoise and the gildersleeve, right beneath the sight-feed oil pump, which caused the wattmeter-catcher to cross fire between the voltcharger and the ampere-handle." But we believe this to be an error, even if Mr. J. E. Beyer, president of the company, did furnish the data to the newspaper quoted. Our belief is strengthened by the further statement that "the ohm-meter jiffer absorbed more electricity than it could get through its digester, and it burned out in a jiffy." Ohm-meter jiffer, indeed! Why will central-station managers rely on this notoriously erratic device, when, by the simple and well-known expedient of installing an ohm-sifter, the pestiferous ohms, which may be regarded as the insidious microbes of the dynamo-electric organization, may be entirely eradicated?

THE interesting but hardly practicable suggestion is made that submarine boats be propelled entirely by electric power instead of merely during submerged periods as at present. The proposition is attributed to Lieutenant-commander John R. Edwards, U. S. N., who is thus reported: "It is impossible to utilize steam for submarines, as the heat would be too great. Inventors, therefore, turned to gasoline engines for surface work and electric storage batteries when submerged. All inventors cling to the gasoline engine, for it gives their boats a radius of action they could not secure by the use of storage batteries exclusively. The French boats, I understand, use electricity alone, but this limits their range to forty miles. I believe it would be possible to build submarine torpedo boats sufficiently large to accommodate batteries which would give a radius of action of several hundred miles. The boats now being constructed for the navy are about 120 tons, and I see no reason why they should not be built 200 or more tons displacement." The objection of the great weight and bulk of the large batteries required has not so much force in the case of submarine boats as with other craft and may be, perhaps, disregarded. But the difficulty with an all-electric submergible boat would be the providing of a source of current to charge the batteries. This is now easily done by a dynamo arranged to be connected to the propelling gas engine. But if the latter be taken out, some outside source would have to be sought, and this dependence on the shore or some other ship would greatly restrict the usefulness of the boat. And if a charging set be installed, the engine might as well be connected to the propeller shaft in order to save the battery current as much as possible.

IT IS extremely gratifying to note that the government reports for September show a very marked increase in electrical exports. In valuation the figure for September, 1902, is $1,188,591, compared with $659,400 for September, 1901. This is an increase of no less than 80 per cent. In August of this year the electrical exports were valued at $821,057, and therefore the increase of September over August was 45 per cent. The increase is shown both in electrical machinery and in electrical appliances and instruments—the two classes into which the government divides the electrical exports—and seems to be a healthy rebound from the lull in the foreign electrical trade of the United States which was observable during the spring and summer months. The unusual volume of the electrical export trade of last September may be judged by considering the fact that if all the other months averaged as well the total for the year would be over $14,000,000, whereas the actual value of the electrical apparatus exported from the United States during the year ended June 30, 1902, was $9,011,505. In other words, the average for the 12 months of the fiscal year was $750,959, compared with the $1,188,591 of September. It is interesting to add that in July the electrical exports amounted to $835,665 and in August to $821,057, so that the prospects for a better showing in the fiscal year of 1902-03 are excellent.

Not alone in the electrical trade are the export figures for September of large volume. In fact, they are the largest ever shown for September, with the single exception of that month in the year 1900, and fall less than a half million dollars below the high-water mark made in that year. The figures, as just presented by the Treasury Bureau of Statistics, show the total exports in September, 1902, to be $115,521,984, against $106,989,926 in September, 1901, and $115,901,722 in September, 1900. This seems to indicate that the downward tendency in the export trade caused by the corn-crop failure of last year has reached its lowest point, and that the reverse movement toward normal conditions has begun.

MR. SCOTT'S "Proposed Developments of the Institute," as given in his opening address as president, presented in full elsewhere in this issue, will meet the cordial approval of all friends of the organization, which designation we take to mean, in general terms, the electrical public of the United States. The society has certainly done a great deal of useful work, as its published transactions show. If it had accomplished nothing more than the standard wiring table and the code for the standardization of electric generators, motors and transformers, its existence would be fully justified, and it has, of course, done much more than this. But Mr. Scott shows that there are several ways in which the usefulness of the Institute may be increased. In the first place, the membership, while good in quality, is not what it should be in quantity. The president makes the curious calculation that if American Institute membership bore the same relation to the kilowatt capacity of the electrical power stations of the country as does that of the British Institution, it would be 25,000 instead of less than 1,600. Again, papers and discussions should be contributed from a larger proportion of the membership. This touches on a difficulty which is encountered in all bodies of like character, and in the case of the Institute it has, in a few instances, caused the acceptance of papers savoring rather more of commercial interests than of the profession of electrical engineering.

Local meetings of the Institute are urged by Mr. Scott to broaden interest in the work. This is a subject in which western members are especially interested and to which they should give careful attention. It must appeal especially to a president, like the present incumbent of the office, who is a non-resident of New York, where the headquarters, library and neighborhood interest of the organization are centered. However, the great bulk of the membership—about 75 per cent., we believe—is not located in New York, and in years past there has been unquestionably a feeling that the honors and attention of the Institute were bestowed in disproportionate degree on members residing in and near that city. No one supposes that there was anything like a deliberate intention to discriminate against the western members; but the men who were nearest the center of the Institute's operations evinced the greatest interest in it and controlled its affairs. Happily, there has been manifest, of late, an earnest effort to make the Institute larger and more truly representative, and with a Pittsburg man as president the charge that the officers of the Institute are chosen almost exclusively from New York city loses much of its force. This broadening-out policy should be continued, and the members in large western centers can and should do their part, by making the slight sacrifice of time that is necessary, to make it successful. Branch meetings have been held irregularly in Chicago for several years. The local honorary secretary has done his part, but the members have manifested only sporadic interest. A movement is now on foot to secure the active co-operation of the 70 or more members in this city and its vicinity, and it is expected that well-attended meetings will be held this winter. A movement for local meetings in Pittsburg has met encouraging success, and similar projects in Minneapolis, St. Louis and Cleveland are in various stages of discussion. The time appears to be now ripe for an earnest, united effort to make the Institute much larger and more truly representative of the electrical thought of the United States than it has ever been, and we trust that the western members will give their hearty co-operation to this end.

Several other valuable recommendations were made by President Scott in his luminous address and all are worthy of careful attention. There is no other body in the United States to take the place of the Institute, and all electrical engineers should give hearty support to the movement to make it more truly national and less open to the charge of at least a seeming sectionalism.

White River Development by Snoqualmie Falls Company.

A new hydro-electric development is being planned by the Snoqualmie Falls and White River Power Company, of which Charles H. Baker is president. It will make an interesting and large addition to the present power-transmission plant of the Snoqualmie Falls Power Company. The general plan will be to divert the water of White River at a point in Pierce County, Wash., and to convey the water thus diverted through an excavated canal, a distance of about eight miles, to Lake Tapps. The level of this lake will be raised until it occupies an area of about 5,000 acres, and will serve as a storage reservoir and settling basin. The outlet of this lake will be a short canal and tunnel connecting with a penstock on the brow of the hill overlooking the Stuck Valley. Steel pipes leading from the penstock will convey the water under a head of 450 feet to the waterwheels in the power house at the foot of the hill, and from the waterwheels the water will escape through a short tailrace into Stuck River. The power house will be connected in with the present Snoqualmie Falls transmission system by circuits about five miles in length.

The above is an outline of the general plan, the several features of which may be more fully described as follows: The intake at the point of diversion will be constructed of concrete masonry. The level of the river will be raised at this point in order to effect a full entrance of the water into the intake by the construction of a submerged dam across the river, which will be continued to the intake in the shape of an earthen embankment, designed to be higher than the river at any stage. There will also be constructed at the intake, and in connection therewith, a set of gates for the purpose of discharging the water back into the river and in shutting the same off from the canal at any time it may be desired to do so for inspection or repair purposes.

The canal throughout its entire length will be a thorough cut through earth and cement gravel. The canal will be 25 feet wide on the bottom with side slopes of 1½ to one below the water line and one to one above the water line, and will flow six feet deep. The canal and intake are designed to discharge a volume of water equivalent to 60,000 theoretical horsepower under 450 feet head.

The contour of Lake Tapps is such that the raising of its level would overflow the lake at eight different points, but this is to be prevented by the construction of earthen dams at these particular points. Aside from these dams, the only work to be done in connection with the reservoir is to clear about 1,000 acres of land around the lake and to build a ditch to connect Church Lake with this storage reservoir.

The outlet canal consists of a canal having the same design as the inlet canal, and the construction of a tunnel which is a prolongation of the outlet canal.

The penstock is designed to receive the full discharge of the canal and will be constructed of concrete masonry. It will have five outlets, through which will be discharged the water to the different pipe lines.

The present development contemplates the installation of one pipe line at present, sufficient in size to deliver 10,000 horsepower. More pipe lines will be added later, as additional waterwheels are installed. The pipe lines will be of rolled steel plates, riveted together, and supported by concrete piers and anchored firmly to the earth.

The power house is designed to accommodate a 50,000-horsepower installation of waterwheels, generators and accessories. The building will be erected in common red brick, although at present it will be erected in part only, sufficient to house a 10,000-horsepower installation of waterwheels and generators. As an adjunct, there will be a machine shop equipped with a lathe, drill press, shaper and blacksmith forge, with the necessary accessories. There will be installed in the power house two 3,000-kilogatt generators and two exciters of the Westinghouse type, directly connected to impact waterwheels of sufficient capacity to drive the generators under full load.

There will also be erected, either separately or in connection with the power house, a transformer house in common red brick, and there will be installed therein 10,000 horsepower of raising transformers. A frame building will also be constructed near the power house for the purpose of housing the men who will operate the plant and which will contain a dining room, kitchen and laundry and rooms for office, store and drafting purposes.

It is understood that there are to be no further extensions of the plant at Snoqualmie Falls for a year or more, as it is Mr. Baker's plan to reach Portland, Ore., with his lines, which the White River power will enable him to do with a saving of 50 miles of transmission. The Snoqualmie and White River plants will be run together, and each will serve as a reserve for the other, the idea being for the former plant to carry the load in Whatcom and the northern cities while the White River plant will supply Portland and the intervening cities lying to the south.

Magnitude of Niagara Power Developments.

Some interesting facts are collected by the journal known as Greater Buffalo in relation to the hydro-electric work at Niagara Falls.

"Already the capital in Niagara power developments amounts to $32,500,000. The Niagara Falls Power Company is now supplying 50,000 electrical horsepower from its Power House No. 1, and shortly after the new year will have Power House No. 2 with a capacity of 55,000 horsepower completed. The electrical machinery is now being installed and the first 10,000 horsepower will be ready this month. The Niagara Falls Hydraulic Power and Manufacturing Company is enlarging its canal, as well as the capacity of the power house, and by the time these improvements are completed will add 100,000 horsepower to its present output. It has recently acquired a large area of land in the north end of the city, where all this additional power will be used in factories that will be built there as fast as the power can be had. The Canadian Niagara Falls Power Company is working night and day on a power development of 100,000 horsepower, most of which will be used on the American side to meet the growing demand for power. The first block of this power will be ready during the coming year. This company also secured the franchise for an additional 100,000 horsepower, work on which will no doubt begin as soon as the present installment has been completed. The Ontario Power Company plans to develop 400,000 horsepower, work on which is being hurried with all possible speed, and contract for the electrical machinery for the first 50,000 horsepower has already been let. The Lower Niagara River Power Company has secured a franchise from the state of New York to develop 200,000 horsepower, work on which will soon begin, which makes five companies, each having abundant capital, which have the right and will develop a grand total of about 1,000,000 horsepower at Niagara Falls as soon as the work can be performed. In addition to this, there is still another very strong combination of wealth which it is known for a certainty is planning for an immense power development, and later there are sure to be still others, so that it may be said that the work of harnessing Niagara is to-day only begun. It is difficult for the average mind to grasp the above figures, especially for those who are inexperienced in engineering science, but some idea of that stupendous force can be gained by comparison stated below.

"Great as is the industrial progress of the city of Niagara Falls, which has resulted within a few years from the beginning of this power development, it must be exceeded by many times in the next few years when the power above referred to will be added, which will then be equal to the combined power used in the cities of New York, Philadelphia, Buffalo, Cleveland and Chicago. These five cities have a population of 7,800,000. This is a significant fact, and we dare neither to limit the possibilities of the city nor the Falls of Niagara. The past record is such that would justify almost any kind of a prediction. The slow and sleepy hotel village of 5,000 inhabitants of a few years ago has already become the hustling, thriving and important manufacturing city of from 25,000 to 30,000 people, showing a greater gain than any city in the country. The capitalization of her factories at present is $37,647,500, and the annual value of manufactured products amounts to $23,409,000. The industries attracted to this spot are the most substantial in the country, and without an exception are successful beyond their highest expectations, which is accounted for by the uniform supply of steady and reliable electric power at a low cost. The demand for this power is continually in excess of the supply; hence the utmost efforts of the several power companies to obtain additional power at the earliest possible date.

"In recent years a great many new uses of electricity have been found in the electrochemical industries, for which Niagara power is particularly well adapted on account of the continuous, uniform and never-failing electric current, and in consequence the city of Niagara Falls already enjoys the distinction of being the greatest electrochemical center in the world.

"Another feature which is favorable to Niagara power is its absolute freedom from such annoying disturbances as coal strikes. This can be fully appreciated just at this time when the great strike is working untold hardships and losses to thousands of manufacturers. Power can be sold at Niagara Falls 50 years in advance, with full assurance that the supply will not be cut off by any cause or condition whatever. This is one of the strongest inducements to manufacturers to seek Niagara's power."

Electrical Exports for September.

The electrical exports from the United States during the month of September, 1902, amounted in value to $1,188,591. During the corresponding month in the year 1901 the value of the electrical exports was $659,400, showing that the increase of the present year over last for the month was no less than $529,191—a sum almost equal to the total valuation in September, 1901. In August, 1902, the electrical exports amounted to $821,057. The increase of September over August this year was therefore $367,534.

Under the head of "electrical appliances, including telegraph and telephone instruments," are found the following figures: September, 1902, $685,987; September, 1901, $272,178—an increase for the present year of $413,809. Under "electrical machinery" these are the figures: September, 1902, $502,604; September, 1901, $387,222. Here an increase of $115,382 is shown.

Classified according to destination, the exports of electrical machinery in September, 1902, to some of the principal buyers were as follows: United Kingdom, $266,258; British North America, $91,929; Mexico, $42,127; British Australasia, $19,836; Colombia, $13,780; Japan, $12,312; Philippine Islands, $10,531; Argentina, $9,340; Brazil, $8,517; British East Indies, $1,135. Of the above, Japan's shipment dropped from $22,954 in September of last year to $12,313, given above, and Argentina from $24,651 to $9,340. The most marked decrease, however, is seen in the exports to the British East Indies, which dropped from $114,585 to $1,135. This is probably due to some exceptionally large shipment in September, 1901.

In spite of these decreases, the machinery totals for the two months show greatly in favor of the present year. This is due to the fact that the few decreases are more than offset by a great number of substantial increases, among which may be cited the following: The United Kingdom, from $99,261 to $266,258; British North America, from $75,810 to $91,929; Mexico, from $4,162 to $42,127; Colombia, from nothing to $13,780; Philippine Islands, from $818 to $10,531; Brazil, from $650 to $8,517.

British Pacific Cable Laid.

The last section of the British Pacific cable was laid at the Fiji Islands on October 30th. This was the last link to be laid between Australia and Vancouver, B. C. The first message sent over the cable was one of congratulation to King Edward. This message was sent to the king on the morning of October 31st, the day following the completion of the cable. Other congratulatory messages were sent to the Canadian and Australian governments.

The cable is still in the hands of the contractors, and it will not be open for business for about three weeks. The section between Bamfield Creek and Fanning Island, which is the longest in the world, has already undergone a series of tests and proved entirely equal to expectations. The great question in the success of the cable was over this enormous stretch, but it was found by test to give a speed of over 100 words a minute with the Deerlove transmitter. The actual time occupied in the transmission of a message from Victoria, B. C., to Sydney, Australia, will be less than five minutes in the case of a short commercial message. Sir Sanford Fleming, at Ottawa, Ont., received the following cablegram over the Pacific cable from Premier Seddon of New Zealand: "Delighted to congratulate you on completion of great work on Pacific cable, thus rewarding your interest and labor and forging further link to advantage of our empire."

The Canadian Department of Marine has issued a notice to mariners stating that the Pacific Cable Board has built a terminus station on the summit of the point between Grappler Creek and Bamfield Creek, Barklay Sound, on the west coast of Vancouver Island. The large and handsome buildings of the station show conspicuously. The cable enters the water at a point within 400 feet southwesterly from the extreme point between the two creeks. Vessels entering Eastern Channel and Bamfield Creek are warned not to anchor where there is danger of fouling the cable. In Bamfield Creek, if they anchor anywhere near the Mills Peninsular Shore, or south of the station building, they will be clear of the cable. A pile wharf for the accommodation of the cable station has been built on the east shore of Bamfield Creek, about one cable length southwesterly from the extremity of the point between Bamfield and Grappler Creek.

General Manager A. B. DuPont of the St. Louis (Mo.) Transit Company, is reported to have said that no material increase in the present street-railway facilities would be necessary to handle the World's Fair traffic in 1904. Mr. DuPont said: "If the World's Fair gets all the people we can haul to it, it will get four times as many as attended the Columbian Exposition at Chicago. Our power houses will be enlarged a little each year. Fifty new cars will be ready by the first of November, and more will be put on from time to time, as needed."

Proposed Developments of the Institute.[1]

By Charles F. Scott.

The position occupied by the electrical engineer is unique. The science which underlies his work is most fascinating and most fruitful. Its applications are not confined to a limited field. There is scarcely a branch of human activity that has not received its quickening touch. So rapidly have electrical novelties become commercial necessities and simple experiments evolved great systems that a new branch of engineering has been developed in a score of years. The scope of the electrical-engineering profession has developed from trivial beginnings until it includes works of the greatest diversity and magnitude and far-reaching consequences, in industrial, commercial and social life. This development has been the result, not of mere chance, but of a combination of favoring conditions. Faraday and Maxwell laid the foundations of electrical science and the general mechanical, industrial and scientific evolution of the nineteenth century gave the necessary opportunity and impetus to its commercial application. Electricity is usually a means, an agency, and is not in itself an end. In order that electricity may be applied, there must be that to which it can be applied. The electric motor, for example, would be of little consequence if there were no field for it—if there were no machine shops or mills, no elevators or street cars. It is because the steam engine has for a century been training men to use mechanical power, and because the existing methods of transmitting and distributing power have such fixed and narrow limitations, that the electrical system has so quickly taken its place between engine and lathe, between the waterfall and the loom. It is because the science of electrochemistry was advancing that the dynamo found a place in electrochemical industries, and, in turn, cheap electrical energy has accelerated electrochemical development. It is notable that the greater part of the power developed at Niagara Falls is used in electrochemical and allied processes, in the manufacture of aluminum, carborundum, sodium, chlorine, caustic soda, calcium carbide, phosphorus, graphite and barium hydrate; while in almost every case even the discovery of the process itself, as well as the development of the industry, has occurred since the work upon the power plant was begun.

It is a hackneyed theme—the infancy of electricity; and yet, to obtain a just view of his position, the electrical engineer must realize how brief, compared with other branches of engineering, is the experience upon which his work is based. Even the man who has been called the "father of electrical engineering," whose theoretical and mechanical skill made possible the success of the ocean cable, is still a vigorous worker, and quite recently the Institute was privileged to tender him a reception. I refer, of course, to our distinguished honorary member, Lord Kelvin. It is not yet 27 years, the age required for full membership in the Institute, since the Centennial Exposition gave an impetus to electrical invention and the telephone was made public. It was not until 1884, the year of the Philadelphia International Electrical Exposition, that measures were taken for establishing a national organization among electrical men, and the American Institute of Electrical Engineers was established. Its first president, Dr. Norvin Green, and half of its vice-presidents and managers were identified with the telegraph. The practical electricians of those days were telegraph men, but now a new generation has arisen to whom the click of the sounder is unintelligible.

The past 50 years and notably the past decade have witnessed a general development of such magnitude that it marks an epoch in the world's history. And in this development, electricity has been foremost. I will not attempt to recount and catalogue what has been accomplished, in how many ways electricity has proven useful, the various purposes for which it is employed in industrial and manufacturing enterprises, nor to what extent the telephone, telegraph and cable have affected domestic, commercial, social and national life. I will not mention the results which the railway motor in city, suburban and interurban service is effecting in the cheapening of travel and the redistribution of population; I will not dwell upon the far-reaching effects in the economic world of an agent which makes possible the combination of formerly diverse interests by operating in one great system local and interurban railways, mills, shops, elevators, street lighting and indoor illumination; nor will I even attempt to sum up all these achievements and estimate by how much the results of human activity are increased through the agency of electricity. The point I do make is the rapid growth and the magnitude of the work, and the far-reaching responsibilities which have so quickly devolved upon the electrical profession.

Consider for a moment the financial aspect. It is estimated that the total investment in electrical applications outside of telegraphy and telephony at the time this Institute was founded did not exceed $1,000,000. At the present time the estimated capitalization of electrical applications in the United States approximates $4,000,000,000. In other words, electricity represents a value about one-third as great as that represented by the investment in our steam-railway systems. Speaking generally, this enormous expansion has been made possible by the electrical engineer, and, furthermore, the successful outcome of these investments depends upon his work. Even these figures do not fully measure the vast responsibilities which are entrusted to the electrical engineer, since they take no account of the importance of his work in the many industries and enterprises which use electrical apparatus in a merely subsidiary or auxiliary way.

The work which the future has in store for the electrical engineer seems even greater. Scarcely a plan for future progress is proposed either by the practical and conservative business man, manufacturer or engineer, or by the sanguine promoter or the imaginative writer who portrays an Utopian civilization, which does not involve some application of electricity.

We are now at a time of general prosperity. Will this continue? Is prosperity a normal condition, or are successions of prosperity and depression inevitable? Continued prosperity requires high efficiency. Effort must not be wasted or dissipated. The ordinary activities and functions of industrial and commercial life must be efficiently performed, and energy must not be lost through great undertakings which fail in the execution, or accomplish no useful result. Think for a moment how different the condition of Italy might be, had the energy which was expended in the construction of cathedrals been devoted to schoolhouses and an educational system. Imagine the results had the hundreds of millions of pounds expended by England on the South African war been devoted to the development of the country, by establishing electrical railways and lighting and power plants. Consider what a drain upon the resources of a country, both in wealth and in men, are a large standing army and navy. Even granting that pyramids and cathedrals and wars have been legitimate factors in the world's history, and that on the whole they have been beneficial, nevertheless they indicate how vast are the forces which have directly retarded rather than advanced material prosperity. There is no doubt that the forces at hand are ample to maintain a constantly increasing condition of prosperity if they be wisely directed. A grave responsibility rests upon the intelligent, the wealthy and the directing classes.

As a factor in maintaining prosperity, the work of the electrical engineer is of great consequence. Applied electricity so increases the efficiency of industrial and commercial life that a given expenditure of energy can produce greater results in less time. The electrical engineer is called upon to advise and direct in many large undertakings, and upon the soundness of his judgment depends success or failure. Since electricity occupies so vital a place in the affairs of the present, and will be an increasing element in those of the future, the electrical engineer must be an important agent in avoiding depression and maintaining prosperity.

If we were to consider further the indirect as well as the direct relations of the electrical engineer to industrial and commercial and social interests, we would be more deeply impressed with the responsibility of his part in the world's work. In a profession where they are so many workers, where the majority of them are young men, where their work is so closely connected with scientific investigation and with what is being done in allied professions, when the rate of advance is so great in scientific discovery, in invention, in application to processes which are new and to undertakings of increasing value, and particularly in a country which is recognized as foremost in electrical development, there is a unique field for a national organization such as the American Institute of Electrical Engineers. In a profession whose interests are so diversified and so extended, workers should be brought together. They should have a common meeting place. Here discoveries may be announced, inventions described, engineering schemes criticized and new undertakings presented and discussed. Here the student and professor, the investigator, the inventor, the manufacturer, the operator and the consulting engineer may meet upon common ground. The engineer who is tempted to ridicule scientific work finds that it is the foundation upon which his own work rests. The professor who regards slightly the work of the designing or constructing engineer may find that his own cherished formulæ are derived from the rules and contain the constants which the practical man has determined for himself. Association leads to mutual understanding, it curbs eccentricity and one-sided development, and promotes symmetrical advancement.

It is the function of the American Institute of Electrical Engineers to bring individual workers into a common unity, to join them in a community of interest—a fraternity which is called the electrical-engineering profession. It should place the profession of electrical engineering above suspicion of corruption and chicanery, and should call for high standards of dignity and honorable accomplishment. It should discountenance the spirit of blind partisanship and of depreciation of others' efforts among those who are divided by commercial interests, whether they represent competitors or buyers and sellers. While each has his individual interests, there is a general interest which is common to all. All share in that which discredits the profession, as well as in that which elevates and advances it.

It is the function of the Institute to bring together continually the diversified achievements of many workers, which, taken altogether, constitute a single total of accomplishment—a total which is called progress. It should discriminate between that which is substantial and that which is not. It should place the stamp of recognition and approval upon all that is meritorious and marks an advance in the art.

It is the function of the Institute to take the lead in such measures as will promote the general interests of the profession and the efficiency of electrical work.

In the past the American Institute of Electrical Engineers has represented the profession and advanced its interests in various ways.

It has taken a prominent part in establishing uniform insurance rules in a National Code.

It has been conspicuous in representing American engineers at international expositions and international congresses, both in America and abroad. In the same connection it has been active in establishing international standards, and through its advocacy the name henry, in honor of an American electrician, has secured a place in the list of electrical units.

It prepared in 1890 the standard wiring table for lighting and power purposes, which has been of great service in standardizing electrical calculations.

It has established a code of standardization covering names, definitions, methods of rating, tests and the like, which is of the greatest service in unifying and simplifying electrical practice.

It has established, through the generosity of a few individuals, a library which in historic value is unequaled.

It has brought electricians together in annual conventions and in monthly meetings, it has stimulated activity through papers and discussions, which have dealt with vital problems, it has developed, in 18 volumes of transactions, a panoramic history of American electrical engineering.

Let us now turn our attention to the future and consider the specific ways in which the work of the Institute may be advanced during the coming year:

1. The membership should be increased. The power and influence of the Institute is dependent upon the number, character and activity of its members. There are many engineers eligible to membership who are not members, because they do not fully appreciate the scope and the work of the Institute. There are many electrical workers who would become worthy associate members if they realized the value of connection with the Institute.

Is it not the privilege and the duty of an electrical engineer to give his best support to the Institute which stands for the highest interests of his profession? Are not the advantages which connection with the Institute affords such that no progressive engineer can afford to be without them? If these things are so, then it rests upon the present members to build up the Institute by making its work known to those who should become members.

During the past year the membership increased 25 per cent. and reached 1,546. This is less than one-half the membership in the British Institution of Electrical Engineers. If American Institute membership bore the same relation to the kilowatt capacity of the electrical power stations of the country as does that of the British Institution, our membership should be 25,000.

There are to-day cities in which are located engineering schools and large electrical interests which have but three or four members. Five states east of the Mississippi River have but one or two members each, and there are three of the New England states that have but three members each.

2. Papers and discussions should be contributed from a larger proportion of the membership. The transactions of the Institute should be a record of the advance in electrical work, and should contain only that which is of material value to the advancement of the art. I submit that even their present high standard does not adequately represent American electrical progress. If it is true that our papers do not fully present the advance thought and best achievements of the time, it is simply because our advance workers do not contribute more.

Material may be presented in formal papers, in original communications or in discussion. Some subjects do not provoke general discussion; others depend for their value upon the experience or the opinions of a large number of members. While the Institute is not as a body responsible for the statements or the opinions of its members, there is nevertheless an obligation resting upon its members not to leave unchallenged any inaccurate and misleading statements.

Our last volume shows that five per cent. of the membership took part in the meetings, and that two per cent. furnished papers. Of these papers, 10 per cent. came from miscellaneous sources, 20 per cent. came from college professors, 25 per cent. from operating and consulting engineers, and 45 per cent. from engineers connected with manufacturing companies.

These figures indicate that electrical matters are advancing so fast that even the teachers in the great technical schools fall behind the pace, because the problems come first to the manufacturer. To the manufacturing companies must be given credit for substantially advancing scientific investigation as well as practical development.

Further examination of the last annual volume shows that although one-fourth of the members reside in New York and the monthly meetings are held there, yet only one-fifth of the papers were presented by New York members. The Institute is national in its scope, and there should be united effort throughout the entire membership to increase

1. Presidential address delivered at the meeting of the American Institute of Electrical Engineers, New York, September 26, 1902.

the quantity as well as the quality and the usefulness of its published proceedings.

3. Local meetings of the Institute in various cities will broaden the interest in its work and generally extend its benefits. Some local organizations have been formed, but this department of our work should be greatly extended. While such organizations should be conducted in harmony with the general methods and purposes of the Institute, synchronizing as far as practicable with its general meetings, they should also become "self-exciting" centers of local electrical activity. There is so much material available and there are so many subject of local and general interest that a small amount of well-directed effort in organization will produce great results.

4. Universities and technical schools with electrical-engineering departments may organize local meetings of the Institute which would be of benefit to both instructors and students in keeping them in touch with the most recent developments and practice in electrical work. Meetings may be under the direction of the professor of electrical engineering and may be conducted in various ways to conform best to the local conditions. Local Institute members may join with the school meetings. A school should be the natural center for engineers of its vicinity. It supplies a suitable meeting place, and the discussion of Institute papers by engineers, instructors and students should be of benefit to all. In the thesis work of students the Institute may be helpful also in recognizing and publishing in abstract or in full theses which are noteworthy. This would give an impetus to the preparation of theses and wholesome rivalry among different institutions, and would add to the value of our transactions.

The proper education of the engineer is a problem to which various solutions are offered. All, however, will doubtless agree that the profession has already reached a stage and is advancing so rapidly that the purely "practical man" cannot hope to maintain himself in the front rank. The rate at which development is progressing demands a thorough grounding in fundamental principles, in order to impart the power for grasping and meeting new conditions. My predecessor spoke truly when he said that the primary aim of the educational institution should be to give the young engineer "a thorough understanding of the fundamental principles of electrical engineering and allied sciences, and a good knowledge of the methods of dealing with engineering problems." The best education is that in which theoretical training in fundamental principles predominates. The true function of practical work in a broad engineering education is not to produce skilled workmen or full-fledged engineers, but it is to supplement theoretical work, making it definite and certain, so that the student may properly assimilate the instruction which he receives. Again, a student should not make his mind a storehouse of facts, but he should learn where facts and information can be obtained, and how to use them

The principal purpose for bringing the work of the Institute directly to the student is to enable him to keep in touch with actual things and give him a definite idea of the kinds of work which lie before him, and for which he is preparing. Fortunate will it be if we can lead him to see that in the development of an electrical engineer there should be something besides technical training—that logical thinking and clear expression and general culture are indispensable in a profession that is closely related to so many departments of science and engineering as well as industrial and commercial and social activity, and that he must be a broad man with a broad educational foundation, who would aspire to the fullest usefulness and success.

5. The collection of engineering data and the establishment of standard practice in electrical engineering is one of the important functions of the Institute. The present years are formative years. Electrical engineering is crystallizing. Electrical theory and laws and electrical measurements are more definite than those relating to the allied professions; for example, compare the accuracy in the predetermination of the efficiency of a dynamo with that of an engine, or the ease and precision of measurement of dynamo output by a wattmeter with that of an engine by a mechanical dynamometer or brake. Electrical-engineering practice, however, is now being established. The apparatus and the methods, both in detail and in general, which characterize present work are radically different from those of five or 10 years ago. It is of the highest importance to the profession that definitions and principles and laws pertaining to engineering practice should be determined and adopted as rapidly as circumstances will permit. General investigations should be made in various lines of electrical-engineering work, not primarily for the purpose of devising theoretical standards or undertaking original investigation, but for the purpose of determining what is best in present practice, and of formulating and crystallizing it into what may be recognized as standard practice.

We must not fail to realize the value of standards. An English engineer in a distant part of the British Empire, in specifying the apparatus for a large electrical railway, strongly recommended that American standard apparatus be purchased, as "England has no standard." In Europe to-day there is a confusion of systems and frequencies and voltages, and a wide diversity in types of construction. Many foreign engineers pride themselves on devising that which is novel, instead of adapting that which is standard. American engineers are not divided by nationality and by language as are those of Europe; they have that unity in which there is strength; they appreciate the advantage of adhering to standard practice; they realize that the manufacture of dynamos and motors, as well as of shoes and clocks, of engines and bridges will be cheaper and quicker if made in quantity.

Do you realize the relative magnitude of American electrical work? The United States, with only one-fifth the population of Great Britain and Europe, has two and one-third times the kilowatt capacity in power stations, and three and one-half times the mileage of electric railways. The power houses in operation and under contract in New York city would replace all the central stations for lighting and power in Great Britain or in Germany; they would operate all the electric railways of Great Britain and Europe combined; one alone would be sufficient for the railways of Germany and the output of a single generator would run all the railways of Switzerland.[1] Although some foreign engineers are still in doubt as to the practicability of the rotary converter, yet the output of American rotary converters is sufficient to operate all the railways in Great Britain and Europe combined. American designs, methods and practice are being introduced into half a dozen factories in foreign countries. Electrical progress and leadership can be promoted by this Institute, as it draws together and unites the efforts of electrical workers and as it aids in establishing the standards for the future. Standards are not to prevent progress, but they are to make definite the steps already taken and they are the foundation for advancement.

6. Our library merits a cordial support. The policy decided upon by the library committee is to place upon our shelves every book relating to electricity in the English language, and every book of any value in the French, German and other languages. Let all who are able, co-operate in this important work of building up a complete reference library.

Through good fortune and the generous assistance of Dr. S. S. Wheeler we have the Latimer Clark library as a foundation. Mr. Carnegie's kindly contribution has enabled the library to be catalogued and otherwise made useful. Various members, notably Messrs. Mailloux, Hutchinson, Wetzler, Arnold, Keith, Caldwell, Jenks, Fish and Clarke, as well as the American Bell Telephone Company, the New York Electrical Society, and others, have contributed valuable sets of books, such as the proceedings of scientific societies, the records in patent litigation and the like. At least one member has provided by his will that a part of his technical library shall pass to the Institute and another is proposing an endowment for the future continuation of the sets which he has presented.

The preceding sentence was written yesterday. I am authorized by the council to state the contents of a letter received to-day from Mr. W. D. Weaver, the chairman of the library committee—to whose efficient services the development of the library is due. This letter reports the receipt of a check from Mr. Mailloux to be used as an endowment for continuing subscriptions to several of the valuable sets which he has presented to the library. Among the books, a thousand or more, which he has presented, are some rare series, some of which have been secured at considerable cost, others by rare good fortune. Our library is already assuming a high rank among electrical libraries, and even among general technical libraries.

7. Permanent quarters for the Institute should be an object of plans and anticipations. An organization which is so closely connected with so many vital interests of such vast commercial value and which possesses such possibilities for promoting the best interests of the profession should not be hampered for want of the most convenient accommodations. Personal acquaintance and social intercourse are influential factors in unity of sentiment and of action. Our library is all but inaccessible in its present cramped quarters which do not permit normal growth.

8. Co-operation with similar institutions in other countries will be mutually beneficial in various ways. In certain lines they may learn from us, but there is a great deal that we can learn from them.

In addition to general co-operation, such as is promoted by international congresses, much is to be gained in less formal ways. For example, different institutions may at times discuss the same subject. Again, they may do a great service to electrical progress by harmonious working in the adoption of standards. The members of one institution may broaden their outlook by becoming members of other bodies. It is the hope and expectation of our Institute to have as its guest, within the next few years, the Institution of Electrical Engineers of Great Britain. The scope of our profession is world-wide. Let us welcome this coming opportunity to extend our acquaintance and broaden our ideas.

In conclusion, I have realized the responsibilities which rest upon the president of this Institute, and it was with reluctance and misgiving that I yielded to some urgent friends and consented to become a candidate. I fully appreciate the confidence you have expressed by your votes and I now ask your co-operation in continuing the high standard of work attained during the past year under my honored predecessor, whose able and enthusiastic efforts have awakened the Institute to new activity and usefulness.

The outlook is propitious. The council of the Institute at its meeting this afternoon authorized the appointment of a committee on membership, also a committee on local organization with authority to make immediate arrangements for the holding of local meetings. This committee also has under its direction the proposed Institute meetings in connection with technical schools. A committee on theses was provided for to consider the relations of the Institute to this branch of student work. A transmission committee was provided to collect data with respect to present practice in high-tension transmission, particularly with reference to the construction of transmission lines and to formulate this data for the use of electrical engineers. It was recognized that this branch of engineering is advancing rapidly and that it merits special attention from the Institute in order that the best elements of present practice may be set forth. The standing committees of the council are taking up their work with renewed vigor.

If, my fellow members, the objects of Institute endeavor which I have outlined are worth while, each of us can well afford to do his part toward realizing them.

1. See "Some Comparative Approximate Figures of Electric Light, Power and Traction Systems in European Countries and in the United States of America at the Present Day," Philip Dawson, Engineering Magazine, February, 1902, page 712.

Remarkable Blasting Accident.

All who have watched the power development at Niagara Falls will be much interested in a truly remarkable accident that occurred there on Tuesday, October 28th, costing the lives of two men. The Ontario Power Company is excavating the site of a power station at the water's edge, in the gorge, close to the Horseshoe Fall, on the Canadian side. The debris slope is being broken away to solid rock. Ever since the work started the blasting increased in force, and at noon of the day referred to a blast containing about 1,000 pounds of powder was shot off. The mass of rock hurled in the air was tremendous. The river, usually clear and green, had its color turned to that of mud, and people who stood at Table Rock, on the Canadian side, state that the New York shore was hidden by the curtain of rock that ascended high above the cliff tops. Over on Goat Island, a portion of the New York state reservation, people had been warned to keep back from the cliff. When the blast was discharged a great mass of rock landed on this island, and one big slab, 32 inches long, 14 inches wide and about nine inches thick, was carried fully 500 feet back in the woods, where it landed on a path along which Patrick Kelley and Patrick Moakler, two aged employes of the state reservation, were passing. The rock struck Moakler on the side, knocking him unconscious to the ground, and then it struck Kelley and cut off both of his legs below the knees. The men were discovered within a few minutes. When Kelley was asked if he was hurt he said, "No; but I have a terrible cramp in my legs and can't raise them." The injured men were hurried to the hospital, where Moakler died within two hours and Kelley died Wednesday night. Powder was used in the blast in order that the rock might be hurled out into the river and thus do away with the necessity of handling it. The work is being done by the company. The rock that killed Kelley and Moakler made a flight of fully half a mile and broke a big limb off a tree before it struck the men. It then dug a hole five feet deep in the ground and dashed against three trees.

Chattanooga Hustling for Street-railway Convention.

"It is practically assured," says the Chattanooga (Tenn.) News, "that the American Street Railway Association will hold its next annual convention in Chattanooga." The article continues: "Superintendent McFarland of the Chattanooga Electric Railway Company, who has been in communication with the executive committee of the association, is assured that if the necessary quarters can be had here for the extensive exhibits of the association, and if the necessary hotel accommodations can be secured, the convention will come to Chattanooga next year. The only hitch now in the way seems to be the necessary building for the exhibits of the association. The hotel accommodations have already been assured, and it would be an easy matter for the city to furnish the necessary building for the exhibits if the business men and the citizens generally would co-operate in the movement. It is said that the building will have to be at least 200 by 300 feet in dimensions in order to contain the many exhibits that are placed on exhibition in connection with the convention.

"The matter of making the necessary arrangements and of extending a formal invitation to the convention, is now in the hands of the convention committee of the Chamber of Commerce, in conjunction with President Sanders and Secretary Goulding, General Manager Brown of the Rapid Transit Company, and Superintendent McFarland of the Chattanooga electric railway."

DEVELOPMENT OF THE TELEPHONE FIELD.

New Telephone Patents.

Among the patents issued from the United States Patent Office on October 28th was one to David S. Hulfish of Chicago, assigned to the American Bell Telephone Company. It is entitled "Signaling and Switchboard Apparatus for Telephone-exchange Circuits," and the application for it was filed November 5, 1901, the patent being numbered 711,973. In one of the claims this description of the apparatus (Fig. 1) is given:

"In a central-battery telephone exchange a metallic telephone circuit having its two main conductors united at a central station to the two poles respectively of a battery, one pole of which is grounded, and extending from said central station to a number of sub-stations, where said circuit is normally open; central-station apparatus, comprising an electromagnetic switch having opposed magnetizing coils in the said conductors and adapted to remain null when both coils are traversed by the same current, but to be responsive to like current in one coil only; and a generator of calling current, and a signal-receiving device in a normally open local circuit, both controlled by said electromagnetic switch; and apparatus at each sub-station comprising an electromagnetic bell responsive to the currents of said call-current generator connected in an inductive bridge between the metallic-circuit main conductors; a normally open conductive bridge between said conductors containing the station-telephone instruments; a telephone suspension switch controlling said open bridge and acting to close the metallic main circuit therethrough, and through the central battery and the two opposing coils of said electromagnetic switch; and two grounding keys, associated with the two main conductors, respectively, both adapted when operated to establish a circuit for the current of the said central battery through one conductor only of said main circuit and one coil only of said electromagnetic switch and thereby operate said switch for the connection of said call-current generator to the other of said main conductors; said keys being also adapted severally, one to direct the currents of said call generator through the several sub-station bells, and the other to divert said currents therefrom."

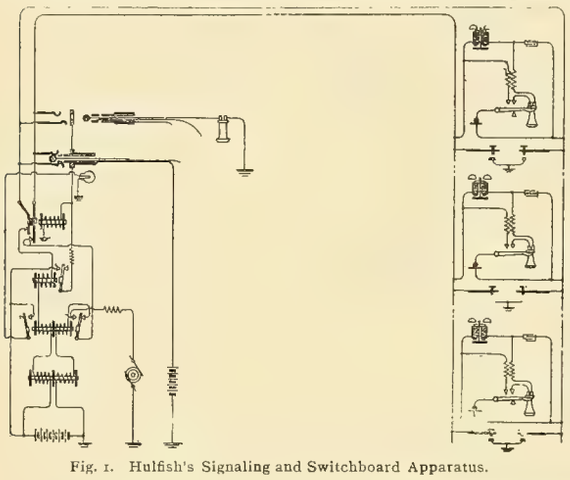


Fig. 1. Hulfish's Signaling and Switchboard Apparatus.

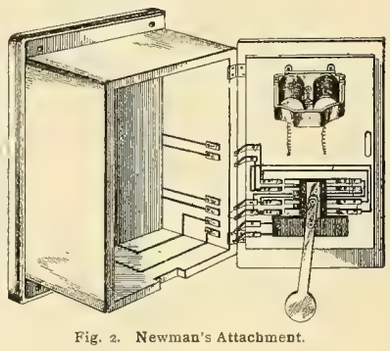


Fig. 2. Newman's Attachment.

NEW TELEPHONE PATENTS.

Mr. Hulfish is also the inventor of a busy-test system (patent No. 712,455) patented on October 28th and likewise assigned to the American Bell Telephone Company. This system is devised for use with central-battery exchanges. It is described as having, in combination, "a polystation-circuit system, comprising a metallic main telephone circuit extending between a central station and a plurality of sub-stations; a battery or like source of current in said metallic circuit at the central station; a call bell in a conductively open bridge of said circuit, telephone instruments in an independent normally open bridge of said circuit, and a suspension switch operated by the removal of the receiver therefrom to close the circuit through said telephone bridge, all at each sub-station; and a battery or like source of current in said metallic circuit, a call-receiving signal device in a local circuit of said battery, a differentially wound relay in said main circuit controlling said signal device and held by its opposing coils irresponsive to the operation of said suspension switch and a multiple switchboard with which the said main circuit is connected, of a single-wound relay in said main circuit responsive to said suspension switch, and a branch circuit leading from said battery through the local contact points of said last-named relay to the busy-test pieces of the several switch sockets of said main circuit on said switchboard, all at said central station."

A third invention (Fig. 2) is for the telephone attachment shown in the cut. The inventor is George T. Newman of Bonaparte, Iowa. In this case a switch attachment for telephones comprises a box, an alarm bell thereon, springs electrically connected with the magnet of the bell, a slide, conductor-strips thereon normally contacting with the springs, a telephone and springs adapted to be connected electrically therewith. Conductor strips upon the slide normally contact with these springs. Contact plates are placed on opposite sides of the slide and in the paths of the strips. Independent telephone circuits are provided, and the contact plates are adapted to be electrically connected with the telephone circuits, respectively. There is an electrical connection between the plates whereby, by shifting the slide, the telephone and bell are placed simultaneously in either of the two independent circuits, respectively.

Interstate Independent Telephone Association.

The second convention of the Interstate Independent Telephone Association will be held in Chicago on December 9th, 10th and 11th. The headquarters of the association will be the Auditorium Hotel, where space will be provided for exhibits. A banquet will be held on the night of either the 10th or 11th at the Auditorium. Other entertainment will be provided, although what it will be has not been decided as yet by the committee in charge, which is composed of James Wolff, C. W. Farr, H. B. McMeal, W. E. Doolittle, S. A. Dinsmore, F. B. Patten and J. J. Nate.

The following provisional programme for the three-day convention has been arranged:

On Tuesday morning, December 9th, the executive committee will receive the visitors at the headquarters of the secretary, after which an inspection of the manufacturers' exhibits will follow. The address of welcome will be delivered at two o'clock in the afternoon by H. S. Taylor, prosecuting attorney, Chicago. The response will be given by President H. C. Raney of Fairfield, Iowa. Following this will come the reports of the various committees and the selection of the nominating committee by the states to report on call of the president.

Wednesday morning will be given up to the reading of papers on rates, as follows: "Measured Service," George N. Bandy, Perry, Iowa; "Sliding Scale Rates for Exchanges," Dr. H. S. Herr, Ottumwa, Iowa; "Toll Rates," H. H. Robinson, Cleveland, Ohio. After the reading of these papers and any accompanying discussion, time will be taken for a review of the "Restrictions by Municipal Authority." It is expected that synopses of the law in Ohio, Iowa, Wisconsin, Minnesota, Michigan, Indiana, Illinois, Missouri and Kentucky will be given in the consideration of this subject. A general discussion will follow.

The afternoon session called at two o'clock, will be given over to the presentation of two papers: "Settlement of Toll Business between Connecting Companies," A. L. Hutchison, Weyauwega, Wis.; "Enforcement of Message Time Limit," H. E. Ralston, Maitland, Mo.

On Thursday morning, December 11th, papers will be presented on "Independent Telephone Securities as an Investment," by Col. J. D. Powers of Louisville, Ky., and J. H. Layne of Carthage, Mo., the former treating the subject from a banker's point of view, and the latter from that of the small investor. A discussion will follow. The above papers will take up the entire morning session and the afternoon meeting will hear and discuss "The Berliner Patent, Bell's Claims of Infringement and Litigation now Pending," by J. J. Nate, Chicago, and "Suggested Methods for Improving Long-Distance Telephony," by Senator C. E. Hull, Salem, Ill.

Telephone News from the Northwest.

The Wisconsin Telephone Company has made application to the City Council of Winona, Minn., for admission to the city over the high bridge. The company already has connection with the city over the wires of the Northwestern Telephone Exchange Company.

The Northwestern Telephone Exchange Company has won its case against the city of St. Paul to prevent the city officials from interfering with the construction of new lines, because of the failure of the city's corporation attorney to file a paper book and brief before the Supreme Court of the state. The latter thereupon rendered judgment by default, leaving the merits of the case untouched. The issue was whether the company could be compelled to accept the provision of the new charter for a five per cent. gross-earnings' tax. The result of the action is simply to declare the tax of the charter not self-enacting, but requiring an ordinance.

The Elbow Lake (Minn.) Telephone Company has began the construction of a local exchange at Tintah, Minn.

The Citizens' Telephone Company of Mankato, Minn., has installed a new central-energy switchboard.

The Consolidated Telephone Company has installed a local exchange at Grantsburg, Wis.

The Ashland (Wis.) Home Telephone Company has arranged to establish toll connection with Mellen, Wis., and will also locate a local exchange. The Superior Construction Company of Ashland will construct the system.

J. A. Steninger of Parker, S. D., was granted a franchise at Marion Junction, S. D., for a local exchange. Some business men contemplated putting in an exchange, and so secured sufficient signatures to a petition to call a referendum election, at which Steninger's franchise was defeated by three votes.

The Iowa (Bell) Telephone Company is said to have adopted a new line of tactics in the competition with Independent telephone systems. It is to encourage the formation of local companies and mutuals, to connect with its toll system wherever it can compete with an Independent toll line or local company. At Guthrie Center, Iowa, a mutual has been formed for local service, to compete with the local and toll service of the Hawkeye Telephone Company. It is said this is to head off the improvement of the Independent companies' toll systems. The latter have proposed a uniting of their toll lines, so that they may be operated as one continuous system.

The Palo Alto Telephone Company has been organized at Emmetsburg, Iowa, with $25,000 capital stock to construct a county telephone system.

There seems to be something of a fight on between the Western Electric Telephone Company of Northern Iowa and local exchanges, where other toll lines run into the same exchange.

The Kossuth (Iowa) Telephone Company has purchased the local exchange at Algona, Iowa, and that at Germania, Iowa.

The County Telephone and Telegraph Company is installing exchanges at Hampton, Geneva and Sheffield, Iowa.

Harter Bros. of the local exchange at Cherokee, Iowa, have had work begun rebuilding it, and installing a modern new switchboard. A farm line will be constructed, requiring 17 miles of wire.

A local exchange will be established at Washta, Iowa. About 75 subscribers have been secured.

The Iowa Telephone Company has begun using a machine for hoisting poles at Burlington, Iowa, which saves time and labor, as well as eliminating danger. R.

Ohio Telephone Notes.

The net earnings of the Peoples' Telephone Company of Akron for the nine months ended October 1st were $13,980.20. The company is earning seven per cent. on the stock, after deducting all interest and other fixed charges. It is now on a four per cent. basis, the first quarterly dividend having been declared.

The Mansfield branch of the Central Union Telephone Company is building a number of farmers' lines in the vicinity of the city.

The Scroggsfield Telephone Company has arranged to extend its line to Carrollton and will ask that town for a franchise within a few days. The company will also put in an exchange there if there is a sufficient demand for the service. It already has its lines connected up with several small towns, and by combining with the Columbiana County line will be able to connect subscribers with 120 boxes.

The City and Suburban Telegraph Association's exchange building at Norwood has been completed and the work of connecting up subscribers' lines is in progress. The exchange will accommodate 4,800 patrons and will serve the following Cincinnati suburban towns: Bond Hill, Carthage, Elmwood Place, Pleasant Ridge, Silverton, Kennedy, Oakley,

Evanston and Hyde Park. Lines from these villages have heretofore been connected with the Walnut Hills and Vine Street exchanges.

The Crestline Telephone Company, lately reorganized, has been granted a 20-year franchise by the Village Council of Crestline. It has over 200 subscribers and is in a prosperous condition. Jacob Babst is the president and C. R. Callahan of Bellevue the general manager.

The Springfield and Xenia Telephone Company has planned to erect a two-story exchange building on South Center Street, Springfield. The first floor will be used for the offices of the company and the second will contain the exchange and switchboard.

The report of the officers of the United States Telephone Company for the six months ended August 31st shows gross earnings, $144,595.37; expenses and taxes, $80,194.57; net earnings, $64,400.80; interest on bonds, $46,625; surplus, $17,775.80. On the basis of this report for six months, the net earnings of the company for the year will be $35,000.

The Urbana Telephone Company, Urbana, has decided to increase the rates for country subscribers from $12 to $15 a year.

The stockholders of the Home Telephone Company of Toledo are formulating a plan to pool their interests and place all the outstanding stock in the hands of a voting committee to be composed of at least 15 of the stockholders. This is done to prevent any other company securing a controlling interest in the company, and it is said that the value of the stock and bonds will be strengthened thereby. The Central Construction Company has turned the plant over to the company. The total number of subscribers is now 5,500.

The Local Telephone Company of Norwalk, Ohio, has filed notice with the secretary of state of an increase of capital stock from $2,500 to $500,000. This is a Lanning company and the increase is for the addition of new plants and facilities.

O. M. C.

Southern Telephone Developments.

It is reported that the Southern Bell Telephone Company will build a direct line from Augusta, Ga., to Columbia, S. C., via Johnston, S. C. Two carloads of poles have already been shipped to Johnston.

The Southern Bell Telephone Company has ordered all necessary material for placing its wires underground at Charlotte, N. C.

The Chesterfield Telephone Company of Chesterfield Court House, S. C., has secured subscriptions to stock, and subscribers for telephones in Cheraw, S. C., for a proposed telephone system.

The People's Independent Telephone Company of Paducah, Ky., has purchased the Alexander Independent Telephone Company of Madisonville, Ky. The latter company now extends into nine of the neighboring counties.

General Manager T. L. Powell of the Southwestern Telegraph and Telephone Company, Little Rock, Ark., announces a proposed erection of a line from Memphis, Tenn., to Jonesboro, Ark., and other points, to be completed within two months.

The Wilkes Telephone and Electric Company of Washington, Ga., has just completed a long-distance connection with a number of neighboring towns. The Southern Bell company has also just completed a line to that city, connecting with its long-distance service.

Regarding the so-called secret contract between the city of Augusta, Ga., and the Southern Bell company, it is said that the contract provides that the city shall receive a percentage of the gross receipts of the telephone company, with a minimum limit. It is also said that no increase in rates can be made for five years.

L.

Indiana Telephone Items.

The Home Telephone Company of Gas City and Jonesboro filed articles of incorporation on October 29th. This company will construct, maintain and operate a telephone system in Gas City and Jonesboro and throughout Grant County. The original capital stock is placed at $50,000. The directors are E. H. Neal, Fred Schrader and others.

The Home Telephone Company of West College Corners was incorporated on November 1st. The capital stock is $4,000 and the directors are Charles Stout, J. C. Barkney and W. H. Hawley.

A new telephone line will be completed and put in operation at Dunlapville this week; as will also the Lynn and Fountain City system. The latter will include service at Spartanburg, Arba and Modoc, with extensions to Bethel, Whitewater, Cox's Mill and Williamsburg. The system will connect with the Richmond Home Telephone Company.

F.

Rocky Mountain Region.

The Nezperce Co-operative Telephone Company, Lewiston, Idaho, has just completed its line from Culdesac to Mohler. This line is an extension of the company's line from Lewiston and gives direct connection between Nezperce and Lewiston. The line is now being raised, by a large force of men, between Nezperce and Kamiah, Idaho. The company proposes to raise its entire line and later on, probably the first of the coming year, will extend its line to Lewiston.

One thousand poles have been contracted for by the Rocky Mountain Bell Telephone Company for reconstruction of the long-distance lines from Missoula, Mont., to Butte and Helena.

The Rocky Mountain Bell Telephone Company is putting in a new telephone exchange at Emmett, Idaho.

A franchise has been granted to H. S. McCullum of Sumpter, Ore., and his associates, for running an Independent telephone line in Baker City, Ore., and throughout the same county. The work on construction will be commenced at an early date on the first line which will run from Sumpter to Baker City.

G.

Michigan Telephone Company's Affairs.

Minority stockholders of the Michigan Telephone Company, representing about $200,000 of stock, have formed a protective committee consisting of Charles F. Hammond of Detroit, Samuel T. Douglas of Detroit and George W. Patterson of Ann Arbor, to take such protective action as shall be considered advisable in behalf of stockholders. Depositors under this plan are assessed 25 cents per share for expenses. Certificates are to be forwarded to Samuel T. Douglas, chairman of the committee, Detroit. This committee has examined into the financial condition of the company to such an extent as is possible without the employment of experts, and after such examination they believe that the interest of the minority stockholders will be best conserved by concerted action. Negotiable receipts will be issued for all stock deposited.

Kentucky and Southern Indiana Telephone Convention.

The fourth annual meeting of the Kentucky Independent Telephone Association was held in Louisville, Ky., on October 28th and 29th, in conjunction with a meeting of the Southern Indiana Telephone Association. Over a hundred representatives of Independent telephone companies operating in Kentucky and Southern Indiana were present, and a very successful convention resulted. Arrangements were effected for long-distance toll connection and an important discussion was held on uniform equipments. Several manufacturers made exhibits of their apparatus, including the Stromberg-Carlson, Kellogg and American Electric companies of Chicago.

GENERAL TELEPHONE NEWS.

The Atwood (Ill.) Telephone Company has certified to an increase of capital from $4,000 to $6,000.

H. H. Robinson, assistant general manager of the United States Telephone Company of Cleveland and editor of "The Telephone Green Book," was in Chicago last week.

The Southern Bell Telephone Company, through its division superintendent, M. B. Spier of Charlotte, N. C., has applied for a franchise to put in an exchange at Newberry, S. C. The matter will be decided within a few days.

The Western Telephone Construction Company of Chicago, Ill., has been incorporated with a capital of $2,500. The purpose of the incorporation is to manufacture mechanical and electrical devices. A. E. Ziehme, G. Hallett Johnson and John E. Kavanaugh are interested.

The People's Telephone Company of Detroit has forfeited its $5,000 check, which it deposited to insure the completion of its plant by October 1st of this year, and by recommendation of the ways and means committee of the Common Council suit will be begun against the company to recover $1,529 due the Department of Public Works for inspection and construction of conduits.

An Independent company is seeking admission to Pasadena, Cal., where there is already a Bell company in operation. Long arguments, both for and against the new concern, have been heard by the Pasadena Council, and, although nothing definite has yet been done, it is quite probable that the city will continue under the present system alone, the Independent company being refused admission to the town.

The charter of the Southern Independent Telephone Company of El Paso, Texas, was filed with the secretary of state in Austin on October 15th. This company has a capital stock of $500,000 and its purpose is to construct, maintain and operate a telephone system in El Paso County and the city of El Paso. The incorporators are Annie McElroy Brett, Lorian Miller, J. B. Badger and B. S. Sprague, all of El Paso, and O. P. Von Swearingen of Cleveland, Ohio.

The Missouri and Kansas Telephone Company (Bell) is sending out circulars in Kansas City recommending the adoption of the measured-service rates. This is similar to the nickel-in-the-slot scheme familiar elsewhere. The measured-service circulars are quoting a rate of $60 a year for business telephones, limiting the service to 1,000 messages a year outgoing, with no limit to the number received. It is asserted by the company that the measured-service system saves the subscriber 25 per cent. of his rental and the company 25 per cent. of its work in the exchange office. The acceptance of the measured service is at the discretion of the subscriber.

Engineering in Argentina.

A paper prepared recently by Mr. E. L. Corthell for the Western Society of Engineers in Chicago treated in a very interesting manner of some of the engineering features in the Argentine Republic. The following are paragraphs extracted from the paper:

Railways have had quite an extensive development within the last 20 years. In 1867 there were 355 miles; in 1880, 1,563 miles; in 1890, 5,862 miles, and in 1901, 10,291 miles, of which 1,243 miles belong to the government and 9,048 to foreign companies. As compared with the United States, the mileage is about six per cent. There are three gauges, 5½ feet, which is really the standard; four feet 8½ inches; and a narrow gauge, usually about three feet three inches, or one meter. The total length of telegraph lines is 27,602 miles, while in the United States the Western Union alone has 192,705 miles of poles and cable.

Iron and steel industries are important, although there is practically no ore and coal in the country. In 1895 there were 154 iron foundries and 66 repair shops, with a capital of $15,000,000. Every class of machinery is now manufactured, even to small engines and boilers. There are some valuable copper mines containing gold and silver, also rich veins of gold and silver, with recent discoveries of iron ore, but these various products have not been developed to any great extent. The total value of minerals exported in 1900 was but little more than $262,000, including gold, borax, copper, marble, silver ore and lead ore.

Buenos Ayres has 810,000 people and is growing at the rate of abopt 4 per cent. per annum. It is now the largest city south of Philadelphia, if we except the Chinese cities. The city is on the right bank of the River Plate, a sloping bank 50 or 60 feet above the level of the water, rising up to considerably greater elevations in the center of the city. It is about 120 miles from the sea at Montevideo. Its area is 44,830 acres, while that of Paris is only 19,280, and Berlin only 15,625.

There is no city anywhere with more lines of street cars; in fact, with the exception of two streets, there is a line in every one of the principal thoroughfares, and leading out to the pleasant suburban towns, Belgrano, Palmero and Flores, there are electric lines similar to those in Chicago and other American cities using the overhead trolley. All the equipment from rails to trolley comes from the United States. There are now 275 miles of street-car lines in the city, which carried in 1900 116,447,982 passengers. The history of lighting the streets in the city is quite interesting and shows that the city keeps pace with others in this respect. The first record of public lighting was in 1778, when the city had lamps in the shape of a tin of horse oil with a wick, then came tallow dips, then oil lamps, then came gas in 1885, and in 1888 electricity began to replace it in part, and on December 31, 1900, the city was lighted with 889 arc lamps, 318 incandescent lamps of 16 candlepower, 14,084 gas lamps, and 8,590 coal-oil lamps. And there were 36 electric-light stations with a capital of $9,000,000 gold, and with a capacity of 23,300 electric horsepower.

As might be expected of such a progressive country adopting promptly new inventions, the telephone and telegraph have come, though there are many improvements in the telephones which have not been introduced here yet. There are four cable companies keeping up a close connection with all parts of the world, though the cost of cabling is quite heavy, one dollar gold per word. The service is very good and prompt, the time of transmission between Buenos Ayres and London, via Galveston and Western Union lines and cables, is 60 minutes and with New York 30 minutes. When we consider the distance and route, we are astonished at the working of this line which crosses over the Andes, 10,000 feet above sea level, tunnels under the snow and avalanches and reaches the Pacific Ocean only to take successive leaps by loops along the coast to Tehuantepec in Mexico over the Isthmus, across and under the waters of the Gulf of Mexico to Galveston, speeding then its swift flight over the poles of the Western Union to New York city, and then, without stopping to rest, plunges into the depths of the Atlantic Ocean and talks to the receiver in London 60 minutes after it left the operator's fingers in Buenos Ayres.

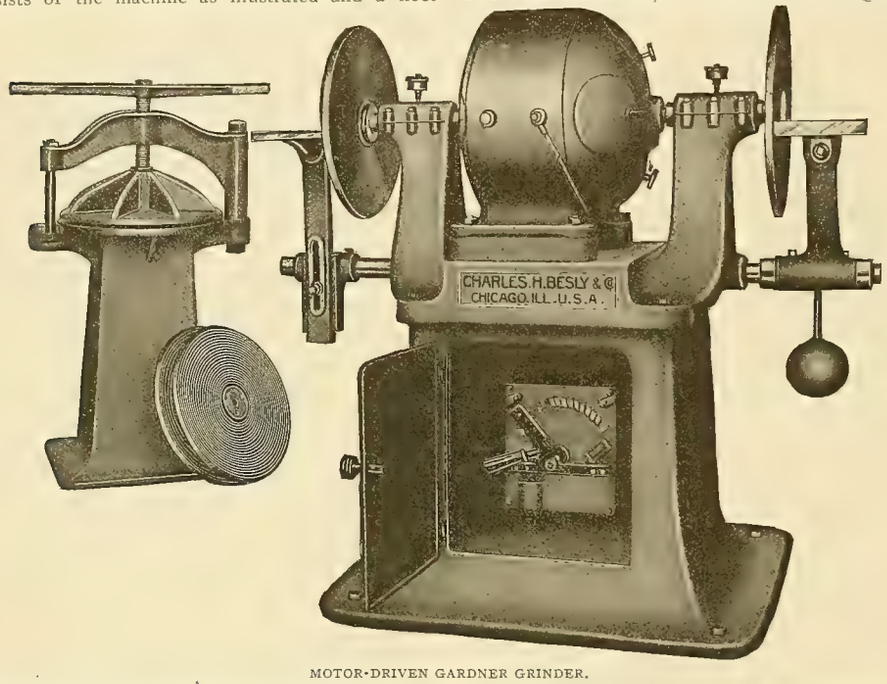
At Buenos Ayres there is a large business with New York by means of five steamship lines and through New York with Chicago and vicinity from which are shipped a large amount of agricultural machinery of all classes from cultivators and plows to great steam threshing machines of the J. I. Case Company of Racine, Wis. Not only from Chicago, but from all manufacturing districts of the country, the trade with this country is rapidly increasing. One sees our machinery everywhere, and everywhere it is considered the best; for instance, Baldwin locomotives, Jackson & Sharp cars, and the Harlan & Hollingsworth machinery.

The American freight cars of 25 and 30 tons are replacing the old Belgian, French and English six, seven and 10-ton cars. If the American freight cars are not all made in the United States, they are copied exactly from ours. The most approved bridges are from the United States. The horse cars by John Stephenson of New York, electric cars by the J. G. Brill Company, and the Westinghouse company are doing well here. I might enumerate many other United States products. I can truly say that the prospects of American trade with this country are exceedingly good.

A word about my own work. I am the only American civil engineer in this country in the employ of the government. My position as consulting engineer of the Ministry of Public Works, particularly in its river and harbor improvements, places me in intimate relation with many officials of the government, and after over a year's experience I am glad to say that they are all not only professional but personal friends. I have had in the past a very large and varied association with the leading railroad, bridge and harbor engineers and officials in the United States, including government officials at Washington, and though all these relations have been most cordial, I have never passed a pleasanter nor more satisfactory year professionally, than the last has been.

Motor-driven Gardner Grinder.

The Gardner grinder, as manufactured by Charles H. Besly & Co. of Chicago is designed and used chiefly for making and for perfecting and finishing flat surfaces of metal. The essential feature of the grinder is the spiral grooved disk wheel, which is covered with a circle of emery cloth fastened on with ordinary glue. In the accompanying illustration is shown a No. 40 motor-driven Gardner grinder, the particular machine shown having been furnished to the new United States Mint at Philadelphia. It is driven by a five-horsepower Crocker-Wheeler motor. The complete equipment of this type of grinder consists of the machine as illustrated and a floor



MOTOR-DRIVEN GARDNER GRINDER.

setting-up press, four 18-inch spiral grooved steel disks, glue pot, Helmet cement, Helmet oil, necessary wrenches and accessories, and complete assortment of emery-paper and cloth circles, also complete assortment of spiral emery-paper circles.

Besly & Co. are prepared to furnish this grinder to be driven by any of the following well-known make of motors: General Electric, Westinghouse, Crocker-Wheeler, Sprague, Northern, Milwaukee, Bullock, Western Electric and Triumph.

The Allis-Chalmers Company of Milwaukee, Wis., has two motor-driven Gardner grinders similar to the one shown in illustration, driven by 6-horsepower Milwaukee Electric motors. The Bullock Electric Company of Cincinnati has a motor-driven Gardner grinder driven by an eight-horsepower type-N motor of Bullock Electric make. The Northern Electric Company of Madison has a Gardner grinder driven by an eight-horsepower Northern motor. Many shops are operating Gardner grinders belted from line shaft, which is driven by motors. Besly & Co. are now building for the new Lake Shore shops at Collingwood, Cleveland, Ohio, some No. 40 Gardner grinders to be driven by eight-horsepower Crocker-Wheeler motors.

Swedish Government Considering Big Electric-railway Project.

From time to time it has been stated that the Swedish government intends to equip a number of government-owned railroads in that country with an electric system, the power to be developed by the vast waterpower resources of Sweden. A news dispatch, dated London, October 31st, again reverts to the subject, giving information, which, if true, is of the greatest interest to electric-railway men. The statement is to the effect that the government plans to convert 4,200 miles of government-owned railroad—two-thirds of the total railroad mileage of the country—into an electric-railway system, utilizing the natural waterpower resources of the country for generating the necessary power. Representatives of the government are said to have been in London recently consulting with American experts, who submitted plans for the work, which is to be completed in three years. Denmark is said to be contemplating a similar move.

Ionization of Gases.[1]

By George F. Stradling.

It has been shown that by the passage of the electric spark through steam as well as by the passage of current through alkali salt vapors products appear, which conform in quantity to Faraday's laws of electrolysis.

By a variety of processes a negative ion, which is not the same in mass as the negatively charged ion of liquid electrolysis, can be separated from the atom. The remainder, having a positive charge, differs according to its origin, while all negative ions seem to be alike in rarefied gases.

The chief agencies in the production of ions are rays from radio-active substances (Becquerel rays), Roentgen rays, ultra-violet light, cathode rays, certain chemical processes, high temperature, electrostatic stress, impact of moving ions, spontaneous production. These are not all independent. Both positive and negative ions, when the ratio of electric force to gas pressure is sufficiently low, become attached to groups of molecules. Generally the negative ions move more rapidly than the positive ones. However, in the case of ions produced by high temperatures, it seems that higher speed goes with the positive ion.

Among the things explicable by the theory of ions are: Many of the phenomena of the discharge of electricity through gases; the tending of the electric current through a gas toward a maximum as the electromotive force rises; the discharge of hot conductors at a lower potential when charged negatively than when positively charged; possibly the weight changes accompanying chemical action observed by Sanford, Landolt and Heydweiller; the occurrence of auroras; the luminescence of nebulæ.

Atmospheric air contains ions. By their presence is explained the discharge of electrified bodies, which takes place independent of the leakage across the insulators. While the rate of dissipation of the charge is greater for both positive and negative electricity on mountains than on the lowlands, it is far greater for negative, because the negative charge of the earth having a very high density upon the peaks attracts thither great quantities of positive ions. The dissipation is much more rapid on clear than on dull, foggy days.

If a charged body be surrounded by a cage of wire similarly charged, the latter attracts ions, some of which pass within it, and thus accelerate the discharge of the body inside. If the cage and body are oppositely charged, the discharge is made slower.

Ebert insulated a portion of the earth; he let its charge be dissipated by the rain of ions constantly occurring and again connected it to the earth. Then a current flowed from the insulated part to the earth. It took in some cases only five minutes for the discharge by ions to be completed. This undoubtedly shows a very high rapidity of discharge for the earth.

The origin of the atmospheric ions is to be sought in the action of ultra-violet light in the upper regions of the atmosphere and in cathode rays developed there by negatively charged particles arriving from the sun.

1. Abstract of paper read before Franklin Institute, Philadelphia, September 25, 1902.

More About the Osmium Lamp.

The interest which has been manifested, both in incandescent-gas-lighting and electric-lighting circles in England and Germany, as to the commercial possibilities of the osmium electric lamp, devised by Dr. Auer von Welsbach, will be somewhat deepened by a noteworthy article which has just been published by a leading Berlin newspaper. It has been claimed that the osmium lamp will effect a revolution in electric lighting in the sense that it will render for this industry similarly advantageous services to those afforded to the gas-lighting branch by the Welsbach incandescent-burner system, and it is believed that when the former is placed on the English market it will be controlled by the British owners of the Welsbach incandescent gas-lighting patents. So far, however, the osmium lamp has not arrived, and the reasons, as given by the Berlin Tageblatt, are not without interest at the present moment, says the London Electrician.

It appears that at one time the shares of the German Incandescent Gas Light Company—the Welsbach enterprise of the Fatherland, and the purchaser of the patent rights of the osmium lamp for Germany, Luxemburg and Holland—advanced to the almost unprecedented premium of 1,000 per cent., and that, apart from the heavy declines which have since occurred, simultaneously with the drop in the very high dividends which were paid, a further fall to the extent of 50 per cent. took place during the month of September. The Berlin newspaper attributes this unfavorable circumstance partly to the fact that, in consequence of increasing competition, the company no longer plays the same important role as in former years, but mainly to the uncertainty surrounding the fate of the osmium lamp, upon which exceedingly sanguine expectations have been based. In support of the latter statement, the article refers to the company's report for 1900-1901, wherein it is stated that it is hoped so to increase the manufacture of the lamp in the winter season as to yield profits in the new year, and that from the measurements and experiments made, the lamp would constitute a lucrative invention in the future. As recently as July last the company repeated the assertion that the lamp would be placed on the market in the coming season, and a few days ago it was stated by the company that the prices and conditions of sale have not yet been fixed, so that there is no information as to when the lamp will be brought out for commercial purposes in Germany, and much less in England.

It appears, however, that, notwithstanding the relatively small consumption of electric current, the construction of the osmium lamp is far more difficult than that of an ordinary incandescent electric lamp with a carbon filament, owing to the metal osmium, apart from its comparative scarcity, being difficult of treatment, so as to obtain an equality of the metal forming the lamp filament. In fact, the principal obstacle is said to lie in the impossibility of constructing lamps having a sufficiently high electrical resistance, as the osmium wire is either so long or so thin that at white heat—that is, when at the incandescent stage incidental to ordinary use—it is unable to retain its original shape. It remains to be seen whether this difficulty can be surmounted, although the company claims to have done so now. The German company, which several years ago paid dividends up to as high as 130 per cent., and as much as 28 per cent. a year ago, announces that the financial year now closed will show a further decline in the amount of the distribution.

World's Production of Coal in 1901

The forthcoming volume of "Mineral Resources of the United States" for the calendar year 1901, United States Geological Survey, estimates the world's production of coal in 1901 at 866,165,540 short tons. The three great coal-producing countries of the world are the United States, Great Britain and Germany. Austria-Hungary comes fourth, France is fifth, Belgium sixth and Russia seventh. The last-named country, notwithstanding its vast area, produces only about six per cent. as much coal as the United States. The three countries which lead in the production of coal are the three countries that lead in industrial development. Prior to 1899 Great Britain led among the world's coal producers, but during 1899, 1900 and 1901 the United States has made such remarkable increases in coal production, due principally to the unprecedented activity in the iron and steel and in other metal trades, that we now stand far in the lead of all competitors, with a production in 1901 exceeding that of Great Britain by 47,965,938 short tons, or 19 per cent. Up to the close of 1900 the coal production of Great Britain and her colonies, if taken together, still exceeded that of the United States, the excess in 1900 being 3,368,825 short tons; but the enormous output of the coal mines of this country last year exceeded by about 26,000,000 short tons the entire output of Great Britain and her dependencies, including India and the Transvaal.

Of the output of coal in 1901 the United States produced 33.86 per cent., Great Britain and her dependencies 30.86 per cent., and Germany 19.42 per cent., or, combined, 84.14 per cent. of the total production.

The Ohio Lighting Company of Cincinnati has been incorporated with $25,000 capital stock by O. T. Blake, T. L. Curley and R. Kennedy.

A New Miniature-lamp Company.

The Rooney-Westbury Electric Lamp Company of 154 East Twenty-third Street, New York, has been incorporated to manufacture all kinds of miniature incandescent lamps and accessories. The use of these lamps has grown in the last 10 years to a very large consumption annually, and the little lamps are steadily increasing in favor. They can be divided into three classes: First, lamps solely designed for decorative work or ornament; second, lamps needed for useful purposes, and, third, lamps combining both the foregoing characteristics. In the first class are the many types of series and multiple lights used for decorating store windows, Christmas trees, moving devices, etc. In the second division are such lamps as those used in telephone switchboards, annunciator systems making use of a visual lamp, dental and surgical instruments, etc., while to the third belong such lamps as the candelabra types used in wall fixtures and brackets, ceiling lights, etc., also the various kinds of battery lamps used in portable novelties, clock lights, etc. There are at the present time upward of 7,000 varieties of miniature lamps, and this number is continually being added to. The manufacture of the miniature lamp is one requiring the most delicate care and attention, as while the large standard lamp is now more or less made by machinery, the miniature, on the contrary, is still almost entirely a hand-made product, demanding the most expert labor and skill in glass blowing, etc., that can be obtained. Owing to this fact the cost of these lamps is likely to remain considerably higher than the standard incandescent lamp, and as a general rule the smaller the lamp the higher the price. Miniature lamps are now made as small as one-eighth of an inch in diameter which will actually burn and give a brilliant white light. Nothing is more deceiving than the candlepower of miniature lamps, as it is practically impossible to estimate it with the naked eye within one or two candlepower. It is therefore desirable to purchase lamps from a reliable maker.

The new company has a number of novelties which it intends to place on the market. One is a double-filament battery lamp, so arranged that it can be burned with both filaments at once, or one at a time, as preferred, thus giving either double brillancy or double life. Another is a special form of miniature reflector lamp with a silvered bullseye, more than doubling the candlepower for the same expenditure of current. Several ingenious novelties in automobile lamps with reflectors should commend themselves to automobile users.

John Rooney, the president of the company, is a man of wide and varied business experience. In his early manhood he read law, and was connected with a leading New York railroad-law firm for over 25 years, during which time he gained a clear insight into the legal business, which, however, he never adopted as a profession. Among the many business enterprises with which Mr. Rooney's name has been connected are the St. Paul Water Works, the Southern Minnesota Railroad, the Iowa Eastern Railroad, and subsequently the Erie and Atlantic and Great Western Railroad. Mr. Rooney was prominently identified with the Boston, Hartford and Erie Railroad Company, of which he was president for years. He was also part owner of the New York and West India Steamship Company and its treasurer and general manager.

Mr. Rooney, in connection with the late General Benjamin F. Butler, played quite an important part in the celebrated Sprague failure of several years ago in Rhode Island. His effort to save the credit and honor of the Sprague family as well as to conserve the interests of the creditors, was unsuccessful, but redounded greatly to his clear brain and kind heart.

It is said that to Mr. Rooney the credit belongs of being the first to bring to the attention of the people of the United States the correct story of the difficulty between Venezuela (on the Guiana boundary question) and Great Britain. On the evening of January 29, 1891, in Everett Hall, Brooklyn, Mr. Rooney delivered an address in which he set forth the facts of the case. The address attracted great attention, and in recognition of his services the Venezuelan government decorated him with the Order del Liberador, and subsequently the Spanish government decorated Mr. Rooney with the Order of Carlos III., in recognition of his great friendship for Spain in his work on the genealogical history of Irish families.

Mr. Rooney entered the electrical field in 1881, and was one of the organizers and the president of the American Electric Light Company. He was also one of the promoters of the Consolidated Electric Light Company and the Sawyer-Man Electric Company, all of which were subsequently merged into the Westinghouse Electric and Manufacturing Company. In his many business enterprises Mr. Rooney became closely connected with many of the great railroad men of the country and with the leading members of the bench and bar, especially with Governor Van Zandt of Rhode Island, Judge Abbott of Boston, the late General Benjamin F. Butler, who was Mr. Rooney's leading counsel for over 20 years. Mr. Rooney was a warm friend of the late Hon. James G. Blaine and also President Harrison, and for more than 20 years the intimate friend of the late President McKinley, his brother, Mr. Abner McKinley, Senator Marcus Hanna and other well-known statesmen.

Harry Westbury, who is the treasurer and sales manager of the company, is well known to electrical men generally all over the country. He graduated from one of the largest colleges in the west of England, and for some years held a position as head accountant and afterward as salesman in the brass-foundry business. On coming to this country he entered the employment of the General Electric Company at Harrison, N. J., and was associated with W. H. Meadowcroft in developing and increasing the sale and use of the miniature lamp, and after the latter gentleman resigned his position in 1899 Mr. Westbury conducted the commercial end until he recently resigned to enter the Rooney-Westbury Company. His name has been intimately associated with the developments in X-ray work for several years, and he is well known in scientific circles, both in this country and Europe, as an expert on X-ray tubes and like apparatus. He is a prominent member of the Roentgen Society, and has written many interesting papers on various subjects pertaining to vacuum-tube work.

Francis J. Rooney, the secretary of the company, is a mechanical engineer and a graduate of the Polytechnic Institute of Brooklyn. He was for over two years assistant manager of a large manufacturing business in New York city and subsequently superintendent of an electric therapeutic establishment and private secretary to his father up to the organization of this company.

John J. Rooney is the general manager of the company. He is a graduate of the Polytechnic Institute of Brooklyn, being one of the first students to take the electrical-engineering course, established in 1893 by Samuel Sheldon, the well-known expert. Always deeply interested in electrical science and inventions, Mr. Rooney early devoted himself to storage-battery work and perfected a type, which, however, he did not place on the market, owing to the patent situation. He then turned his attention to high-tension electrotherapeutic work, and recently installed a large plant for this purpose in London. Mr. Rooney will soon place on the market, through the new company, a new type of incandescent lamp, upon which he has spent much time.

W. H. Meadowcroft, Vice-president. J. J. Rooney, General Manager. John Rooney, President. F. J. Rooney, Secretary. H. Westbury, Treasurer.

OFFICERS OF ROONEY-WESTBURY ELECTRIC LAMP COMPANY.

William H. Meadowcroft came to the United States from Manchester, England, in 1875. Shortly after coming to America he entered the law office of Carter & Eaton at 346 Broadway, New York, and remained with that firm and its successors over five years. While there he studied law and was admitted to the New York bar in May, 1881. Major S. B. Eaton of the above law firm, early in 1881, had accepted the vice-presidency of the Edison Electric Light Company, and Mr. Meadowcroft left the legal profession, after being admitted to the bar, and became assistant and secretary to Major Eaton in May, 1881, continuing in that position for about four years. Mr. Meadowcroft continued his association with the Edison company and its successors over 18 years, having been engaged in various departments of the companies, two years being spent in the legal department. During the last 6½ years of his association with the General Electric Company he devoted his entire time to the miniature and decorative-lamp business, a branch of the lamp department which he originally started in 1885. Mr. Meadowcroft took part in the development of the Roentgen-ray business of the General Electric Company from its commencement. In the 18 years that he was with the Edison company and its successors he took part in the growth of a wonderful business, and having been engaged in the early struggles of the parent Edison Company, has been closely identified with the electric-lighting industry. In the early '80's he took an active part in the Edison Electric Illuminating Company, the Edison European Company and the Edison Ore Milling Company, as well as with various standardizing and technical committees that were organized in those days for operating part of the business. He also wrote the first commercial pamphlet on incandescent electric lighting that was published in this country, and prepared all the catalogues for the Edison companies in 1884, as well as a number of booklets that were published in 1887 and 1889, and some other special catalogues in later years. Mr. Meadowcroft has also done some other writing in his leisure moments such as, for instance, his popular manual "A B C of Electricity," of which over 76,000 copies have been sold. In the summer of 1899 Mr. Meadowcroft left the General Electric Company to go into the storage-battery business with Theodore Berdell and Frank A. Perret, and the Perret Storage Battery Company was organized, with a factory in Brooklyn and an office in New York. After considerable preliminary work had been done, and by the time that the battery was ready to be put on the market, the president and financial member of the company, Mr. Berdell, unexpectedly died, and Mr. Perret was taken seriously ill. Owing to these unfortunate circumstances it was deemed advisable to suspend for a time the operations of the Perret Company. Mr. Meadowcroft having some financial interests in the National Bread Company and The United States Bread Company, and being a director in both, accepted the position of treasurer of both these companies and still occupies the same official relations. His love of the old business of decorative and miniature incandescent lamps has prompted his joining forces with Messrs. Rooney and Westbury, in the Rooney-Westbury Electric Lamp Company, of which he is vice-president. He is also treasurer of the Foreign Patents Company and treasurer of the American Stone Company.

The Technolexicon.

At the recent meeting of the Verein Deutscher Ingenieure at Düsseldorf, Dr. Hubert Jansen, editor-in-chief of the Technolexicon, the new French-German-English technical dictionary, made a progress report. He said that, thanks to the energetic efforts of the management, there are now interested in the work, according to the record at the close of June, 1902, 316 technical societies, of which 266 are in Germany, 25 in England and America, and 25 in France. There are also 1,754 independent collaborators at work, 1,333 in Germany, 229 in England and America, and 192 in France. Various circulars, note books, and instructions have been sent out, and the work has been prosecuted in a most systematic manner from the start. Dr. Jansen estimates that

the collection of the material will be accomplished by the close of 1904, and that the final revision and publication will bring the completion of the work to the close of the year 1906.

The Field for Electric Railways.

The report of the Industrial Commission on the marketing and distribution of farm products shows that the cost of handling farming products over the country roads is estimated at $900,000,000 a year, or more than the entire cost of operating all the railways in the United States, which is placed at $818,000,000. The average haul to the nearest shipping station is 12 miles and the average cost is 25 cents per ton per mile, or $3 per ton for the 12 miles.

By comparing this ton-mile cost with the average ton-mile revenue for all the railroads of the country, which is only about seven mills, the immense opportunity that lies in this field is readily seen. It may be interesting to calculate that the railroads at seven mills per ton-mile would charge less than $26,000,000 to carry this tonnage the same distance which it cost the farmers of the country around $900,000,000 to haul over ordinary roads.

It would seem that in this field there lies an excellent opportunity for the development of electric railways. It is not in paralleling but in supplementing the steam-railroad system of the country that the destiny of the electric railways lies. In pointing out a notable change in the movement of passenger traffic during recent years it was stated in this column that the electric railways of the country are carrying more and more of the short-distance passenger traffic and that this competition was welcomed by the steam railroads. A similar situation exists in regard to freight traffic. The steam railroads of the country will welcome any means of transportation which will result in concentrating traffic at shipping points by a more economical method than the present cumbersome one of hauling it in wagons over country roads.—Bankers' Monthly.

A Railway Franchise in Jamestown, N. Y.

The Common Council of Jamestown, N. Y., recently granted a franchise for a street-railway system to the Warren and Jamestown Electric Street Railroad Company. The grant gives the company operating privileges on certain streets for a period of 50 years from the incorporation date, subject to several conditional clauses.

One of the conditions of the grant is that the company shall use grooved rails or "some other kind of rail not 'center-bearing,'" such rail to be approved by the Common Council. As a return for the concessions received by the company, it is to pay to the city annually a percentage of three per cent. of its gross receipts.

The most interesting clause in the franchise pertains to "leakage" currents, and is as follows: "This company shall use all proper and reasonable means to prevent the currents from its wires, through leakage, induction or otherwise, from interfering with the currents upon the wires of other companies, whether telegraph, telephone or other wires, and shall by the bonding of rails and the use of return feeders, sufficiently large to carry the current without loss of pressure, or by some better means, prevent the escape of its current, or any part thereof, to pipes buried in the earth to the injury of the latter by electrolysis. Frequent tests shall be made by the company to detect leakage."

BOOK TABLE.

Forest Reserves. By Henry Gannett. (Part V. of the Annual Report of the United States Geological Survey for the Year Ended June 30, 1900.) Washington: Government Printing Office. Pp. (7¾ by 11¼ inches), xi., 711, with 143 plates and maps.

This voluminous report contains a collection of papers, reports and maps, descriptive of the forests of the West, including the governmental reserves in Montana, Washington, Oregon, California, Yellowstone Park, Minnesota and Indian Territory. Mr. Gannett gives a summary of the forestry work in 1899-1900 and special contributors describe the conditions in and work done on the Lewis and Clarke Forest Reserve in Montana, the Mount Ranier Reserve in Washington, the Olympic Reserve in Washington, the Cascade Range and Ashland Reserves, and the Stanislaus and Lake Tahoe Reserves in California. Other papers treat of the classification of lands, the woodland of Indian Territory and the timber conditions of the pine region of Minnesota. The text is very complete and should form a valuable guide to all interested in forestry conditions in the West. A very important feature of the report is the large number of photographic reproductions of views showing the conditions in the forests, and the colored land-classification maps.

Manager E. E. Downs of the Winnebago Traction Company of Oshkosh, Wis., and General Manager W. H. Holcomb of the Fox River Valley Electric Railway Company are said to be making arrangements by which it will be possible for residents along either line to charter through cars over either road, and by which, when the Fond du Lac-Oshkosh interurban line is in operation, cars may be chartered from the former city also clear through to Kaukauna and vice versa.

CORRESPONDENCE.

New York Notes.

New York, November 1.—A plan for the new Grand Union Station of the Bronx was submitted to the Rapid Transit Commission last week by the engineers. The proposed site for the building is on the Harlem River, between One-hundred-and-thirty-eighth and One-hundred-and-thirty-ninth Streets. In presenting the above location the North Side Board of Trade, which was the author of the proposition, expressed the opinion that the proposed site would afford advantages to be found nowhere else in the city of New York for the bringing together under one roof of all existing and contemplated railroads entering New York city, thus resulting in great convenience to the public and the stimulation of travel on all of the lines.

The Metropolitan Street Railway, exclusive of Third Avenue, earned for the year ended June 30, 1902, $14,504,000, an increase of about $500,000 over the previous period. Operating expenses decreased slightly and surplus earnings were $7,766,000. Other income amounted to $594,000. After paying fixed charges of $4,642,000 and seven per cent. dividend, amounting to $3,640,000, there remained a balance of $78,000 against $38,000 the year before. Current earnings are about $2,000 a day better than in 1901, although business is adversely affected on Fourth Avenue, Sixth Avenue, Columbus Avenue and the Boulevard by subway construction.

Yesterday an electric train ran over the tracks of the West Side elevated system between Fifty-third and One-hundred-and-fifty-fifth Streets. It carried no pay passengers, but a regular service of a dozen such trains began this morning between South Ferry and One-hundred-and-fifty-fifth Street, and as rapidly as possible the steam service will be reduced. Electric service on the Ninth Avenue line will not be installed for several weeks. The train yesterday was of six cars, four motors and two trailers. On board with the crew were Superintendent S. D. Smith of the Manhattan Railway Company, Chief Engineer G. H. Pegram, J. S. Doyle, master mechanic, and H. Hazleton, electrical engineer. The train was run between regular trains on schedule time on the east and west tracks with an express train on the central track. Everything worked perfectly.

It is reported in financial circles that negotiations are under way to consolidate New York companies now operating as independent concerns and controlled by a group of prominent western men in conjunction with Frank Tilford, Henry R. Wilson and their associates in the East. It is probable an operating company will be formed to acquire the ownership of these plants. The most important properties affected by this contemplated consolidation are the New York and Queens Electric Light and Power Company, the Newtown and Flushing Gas Company and the Williamsport (Pa.) Gas Company.

Charles A. Becker, who has the contract for placing the illuminated street signs on lamp posts has complained to Borough President Cantor that he is being seriously hampered in his work by the Municipal Art Commission. Mr. Becker has all the material ready, but there is some difference of opinion between the city authorities with relation to the height of the letters to be used. The difference is about one-quarter of an inch.

Frederick K. Day of Elizabeth, N. J., whom the Court of Chancery of New Jersey made receiver of the American Union Electric Company of that state, has been appointed by Judge Lacombe in the United States Circuit Court receiver of the property of the company in the southern district of New York. Frank C. Hollis, who brought the action asking for the receiver, says he holds notes given by the company to the amount of $26,536.36, and that all these notes are past due.

The steam locomotives of the Manhattan elevated railroad, released by the adoption of electricity as a motive power, will not go to the scrap heap just yet. They will be sold for use as switching engines, for logging service, and dirt and rock haulers in excavation work. Some of them will be retained by the company to do the drudgery of the electric service.

The following-named companies were incorporated this week:

The Cross Country Railroad Company of Brooklyn; capital, $250,000. Directors: J. F. McClean, A. A. Halsey and Theo. Bernard, all of Brooklyn.

United States Electric Company, Jersey City; object, to manufacture electrical devices; capital, $25,000. Incorporators: George C. Wilfore, New Brighton, L. I.; Henry McDonough, Montclair, and Clarence Kelsey, Jersey City. O.

Canadian Intelligence.

Ottawa, Ont., November 1.—The Canadian General Electric Company will, in a short time, commence operations on its new building in Toronto. The plans show that the building will be one of the handsomest and most artistic in the city.

Captain Bernier, who is organizing the Canadian North Pole expedition, has received from the Toronto Wind Engine and Pump Company two of the latest improved windmills, which, the captain says, will be of great value to the expedition. One or both of these windmills will be used to drive machinery in the workshop, produce electric light, and thus also enable his medical staff to use electricity to cure any polar disease which may develop during the search for the pole. Captain Bernier has received from a London (England) firm the latest appliances for using electricity in the treatment of such diseases.

Mr. Kennedy, manager of the Deering division of the International Harvester Company, states that his company will not cease building operations in Canada for fully three years to come, upon so great a scale are these buildings to be erected. Mr. Kennedy has just closed a contract with the Cataract Power Company of Hamilton, Ont., for the supply of 3,500 electrical horsepower This is said to be the largest contract of its kind ever made in Canada.

The initial operations of the great waterwheels and electric generators in the power house of the Shawinigan Power Company, at Shawinigan Falls, Quebec, have proved eminently successful. The machinery consists of a waterwheel of 6,000-horsepower capacity, and the generator of 5,000-horsepower capacity. The waterwheel is the largest in Canada, and was built by the I. P. Morris Company of Philadelphia, and the electrical apparatus by the Westinghouse company of Pittsburg. W.

New England News.

Boston, Mass., October 31.—The Massachusetts railroad commissioners have authorized the sale by auction of 1,220 shares of the Boston Elevated Railway Company's capital stock. The stockholders did not subscribe for this amount of the 33,000 shares issued under the commissioners' authority dated August 22, 1902. The authorized price per share was $155.

A syndicate of Boston and New York men is preparing to utilize the Union River, near Ellsworth, Me., for the generation of electrical power to be transmitted to points between Bar Harbor and Bangor. The engineers estimate that the head and volume are sufficient to generate 40,000 horsepower of electricity. Ellsworth manufacturers have contracted for 4,000 horsepower, and the agents of the syndicate are negotiating with other large concerns. The projectors have organized a corporation with a capital of $1,000,000, and they propose to build a dam 60 feet high at Ellsworth and another dam 12 miles above there, by which they can obtain a large basin for water-storage purposes.

The Providence and Danielson Electric Street Railway Company has awarded contracts for the extension of its line from its junction with the Worcester and Connecticut Eastern system to East Killingly and Elmville, Conn. The work of construction has been begun. The Worcester and Connecticut Eastern Company has practically completed a line between Wauregan and Central Village, Conn., and is building a line from the latter place to Moosup. It is expected that by January 1st the company will be operating a line from Danielson to Moosup.

The Connecticut Railway and Lighting Company will soon begin the stringing of a circuit from its Milldale, Conn., power station to Cheshire, Conn.—a distance of five miles—and expects to have cars running between Cheshire and New Haven before the first of January. The company has been so hindered by the difficulty of obtaining rights-of-way that it has not begun the construction of its half of the proposed line between New Haven and Derby. The Fair Haven and Westville company has completed its half of the line, but is running no cars over it.

The Contoocook Mills Company has erected a power house in Hillsboro Bridge, N. H., and proposes to furnish electric lights for several factories in that vicinity.

The Berlin Mills Company is building a power house and will install an electric plant therein, at its plant in Berlin, N. H.

The Saco and Pettee Machine Shop Company is building an electric railroad for the transportation of its freight at Biddeford, Me.

The Broad Brook (Conn.) Company is preparing to light its entire plant by electricity and is enlarging its engine room in order to obtain the necessary room.

A year ago Joseph P. Bass of Bangor, Me., bought all the stock and bonds of the Oldtown Electric Light Company and the Oldtown Gas Light Company, and he has recently sold them to the Public Works Company of Bangor, which will make many improvements in both plants.

The Connecticut Railway and Lighting Company has secured rights-of-way for an electric railway between Waterbury and Milldale, Conn., over Southington Mountain. Contractors are estimating on the work of building the line which will put Waterbury in direct electric-railway connection with New Haven, Hartford and Meriden.

The Willimantic Traction Company has decided to build a new power house at South Windham, Conn. Steam power will be used. B.

Southern Developments.

Charlotte, N. C., November 1.—The Villa Rica (Ga.) Light and Power Company has been organized by local people, with C. M. Griffin as president and E. R. Ayers as secretary and treasurer. It is proposed to erect a plant at once.

It has been practically decided to extend the elec-

tric lines of Rome, Ga., to Lindale, at a cost of $50,000.

The new route to Decatur, Ga., of the Georgia Railway and Electric Company of Atlanta has been put into service, the cars running on a 30-minute schedule.

The Gadsden (Ala.) and Attalla Electric Railway Company has been purchased by the Schuler interests, who have also secured other valuable properties in that section.

The Salisbury Light and Power Company has been organized at Salisbury, N. C., with J. S. McCubbins, treasurer. The minimum capital is $50,000. Work will begin on an electric line at an early date. It is proposed later to extend the line four miles to the Yadkin River.

The town of Camden, S. C., has voted a 17-year franchise to the Camden Water, Light and Ice Company. Lights have been turned on for the first time since the burning of the power house last May.

The Concord (N. C.) Electric Light Company has secured an extension of franchise, and the owners, Burton & Scott, will at once put in a new plant at a cost of $75,000. L.

From the Buckeye State.

Cleveland, Ohio, November 1.—Several meetings have been held the past week by the syndicate which is refinancing the Lake Shore Electric Railway Company, and the plans have been discussed by which this is to be accomplished. At this time, however, nothing definite has been announced.

W. G. Wagenhals, formerly manager of the Millcreek Valley lines, has turned his attention to a plan for bringing the steam railroad trains into the business district of Cincinnati. In brief, the idea is to build a system of elevated tracks into the business district and connect them with the steam roads in the bottoms. The trains from the latter point will then be pulled into the city by electric locomotives. It will require the expenditure of probably $2,000,000, but it is said to be the cheapest and most feasible plan yet made.

Plans are on foot for the consolidation of the three Scrugham companies at Cincinnati—the Cincinnati and Eastern, the Rapid Transit and the Suburban. Arrangements have been made with the Mandelbaum people by which the Rapid Transit is to be extended from Lebanon to Xenia, and rights-of-way are now being secured. Connection will be made there with the Springfield and Xenia Traction lines which are owned by the Mandelbaum people, and they will thus have two entrances to Cincinnati.

The Falk Company of Milwaukee has the contract to build the Cincinnati, Milford and Goshen line, the consideration for the entire work being about $1,000,000.

The business office of the Crouse-Tremaine Carbon Company of Fostoria has been moved to Cleveland.

The Brown-Cochran Company, incorporated in the East, has been admitted to Ohio. It has a capital stock of $225,000, and will manufacture gas engines and electrical machinery. It is a combination of the Brown Gas Engine Company of Columbus and the Cochran company of Lorain, and the plant will be located at the latter place.

The Cincinnati Traction Company has asked for a franchise to extend its line to the corporation limit, where it will make connections with the Cincinnati and Eastern and the Cincinnati, Georgetown and Portsmouth.

The Cincinnati, Lebanon and Northern has increased its capital stock from $1,000,000 to $1,500,000.

The Central Market Street Railway Company of Columbus has purchased a storage battery at a cost of $35,000, in order to increase the capacity of the plant.

Connections between the Columbus, London and Springfield and the Dayton, Springfield and Urbana roads have been completed, and it is the intention to put on through trains in a short time.

The Zanesville Railway, Light and Power Company of Zanesville is planning to make some extensive improvements on the properties just transferred to it. The plan includes the entire rebuilding of the railway lines and the addition of five or six miles of track. The electric-light plant will also be overhauled and several new pieces of machinery will be added. The company has filed a mortgage to cover the issue of $1,000,000 five per cent. 10-year bonds. This will be used partly to redeem outstanding bonds and to pay for the improvements and extensions. O. M. C.

Detroit, Mich.

Detroit, November 1.—The promoters of the electric road between Battle Creek and Jackson announce that cars will be running between these cities by January 1st. The Plainville Water and Electric Light plant will furnish the power until the property of the Albion Milling Company, purchased by Mr. Boland, can be equipped as an electric power plant. This will give an all-electric line from Detroit to Kalamazoo, a distance of 144 miles.

A company of eastern capitalists will ask the Common Council of Lansing for a franchise to erect a large heating, lighting and power plant, and also to furnish cold storage. The company will have a capital stock of $100,000.

The proposition to bond Trenton for a $7,500 electric-lighting plant was carried, and bids for machinery will be asked for at once by President Stokes.

The Common Council of Oswosso has declared in favor of a public lighting plant, and a committee has been appointed to investigate. It is asserted that the service of the Owosso and Corunna Electric Company was not satisfactory. C. G. W.

Information from Indiana.

Indianapolis, November 3.—Articles of incorporation have been filed by the Electric Railway Security Company, representing a capital of $5,000,000—the largest amount ever named in incorporation articles filed in any county in Indiana. The company will have its main office in South Bend. Its object is to purchase the securities of electric railroads, purchase lands and buildings in Indiana for the erection and establishment of manufacturing plants with the view to the manufacturing of electric-railroad appliances. The incorporators are Dr. S. M. McDonald, South Bend; T. W. Kenyon, Mishawaka, and Philip Lawrence of Huron, S. D. All of the persons interested in the corporation have not been made known, but the list is said to include a number of prominent men in electric-railway circles, among them officials of the Union Traction Company.

The Warsaw and Winona Electric Railway Company filed articles of incorporation with the secretary of state on October 29th. The capital stock is $50,000. J. E. Byers of Rochester is president, A. N. Dukes of Peru, and W. N. Smythe of New York are vice-presidents, and Sol. C. Dickey of Indianapolis, secretary. This line extends from Warsaw to Winona Assembly Grounds on Winona Lake, and the road is completed except as to motive power. It was necessary to complete the Winona line to save the franchise. It is now operated by animal power.

Another new traction line incorporated last week is that of the Fort Wayne, Bluffton and Richmond Traction Company. The capital stock is $50,000. The company proposes to build an interurban line from Fort Wayne to Richmond. The incorporators are Edward Mainer, Frank X. Schaffer, C. S. Durst, C. F. Manning and W. F. Dinnin.

The Southern Indiana Traction Company has been granted a 50-year franchise to operate electric cars in Vincennes. The company is building a line between Jasper and Vincennes.

Additional evidence of electric competition is shown at Bridgeport, where the Indianapolis and Plainfield line has taken the passenger business almost entirely away from the Vandalia steam road at that point. The same is true at Plainfield, the terminus of the line.

The Indiana Supreme Court has affirmed a judgment against the Indianapolis Street Railway Company for injuries sustained to a woman who was shocked and injured by a trolley wire which fell on her as she was crossing the tracks. The court said the company was negligent in continuing the use of a wire so long that it ought to have known it had become weak and liable to break.

Judge Baker of the United States Court has rendered a decision in the case of F. B. Cook against the Sterling Electric Company of Lafayette, involving the right of the latter to manufacture certain electrical devices, the patent rights of which are owned by Cook. Cook, by oral agreement, sold an interest in his patents to the Sterling Electric Company, in exchange for stock, and afterward brought suit for injunction, asserting that the company was manufacturing the devices without right. He set up the claim that the oral agreement was not binding. But Judge Baker held differently, and in his opinion said: "An oral agreement or sale of an invention before the issuance of a patent therefor is valid and invests the purchaser with equitable title, and the inventor who, after such assignment or sale, obtains a patent, holds the legal title in trust for the owner of the equitable title." F.

Northwestern Notations.

Minneapolis, November 1.—The John U. May Company, which was denied a franchise by the County Board of Supervisors along the river road from Davenport, Iowa, toward Clinton, has another project for a route between those cities—this time inland. It is claimed that it will be shorter and will take in a number of villages. The Illinois and Iowa company has the right to the river route.

The new electric-light plant at Garner, Iowa, has been completed and put in operation. The company is composed of home people, mostly of small means. Under the articles of incorporation no person can hold more than 50 shares of stock. The capitalization is $20,000. The plant cost $16,000.

The Western Electric Company of Jamestown, N. D., has been granted a franchise for a lighting plant for Carrington, N. D. The company was formerly the Jamestown Electric Light Company, but has changed its name. Improvements are in progress to the plant at Jamestown, including a new dynamo and an extension to the power station. The company will also erect a flat building adjoining the power station, of three stories.

The street-railway company of Muscatine, Iowa, will make extensive repairs to its system this fall, in preparation for the winter.

A site has been selected for a new power plant for the electric-lighting system for Lanesboro, Minn.

George E. Marvin, a lineman of the Public Service Company, St. Cloud, Minn., received a painful shock while attempting to remedy a burned-out arc lamp. The ground was damp and he wore no gloves. He took hold with both hands and was thrown to the ground by the shock, but could not let go. A companion, who wore rubber gloves, wrenched the lamp from his grasp. The manager of the company has given order that in the future when a lamp goes out, it is to remain untouched until the following day, when the current is off.

An electric railway is projected at Yakima, Wash., from Sunnyside, as a feeder to the Northern Pacific Railway.

Guttenberg, Iowa, has voted to grant a franchise for a private electric-light plant.

The Highland Canal and Power Company of Duluth has purchased the waterpower rights of the St. Louis River Water Power Company, commonly known as the Jay Cooke property. The engineers of the new owners claim that this gives them a total available power of 500,000 horsepower. The available fall under the Duluth Heights system is 740 feet, and of the St. Louis River Rapids, 370 feet. The available fall at Niagara is only 160 feet, and at Sault Ste. Marie, Mich., is but 17 feet. The power will be transmitted to points on the Mesaba iron range, northwest of Duluth, and elsewhere.

The interurban road which has been completed from Moline and East Moline to Watertown, Ill., may be extended to Port Byron. R.

Among the Rockies.

Salt Lake City, Utah, November 1.—The mayor and council of Brigham City, Utah, have signed a contract for the construction of a 30-inch wooden-stave pipe line from Brigham City to the Merrell Lumber and Salt Company for the Brigham City power plant, the bid of the company for laying the pipe line having been accepted. This will give Brigham City two electric plants instead of one.

All of the rails and trolley wire have been ordered for a new electric railway which is to be installed at Boise, Idaho, within a short time, and as soon as they arrive the work will be pushed to completion. Surveys have been made for an extension of the line to Caldwell from Boise.

The citizens of Montpelier, Idaho, have organized a company for putting in an electric-light system at an early date.

Superintendent W. P. Read of the Consolidated Railway and Power Company of Salt Lake, after a careful investigation of the various makes of car fenders, has decided upon adopting the Hunter fender, similar to those now in use in Cincinnati, Ohio, and will order their immediate shipment to Salt Lake City, where they will be attached to all street cars.

Springville, Utah, granted a franchise this week to Jesse Knight, C. E. Loose, S. R. Thurman, George Havercamp and others of Provo for an electric car line through Springville. Waterworks and electric lights are also to be installed in Springville at an early date. G.

On the Pacific Slope.

San Francisco, October 29.—The Board of Supervisors of San Francisco has called a special election to be held December 2d, for the purpose of voting on the issue of bonds to the amount of $700,000 for the acquisition of the Geary Street railroad system.

On October 22d the property, franchises, etc., of the San Joaquin Electric Company of Madera, Cal., were sold by order of the United States Court. The purchasers was Charles Monroe, representing the Mercantile Trust Company of Los Angeles, which in turn represented the bondholders of the company. The price paid for the road, franchises and other property, was $351,000. The property included all the stock of the Fresno Water Company, a subcorporation of the Fresno Electric Company, and all the franchises held by the company in Fresno, Madera and Kings Counties, as well as a large quantity of material, real estate, rights-of-way, power rights, etc. The sale has yet to be confirmed by the United States court, and the property will not be transferred until December 20th. At present it is in charge of J. J. Seymour, receiver.

Advices from Tacoma, Wash., state that the work of moving the city's electrical apparatus from the Tacoma Railway and Power Company's plant to the Tacoma Cataract Company's building was begun on October 20th, under the supervision of City Electrician Nisbet. The five-year contract with the Tacoma Cataract Company does not become effective until November 7th, but the city electrician decided to begin the work of removal early in order to install the panels without any serious interruption in the public-lighting service. The various circuits will be transferred one at a time.

The National Electric Company has been incorporated in San Francisco with a capital stock of $500,000. The incorporators are H. D. Hawks, W. F. Perry, F. V. Moebus, W. Ray, H. D. Morris, G. F. Page and E. C. Priber.

The Phœnix Electric Lighting Company, Limited, has been organized at Phœnix, B. C., for the purpose of supplying that city with electric lights. The company, which has a capital stock of $100,000, will take over the franchise recently granted to Messrs. Graves, Plummerfelt and Williams of Phœnix. The chief owners in the new company are also the leading stockholders of the Phœnix Water Supply Company, which put in a water plant at Phœnix last year. As soon as the Cascade power is available, the new company will take over the present electric-lighting lines in Phœnix, owned by the Greenwood Electric Company. A.

PERSONAL.

Robert K. Howard of Knoxville, Tenn., has been appointed superintendent of the Dayton, Springfield and Urbana Electric Railway Company.

Will S. Cook has resigned as superintendent of the electric-light and waterworks plant at Petoskey, Mich. He becomes superintendent of the Petoskey, Bay View and Northern Gas Company.

Edward Plaisted has been appointed manager of the Kenton Gas and Electric Company, Kenton, Ohio. He was formerly superintendent of the Columbus Electric Light and Power Company.

W. C. Ward, mayor of the town of Warren, Ohio, has tendered his resignation to become manager of the Peerless Electric Company of that city, which was incorporated some time ago, with a capital stock of $500,000.

G. R. Newcomer, an experienced electrical salesman, has formed a connection with the Columbia Incandescent Lamp Company of St. Louis, and will have charge of the territory served from Memphis, Tenn., with headquarters in that city.

The Indiana correspondent of the Western Electrician writes: "Harry Slough of Indianapolis has been assigned the district of Indiana in the gathering of statistics for the Census Department at Washington, on electric-light and street-railway franchises. Inspector Garber, from the Census Department, is in Indianapolis conducting the preliminary work. Mr. Garber is amazed at the magnitude of electric industries in the state."

The following changes have been made in the officials of the Cincinnati Traction Company, all of which are the result of Mr. Todd leaving the service of the company to take charge of the Rhode Island interests of the Philadelphia syndicate: Dana Stevens, promoted from treasurer to assistant general manager; William H. McAllister, from auditor to treasurer; Charles F. Callaway, from assistant auditor to auditor; E. H. Berry, from assistant engineer to engineer of roadways; C. E. Collins, appointed superintendent of construction.

Paul Hoffman, construction foreman for the Snoqualmie Falls Power Company of Seattle, Wash., received a fatal shock while tightening some screws on trusses in the sub-station in Seattle. It is supposed that some broken wires fell on the trusses and charged them. Mr. Hoffman had both hands on the truss and received a very heavy shock, which threw him forward with his face across the rod. He lingered for four days before death ensued. Mr. Hoffman was a superintendent on the Chicago Drainage Canal, but left there two years ago for the position with the Snoqualmie Falls Power Company.

The Michigan-Wisconsin football game at Marshall Field, Chicago, on Saturday, November 1st, attracted large numbers of students and faculty members from both universities, the engineering departments being well represented. Among those in attendance at the game were Prof. D. C. Jackson, professor of electrical engineering at Madison, and Prof. George W. Patterson, professor of electrical engineering, and Prof. John R. Allen, assistant professor of mechanical engineering at Ann Arbor. Prof. H. S. Carhart, professor of physics and director of the physical laboratory at Michigan, was also in Chicago on that day, engaged in giving expert testimony.

ELECTRIC LIGHTING.

The Calcutta (India) Electric Supply Company will increase its capital from $1,000,000 to $2,500,000 to extend its plant.

Extensive repairs and improvements are being made to the International Light and Power Company's plant at El Paso, Texas.

The Vincennes (Ind.) Electric Light Company was recently granted an extension of 25 years to its franchise by the Vincennes council.

The Bath (Maine) Light, Heat and Power Company, capitalized at $1,000, has been granted franchises allowing the supplying of light to Bath and adjacent territory.

The Woman's College of Baltimore, Md., has awarded a contract, at $11,099, to Crook, Horner & Co. for the installation of an electric-lighting plant and steam-heating system.

The Public Service Company of Columbus, O., has been incorporated. The concern was incorporated in West Virginia, and has been qualified to do business in Ohio. The capital stock is $500,000. The company is organized to operate an electric-light, heat and power plant in Columbus. The incorporators are William H. Sharp, A. S. Green, R. H. Sharp, C. L. Kurtz and Eli M. West. The company's plant will be erected at an early date.

E. Zorilla, general manager of the Spanish-American Light and Power Company of Havana, Cuba, has come to the United States to obtain an interview with Secretary Hay looking toward an intervention by the latter in the manner in which the Cuban authorities are treating the lighting company. Much of the company's stock is in the hands of United States citizens, and it is on behalf of these that Mr. Zorilla pleads. Much of the trouble arises from former orders of military officers issued during the American occupation.

The Oshkosh (Wis.) Electric Light and Power Company will soon commence work on its new power plant which is to be completed and ready for occupancy by January 15th. The structure will be built of brick and will have ground dimensions of 133 by 79 feet. It will be 18 feet to the eaves and will be topped with a slate roof. Another building will be built exclusively for a boiler room, which will be 72 by 45 feet in ground dimensions and be 36 feet high.

Wrightsville, Pa., will have a complete electric-lighting plant in operation by April 1st next. A company was formed a year or so ago and obtained a franchise from the Town Council. This company ordered part of its apparatus and then allowed the project to come to a standstill. A controlling interest in the old company was recently purchased by New Haven (Conn.) men, who are financing the present project. Waterpower from the Susquehanna River will be used.

A unique system of wiring has been recently installed in a new 12-story building in Providence, Rhode Island, built for the Union Trust Company of that place. Direct current is used, and iron conduits contain all the wires. The neutral bus-bar of the system is electrically connected to all the iron conduit piping, which is in turn grounded on the steel framework of the building. It is hoped, in this way, to do away with possible annoyance from electrolysis. All the pipe joints are bonded.

ELECTRIC RAILWAYS.

The Jackson and Albion (Mich.) electric railway is now being ballasted, and officials of the company assert that through cars will be running by January 1st.

The United Traction Company of Albany, N. Y., is considering the erection of a larger and more commodious transfer station in Rensselaer, N. Y. Inasmuch as the present one is used as a ticket station by the Albany and Hudson Railway Company, the two companies may reach some agreement whereby the building may be constructed and used by both.

It is reported that a plan has been laid before the Berlin (Germany) Municipal Council for an underground electric railway from the extreme north of Berlin through the center of the city to the suburb of Schoenberg, a distance of seven miles. Four years will be required for the construction of the road and its cost is estimated at $14,000,000, to be covered by a loan.

The Waukegan and Western Railway Company of Waukegan, Ill., has been incorporated with a capital stock of $50,000. The road is to be constructed from Waukegan in a westerly direction to the boundary line of Lake County. The incorporators and first board of directors are William H. Dodge, Clarence A. Murray, John W. Besley, Daniel A. Grady and William W. Pearce, all of Waukegan.

The Electric Equipment Company of Reading, Pa., has secured 51 per cent. of the stock of the Elmira and Waverly Railway Company, New York, and is making preparations to equip the road. The remainder of the stock is held by capitalists in Elmira, N. Y. Heretofore the New York street-railway commissioners refused to grant the necessary permission to proceed with the line because of alleged insufficient capital.

The London, Aylmer and North Shore Electric Railway Company, recently incorporated in Canada and New York, will have its head offices at Aylmer, Ont. American and Canadian capitalists are back of the enterprise. The directors are J. H. Hitchcock, New York city; Frederick Hitchcock and Frank Hasslock, Detroit, Mich.; C. Lenton, Robert M. Lenton and W. A. Dorland, Grand Rapids, Mich.; W. A. Stephens, M. E. Loyd, Aylmer, Ont.

South Haven, Mich., has granted a 30-year franchise for an electric railway which, it is said, in 18 months, will traverse a good share of the Michigan fruit belt. Work will be commenced early on the tracks, which next summer will be extended into interurban connection with Douglas on the north and Kalamazoo on the east. Eventually another spur will be run south to St. Joseph, and the line will run through almost the length of the fruit belt, with especial accommodations for carrying fruit freight.

Negotiations having for their object the formation of a combined electric-railway system to operate in opposition to the Norfolk (Va.), Portsmouth and Newport News Company are said to be under way. The Bay Shore company, the Chesapeake Transit Company and the Hampton Roads company are about the only concerns that are not in the Norfolk, Portsmouth and Newport News Company as the result of the combination formed on May 2d last. The Hampton Roads company operates between Newport News and Hampton, the Bay Shore lines run from Norfolk to Willoughby Spit, and the Chesapeake Transit Company has completed its road from Norfolk around Cape Henry and to Virginia Beach. A ferry across Hampton Roads would connect the first two roads, and a few hundred yards of track along Princess Anne Avenue would make the junction with the Chesapeake Transit Company complete.

POWER TRANSMISSION.

The Union River Light and Power Company of Augusta, Maine, has been incorporated to develop the waterpower of the Union River. The officers are: President, A. W. Jackson, New York city; treasurer, I. L. Halman, Boston, Mass.

SOCIETIES AND SCHOOLS.

At the tenth general meeting of the Society of Naval Architects and Marine Engineers, to be held at 12 West Thirty-first Street, New York, on November 20th and 21st, 16 technical papers will be presented, among which may be mentioned "Technical Training for Shipbuilders," by Henry S. Pritchett; "Vibration of Steamships With Special Reference to Those of the Second and Higher Periods," by Rear-Admiral George W. Melville, engineer-in-chief, U. S. N.; "The Possible and Probable Future Developments in the Use of Electricity on Board Ships," by F. O. Blackwell; "Submarine Boats, Their Present Development and Future Possibilities in Naval Warfare," by Lawrence Y. Spear.

TELEGRAPH.

Rapid automatic telegraph machines of the type invented by Pollak and Virag have been put into practical use between Budapest and Pressburg by the Hungarian government and are said to be giving the fullest satisfaction. The messages are delivered by the receiving machines on long slips of thick paper with firm, clear writing at the rate of 50,000 words an hour in all kinds of weather. The Pollak-Virag apparatus, before it was developed to its present stage of efficiency, was exhibited in this country about two years ago.

It is said that the Western Union Telegraph Company has discharged a number of its operators who have been prominent in the formation of a national union of telegraph operators. The attitude of the Western Union in the matter of the organization is being resented, and it is said as soon as the union becomes strong enough to enforce its demands it will insist upon an increase in wages being paid by the Western Union company. So far the Postal Telegraph-cable Company has remained neutral in the affair. Local organizations have been effected in Chicago, New York, San Francisco, Boston and other principal cities, and President Thomas of the New York local organization said recently that he expected 60 per cent. of all the telegraph operators of the United States would have a membership in the organization within a year.

PUBLICATIONS.

Munn & Co. of New York have issued a new edition of their little handbook relating to patents, caveats, designs, trademarks, copyrights, etc.

Recent bulletins issued by the Fort Wayne Electric Works of Fort Wayne, Ind., describe and illustrate their multiple-type, form C, enclosed alternating 104-volt arc lamps, electrostatic ground-detectors and small direct-current motors of type E. These motors with enclosed, semi-enclosed and open casings are also shown on the firm's November calendar card.

The October revision of the supplement to the National Electrical Code has just been issued by the Underwriters' Laboratories, Chicago. The publication contains a list of electrical fittings that has been examined and approved by the Underwriters' National Electric Association for use in installing electric wiring and apparatus. Copies of the supplement may be obtained from W. H. Merrill, Jr., secretary, 67 East Twenty-first street, Chicago.

The new illustrated catalogue of Holophane glass globes issued by the Holophane Glass Company, 15 East Thirty-second Street, New York city, shows globes made for arc, incandescent, Nernst, gas, pintsch, acetylene and kerosene lighting. A large variety of globes is shown by the various electric lights and also gas lighting. The company has published the first number of "The Holophane News," a sheet devoted to the interests of the company's product.

Three publications recently issued by the Christensen Engineering Company of Milwaukee depict that company's products in terse and attractive form. One catalogue is devoted to a thorough exposition of the Christensen straight air-brake equipments for electric-railway cars. The various devices that comprise the equipment are described and the function of each part is explained with the aid of diagrams and illustrations. Another publication shows where the Christensen air brakes are built and where they are used, the illustrations showing a number of views in the company's works, together with pictures of various types of cars that are equipped with the brakes. A long list of patrons shows that there are 6,410 Christensen air-brake equipments now in use throughout the world. The third catalogue is descriptive of the company's new line of Ceco electrical machinery, including direct-current motors

and generators, alternating-current generators and transformers, and is the first catalogue the company has issued on electrical apparatus. All of the catalogues are well printed and have attractive cover designs.

Dick, Kerr & Co. of London, England, are distributing to their patrons and friends some interesting catalogues descriptive of their field of electrical operations. One catalogue gives a detailed description of the works at Preston, England, of the English Electric Manufacturing Company, for which Dick, Kerr & Co. are sole selling agents. Views of the different departments are well illustrated by large pictures. A second catalogue with cloth covers illustrates with large plate engravings the line of continuous-current generators manufactured by this company. The line of rolling stock supplied by Dick, Kerr & Co. is shown in another publication, the cars illustrated being designed to meet widely differing conditions. "Electric Traction at the Cape" is the title of a well-illustrated description of the picturesque and interesting system of electric railways operated by the Camps Bay, Cape Town and Sea Point tramways at Cape Town, Africa.

MISCELLANEOUS.

Cincinnati (Ohio) capitalists have purchased the electric-light plant and the street railway at Zanesville, and have combined the two under the name of the Zanesville Railway, Light and Power Company. The company will be capitalized at $1,000,000 and the power plant will be greatly improved and enlarged and new machinery installed.

The natives of Morocco are becoming outspoken against the present ruler, and an overthrow of the government is imminent. The trouble is all due to the progressive ideas of the sultan, who has introduced the telephone, electric light and electric railway into his country. These foreign products and the superstition against electrical machinery have stirred up things to a dangerous state for both the foreigners and the sultan.

The city of Schenectady, N. Y., has been offered an electric fire engine by the General Electric Company. The engine is to be 12 feet long, 30 inches wide and 30 inches high, and will weigh about a ton. It will be provided with a cable that will allow it to be attached to a source of power not more than 200 yards from the fire. The electric power thus received will be used to operate the pump, which has a capacity of 1,500 gallons a minute. The advantages of this engine are that it can be operated at less expense than a steam engine, requires but one horse to draw it, and needs but one man to operate it.

This is an item floating about in the daily press: "The new image-transmitting apparatus of a Belgian engineer includes two synchronous motors, each about as large as an egg, which are mounted at the transmitting and receiving stations, and are driven at exactly the same speed of 500 revolutions per second by current from the same generator. Each armature carries a small lens, which, in every 50 revolutions, is oscillated through five degrees from the axis of revolution. The receiving lens, therefore, 'sees' over a circle of 10 degrees, and the luminous variations in the spiral path are instantly transmitted to the same points on the receiver, and by the second lens are thrown on a screen. The light and dark points of the spiral being passed through the selenium 40 times a second, the image on the screen appears continuous."

TRADE NEWS.

The War Department, through the Corps of Engineers, is inviting sealed proposals until December 4th for furnishing generator, engine, switchboard, boiler and storage battery for an electric plant at Fort Monroe, Va. Information will be furnished intending bidders upon application to the United States engineer, Custom House, Norfolk, Va.

Ray F. Nailler has filed a petition asking for the appointment of a receiver for the General Engineering and Construction Company of Akron, Ohio. The company was organized under the laws of Delaware with a capital stock of $25,000, of which $3,200 was issued. The concern was incorporated to manufacture and sell electrical apparatus, appliances and devices. Mr. Nailler asserts that the firm has ceased to do business and is unable to pay its debts.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until 2 p. m. on December 3, 1902, for the construction—including plumbing, heating and ventilating apparatus, electric wiring and conduits—of the United States postoffice at Emporia, Kan., in accordance with drawings and specifications, copies of which may be had at the office of the supervising architect or at the office of the postmaster at Emporia, Kan.

The H. P. Cameron Electrical Manufacturing Company, recently incorporated under the laws of Connecticut, has purchased the interests of the old company, which was organized under the laws of the state of New York. The new company will move into a new factory which is being erected for its use at Ansonia, Conn., about December 1st. The intention of the company is to install a complete line of new machinery for the manufacturing of all kinds of commutators, armature coils and electrical supplies in general.

BUSINESS.

The Electric Appliance Company, Chicago, is advising the use of arc lamps by merchants for store lighting. This is the season when advertising pays the local merchant, and a store cannot be advertised to better advantage than by being well lighted and therefore attractive. The company insists that there is one arc lamp a little better than all the others, namely, the Adams-Bagnall.

The Sherwin-Williams Paint Company of Cleveland, Ohio, is equipping all its works for electric power distribution. It recently purchased three alternating-current generators of 150, 120 and 75-kilowatt capacity, respectively, and about 500 horsepower in induction motors, which will be used to drive all the paint and varnish-making machinery. The company has also equipped its Newark (N. J.) works with one 75-kilowatt, alternating-current, engine-type generator and a number of motors, and is about to install a duplicate plant at the same works. At Pullman, Ill., the company is putting in a 120-kilowatt, alternating-current generator and one of 100 kilowatts, and about 200 horsepower in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric and Manufacturing Company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, October 28, 1902.

711,934. Automatic Weighing Scale. Charles L. Bond, Los Angeles, Cal. Application filed March 18, 1902.

Electrical means are adapted to weigh a given quantity of any substance, the substance being automatically cut off when any predetermined quantity is upon the scale.

711,935. Automatic Photographic Detector Device for Passenger Cars. Frederick W. Brooks, Brooklyn, N. Y. Application filed August 28, 1901.

See page 327.

711,941. Submarine Cable Telegraph. Albert C. Crehore, Hanover, N. H., and George O. Squier, United States Army, assignors to the Crehore-Squier Intelligence Transmission Company, Cleveland, Ohio. Application filed November 3, 1898.

In a telegraph the combination with means for generating a series of electromotive forces which gradually rise and fall and differ in sine as well as in value of a synchronously operating transmitting apparatus adapted to impress upon the circuit for the several characters of the code, a succession of elementary generated pulses of electromotive force differing from one another as to potential and polarity for different characters, so as to combine different values of electromotive force or potential with the elements of time and polarity to distinguish the characters of the code from one another. (See cut.)

711,942. Telegraphy. Albert C. Crehore, Tarrytown, N. Y. Application filed October 21, 1901.

In a quadruplex-telegraph apparatus the combination for the two sides of the double transmission at each station, of continuous-current and pulsatory-current apparatus, balancing branches for both sides of the system, ground branches or connections from which the balancing branches are derived, and an inductance in the ground branch or connection for the continuous-current side.

711,943. Telegraphy. Albert C. Crehore, Tarrytown, N. Y. Application filed March 8, 1902.

In a repeating apparatus for superposed-current systems, the combination with the differential relay on the pulsatory-current side and an inductance coil in one of the branches of a transmitter and means controlled thereby for taking the inductance out of circuit to render the repeating transmitter quiescent.

711,944. Electric Clock. Charles M. Crook, Bristol, Conn., assignor to the National Self-winding Clock Company, Bristol, Conn. Application filed September 30, 1901.

One claim describes a clock train having one of its shafts cranked between its bearings. There is an electromagnet on the clock frame with its armature and a lever on which the armature is carried, extending across the cranked shaft in the plane of the orbit of the crank-wrist, whereby when the magnet is energized the lever may drive the crank wrist to a point of its orbit most remote in the direction of the movement of the lever.

711,973. Signaling and Switchboard Apparatus for Telephone-exchange Circuits. David S. Hulfish, Chicago, Ill., assignor to the American Bell Telephone Company, Boston, Mass. Application filed November 5, 1901.

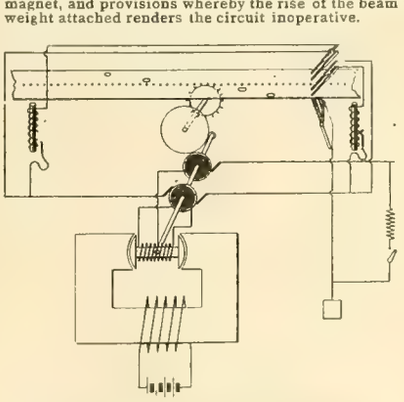
See page 332.

711,997. Process of Forming Electric Accumulators. William Morrison, Chicago, Ill., assignor to the Helios-Upton Company, Philadelphia, Pa. Application filed March 18, 1901.

A step in the process of producing active material, or material to become active, upon a lead structure for electric accumulators, which consists in partially disintegrating the lead structure in a solution containing a soluble fluoride and a nitrate, by passing a current of electricity from an extraneous source through the solution.

712,006. Weighing Machine. Walter E. Rice, Chelsea, Mass. Application filed May 27, 1901.

A weighing machine comprising a beam, a poise thereon, a detachable weight adapted to increase the weighing value of the poise, a latch automatically engaging by the descent of the beam for attaching the weight to the beam, a latch-releasing electromagnet, a circuit controlling the magnet, and provisions whereby the rise of the beam with weight attached renders the circuit inoperative.



NO. 711,941.—SUBMARINE TELEGRAPH.

712,026. Electric or Automatic Switch-throwing Mechanism. Joseph M. Walker, Newcastle, Pa. Application filed February 25, 1902.

In this device the essential parts are a casing, a solenoid supported by a cross-head in the casing, a plunger connected to the cores of the solenoid, a spring connected to the upper end of the plunger, a lower casing into which the plunger extends, a dash-pot within the lower casing for the plunger, a pair of vertically arranged disks within the lower casing, inwardly projecting pins carried by the cross-bar to engage the pins, a link connected to the lower ends of the hooks, and an operating rod connecting one of the disks with the switch tongue.

712,041. Exciting Dynamo. Harold W. Buck, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 2, 1898.

One claim is: "The combination of a direct-current dynamo-electric machine and means for exciting one member of the machine by wattless current flowing in the other." Another: "The combination of a direct-current dynamo-electric machine and condensers in multiphase relation to the armature winding." (See cut on next page.)

712,046. Means for Attaching Commutator Leads. William F. Dawson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 27, 1901.

The commutator bar is combined with a seamless metal tube which has had its lower walls pressed together to form a pocket or depression to receive the commutator lead.

712,050. System of Electrical Distribution. Harold Edwards, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 30, 1901.

A motor-driven booster having a plurality of field windings, one of which is in series with the armature of the booster, another in series with the driving motor, and a third constantly excited from a suitable source.

712,052. System of Electrical Distribution. Hermann F. T. Erben and Arthur F. Knight, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed April 8, 1901.

The combination in a booster of a winding in series with its armature and a constantly excited differential winding adjusted so that the booster generates practically no voltage at no load.

712,056. Microphone for High-tension Currents. Raoul Gaillard and Eugène Ducretet, Paris, France. Application filed March 3, 1902.

In a microphone the combination with a striated conducting plate, a ring of soft velvety material mounted upon the plate and a vibrating membrane placed above the ring, of strips of flexible material dividing the space between the plate and membrane into a number of independent compartments, and a variable resistance of granulated material filling the compartments.

712,057. Dentist's Electrical Annealing Furnace. Nathan K. Garhart, Indianapolis, Ind., assignor to the Garhart Dental Manufacturing Company, Indianapolis, Ind. Application filed August 22, 1902.

An electric heater is arranged for dentists' use.

712,060. Overhead Electric Conductor. Robert Hacking, West Bridgeford, England. Application filed February 26, 1901.

In a system of overhead electric conductors, the combination of a conductor forming the lead, an ear to which the conductor is attached, a return conductor, a contact piece connected to the return, and a member on the side of the ear having its outer end rigidly connected to the lead at a point which is a distance from the end of the ear and forming a branch of the lead having a free inner end which is moved by the bending down of the lead into contact with the contact piece.

712,063. Anti-creeping Device for Electric Meters. Caryl D. Haskins, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 30, 1901.

The anti-creeping device consists of co-operating parts arranged to prevent creeping and to retard and accelerate the meter alternately when the latter is in normal operation.

712,076. Blue-printing Machine. Samuel L. G. Knox and William O. Wakefield, Schenectady, N. Y. Application filed March 3, 1902.

Electric lamps form the best source of light for this machine, which consists essentially, of a horizontal stationary, cylindrical segment of glass, with means for securing the work to the outer surface of the segment. The lamps are placed near the axis of the segment.

712,090. Electric Meter. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 15, 1901.

There is a circuit upon which is impressed an electromotive force varying with the quantity to be measured. An electromotive-force generating device is connected in opposition in this circuit, and means are provided for controlling the latter device so as to maintain an approximate balance between the electromotive forces in the circuit.

712,103. Polyphase Induction Regulator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 27, 1899.

See page 326.

712,104. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 11, 1900.

See page 326.

712,106. Electric Meter. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 13, 1898.

The combination in a motor meter of a fan, a motor for actuating the fan, a contact for controlling the circuit of the motor, means tending to close the contact with a force proportional to the square of the current flowing, and a vane actuated by the pressure of air from the fan for opening the contact.

712,107. Thermal Cut-out. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 11, 1899.

A thermal cut-out comprising a fuse surrounded by an inclosing non-conducting tube, one end of which is closed and the other open to the atmosphere. The fuse extends through the open end of the tube and is fixed outside of it between its ends.

712,112. Illuminated Watch Box. Carolus Arnold, Hamburg, Germany. Application filed January 14, 1902.

This German novelty consists of a casing for a watch containing also a small battery. The lid of the box has a miniature incandescent lamp, which is thrown into circuit when the lid is raised.

712,131. Insulated Rail Joint. George L. Hall, Brooklyn, N. Y. Application filed January 18, 1902.

A fish plate for rail joints comprises two parts, each having a portion adapted to fit in the web of the rail, and an offsetting lug adapted to match with a similar lug on the other part. A bolt or bolts pass through the lugs. Insulating material is placed between the lugs and also between every one of the bolts and every one of the lugs

712,132. Insulated Rail Joint. George L. Hall, Brooklyn, N. Y. Application filed February 12, 1902.

Details of a rail joint are described.

712,134. Electric Time Switch. Miller R. Hutchison, Upper Montclair, N. J., assignor to the Hutchison Acoustic Company, New York, N. Y. Application filed November 22, 1901.

Features of this invention are a double-compartment vessel containing a liquid, means for causing the liquid to flow from one compartment to the other, means whereby the rate of flow from each compartment to the other can be predetermined, and two electric circuits respectively under control of the liquid flowing in the two directions. (See cut.)

712,138. System of Electric-railway Signals. Earl P. Jessop, United States Navy. Application filed March 15, 1902.

The combination with the grounded rail of a double conductor arranged in sections, each the length of a block, a source of electricity for each block connected to one conductor at its forward end, a connection between the rear end of the same conductor with the front of the succeeding conductor on the opposite side contacts on the locomotive engaging with the conductors, a circuit connected with the contact embracing a magnet, a brake-controlling device actuated thereby, and a connection between one of the contacts and the grounded rail.

712,149. Electric Lamp Socket. Henry T. Paiste, Philadelphia, Pa., assignor to William P. Pinckard, Birmingham, Ala. Application filed April 6, 1901.

This is a turn-down lamp having two or more filaments. The mechanism is such that the light may be regulated by varying the line connections of the filaments.

712,153. Method of and Apparatus for Electrodeposition of Metals. Charles J. Reed, Philadelphia, Pa. Application filed August 1, 1901.

An electrolytic apparatus comprising a mixture of liquid electrolyte and an inert or non-conducting granular substance, in combination with two electrodes or sets of electrodes located in the mixture, and one of which receives the metallic deposit, and means for producing relative movement between the last-named electrode or electrodes and the mixture. (See cut.)

712,174. Synchronism Indicator. Joshua F. Begole, St. Louis, Mo., assignor to the Wagner Electric Manufacturing Company, St. Louis, Mo. Application filed June 9, 1902.

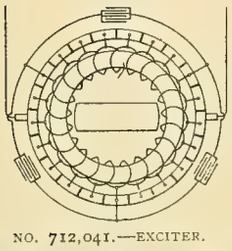
There are two sources of alternating current, a voltage indicator energized from these sources, and a phase indicator comprising two coils, one of which is movable relative to the other. One of the coils is supplied with current from one of the sources and the other of the coils is supplied with current from the other source. (See cut.)

712,178. Separator for Storage-battery Plates. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York, N. Y. Application filed May 13, 1901.

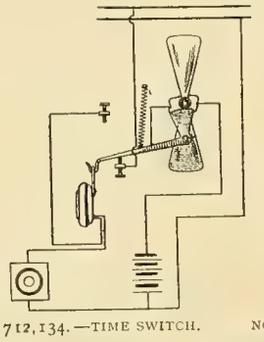
A separator for storage batteries, consisting of a perforated plate of non-conducting material having on its flat faces upright spacing ribs adapted to bear against the electrode and provided at its upright sides with flanges which project both in the same direction and are of greater width than the spacing ribs.

712,201. Signal for Traveling Cables. Mortimer Norden, New York, N. Y., assignor to the Norden-Bittner Electric Company, New York, N. Y. Application filed November 23, 1901.

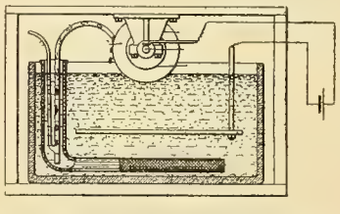
The combination with a traveling cable and supports for maintaining it in position of slabs of insulating material between which the cable passes and a metallic conducting means extending across the path of the cable and secured to the slabs and having an aperture through which the cable passes. Electrical connections to the conducting means are provided, and a device is connected to a slab of insulating material and bearing upon the cable with electric connections therefrom, by which an alarm is brought into action by a broken strand or projection from the cable.



NO. 712,041.—EXCITER.



NO. 712,134.—TIME SWITCH.



NO. 712,153.—ELECTRODEPOSITION OF METALS.

712,204. Automatic Switch for Fuse Wires in Electric Circuits. Edward W. Pelton, Springfield, Mass. Application filed November 30, 1901.

In an electrical circuit a series of successively arranged safety connections between the two parts of the line, each including a fusible section and a switch, and a fuse-restrained trip for each switch.

712,218. Electrolytic Cell. Arthur E. Truesdell, Pittsfield, Mass. Application filed April 13, 1901.

Invention is allowed for the combination of a vat, a fluid-metal cathode, a container therefor, a suitable anode, a source of electricity, suitable connections from this source to the cathode and anode; whereby, under operative conditions, an amalgam may be formed on the cathode. Other features are a channel having an inclined bottom at the side of the container, means for removing the amalgam to the channel, an outlet from the lowest point in the latter and a trap in the outlet.

712,220. Automatic Medical Electrical Apparatus. Alexander F. Vetter and Joseph C. Vetter, New York, N. Y., assignors to the Vetter Manufacturing Company, New York, N. Y. Application filed February 26, 1901.

This apparatus is provided with a set of electrodes differing in resistance, and forming a means for increasing or diminishing the current flow.

712,257. Armature for Dynamo-electric Machines. James Burke, Berlin, Germany. Application filed January 6, 1900.

An armature having means for diverting the magnetism, or a portion of it, from the central portion of the armature into the teeth while the latter are in the commutation zone, and thereby magnetically saturating the teeth.

712,316. Electric Accumulator. François Loppé, Henry P. Morin, Georges J. A. Griner and Denis P. Martin, Paris, France. Application filed October 26, 1899.

Perforated plates, the walls of the perforations having conical projections with an active mass arranged between the plates, metal distance pieces arranged between the plates at one end, and perforated rivets connecting the several plates are described.

712,333. Electric-railway Signal. Charles V. Richey, Washington, D. C., assignor of one-fourth to Leonard C. Bailey, Washington, D. C. Application filed April 8, 1902.

One track rail forms a continuous conductor, the other is divided into blocks or sections. Batteries are provided at the junction points of the sections, each battery having one pole connected to the end of one section and the other pole to the contiguous end of the next section, the ends of a section being connected to similar poles of adjacent batteries, whereby the sections are made alternately negative and positive. A signal is in circuit with each battery.

712,346. Photometer. Eugene T. Turney, San Francisco, Cal. Application filed June 23, 1902.

The combination of a screen, a light box covering one face of the screen, an electric lamp located within the light box and adapted to produce the measuring light, controllable means for varying the current supplied to the lamp and an indicator operatively related to the controllable means.

712,397. Photometer. Charles P. Matthews, Lafayette, Ind., assignor to Louis B. Marks, New York, N. Y. Application filed March 24, 1902.

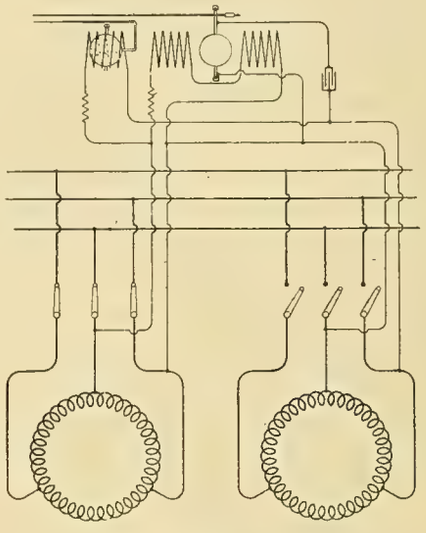
See Western Electrician of last week, page 313.

712,402. Telephone Attachment. George T. Newman, Bonaparte, Iowa. Application filed September 6, 1901.

See page 332.

712,440. Insulator. James L. Shreffler, Lewistown, Pa. Application filed April 2, 1902.

Features of this insulator are a metallic exterior casing, a slot or recess formed in this casing, a screw-threaded rod threaded through the casing, a concaved plate swiveled to the lower end of the screw-threaded rod and located within the slot or recess, a thumb-nut secured to the upper end of the screw-threaded rod, an inverted cup-shaped cap of non-conducting material embedded within the casing, a bolt, an enlarged head formed upon the upper end of the bolt, the upper end of the bolt being embedded within the interior of the non-conducting cap.



NO. 712,174.—SYNCHRONISM INDICATOR.

712,447. Magnetic Medicine Holder. Leonidas G. Woolley, Kenton, Ohio. Application filed May 23, 1902.

A goods-holder, consisting of a horseshoe magnet, non-magnetic side plates, the upper ends of which extend beyond the pole ends of the magnet. These ends have apertured ears, and a keeper is pivotally mounted on the ears to close down on the pole ends of the magnet and form a closure member.

712,451. Exciting Dynamo. Harold W. Buck, Niagara Falls, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed September 2, 1898. Divided and this application filed March 31, 1902.

The method of impressing a magnetomotive force upon the field magnets of direct-current dynamo electric machines, which consists in artificially producing phase-displaced currents in conductors movable relatively to the field magnets.

712,455. Busy-test System. David S. Hulfish, Chicago, Ill., assignor to the American Bell Telephone Company, Boston, Mass. Original application filed November 5, 1901. Divided and this application filed April 5, 1902.

See page 332.

712,457. Electric-signal System for Railways. Earl P. Jessop, United States Navy, assignor of one-third to Dudley W. Knox, United States Navy. Application filed April 5, 1902.

The combination, in an electric signal system, with a track circuit, adapted to be completed by the movement of a track signal, of a car circuit embracing a magnet, a release valve operated thereby and a hook for retaining the valve in operative position.

712,463. Polyphase Induction Regulator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed February 27, 1899. Divided and this application filed March 27, 1902.

See page 326.

712,464. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed July 11, 1900. Divided and this application filed March 31, 1902.

See page 326.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, NOVEMBER 15, 1902. No. 20

Machinery Hall of Armour Institute.

The rapid growth of the Armour Institute of Technology of Chicago during the last few years has resulted in serious crowding in the main college building, and has made necessary the new structure, known as Machinery Hall, which has just been completed and was occupied for the first time at the opening of this fall's term. The new building is used exclusively for shop purposes and is admirably designed and equipped for this work. The building, shown in Fig. 2 on the next page, occupies the northwest corner of Armour Avenue and Thirty-third Street, directly across the street from the main building of the institute. It has a frontage of 84 feet on Thirty-third Street and 50 feet on Armour Avenue, and is constructed to conform in general appearance with the other buildings, its basement and first floor being of stone and the upper stories of red pressed brick. The cost of erection was about $150,000, which amount was the gift of Mrs. Philip D. Armour.

The building has four floors and a basement. Each of the four floors is given up entirely to a separate shop, the general arrangement of all the floors being the same. In the southeast corner of each floor (the corner nearest the observer in Fig. 2) is located a small lecture or demonstration room seating 40 students and arranged to be used in conjunction with the practical work given in the shop immediately adjoining. In the southwest corner is a large space given up to lockers and lavatories. In each room there are 120 students' lockers, constructed of expanded metal, and all modern sanitary and plumbing conveniences are provided. Between the locker and lecture rooms is the stairway and elevator shaft, back of which and connecting with the elevator is a tool room. The remaining space on each floor, extending the whole length of the building on the north side and occupying some 3,600 square feet of floor space, is devoted to the shop work proper, entrance being had through a door from the main hall and also through one from the lecture room.

The disposition of the different shops is perhaps somewhat unusual, but was made for good reasons that are well borne out in practice. On the first floor is located the forging and blacksmith shop, this being advisable on account of the heavy foundations required for the heavy hammers of this shop. This arrangement is also better for the reason that the blowers for the forges can be located in the basement and piped along the ceiling to a point under each forge on the floor above. The next heaviest machinery, that of the machine shop, is placed on the second floor, and the third floor is devoted to the wood-working and pattern shop. This leaves the assignment of the foundry to the fourth or top floor, which is advisable, as the fumes and gases of this department can be carried off through the roof without inconvenience to the other shops.

The equipment of the forge shop (a portion of which is illustrated in Fig. 5) consists of 15 down-draft forges, 12 power forges and a hand forge, a 200-pound steam hammer and a power hammer, a coke furnace, a 20-inch drill press and a 16-inch double emery grinder. Both hammers are served by a jib crane for heavy work. In the basement a 20-horsepower electric motor is used to drive an exhaust fan and blower and also a swing saw for cutting up stock. A steam-fitting equipment with seven pipe benches is arranged on the east side of the room, the apparatus including a six-inch pipe-threading machine driven by a five-horsepower motor. In the lecture room on this floor are a down-draft forge driven by a 2.5-horsepower motor suspended on the ceiling and an anvil for use in the instructor's demonstrations.

A full line of machine tools is located in the machine shop, the equipment comprising 13 engine lathes of different sizes up to 26-inch, three speed lathes, a Diamond grinder, and a Brown & Sharpe universal grinder, surface grinder, and cutter and reamer grinder. There are also three milling machines, a 30-inch planer, two shapers, a complete line of drill presses, a screw machine, a horizontal boring machine, a lathe center grinder and a twist-drill grinder. All this machinery is driven through line shafting by a 30-horsepower motor, located on the floor in the center of the room, as shown in Fig. 4. Other apparatus in the machine shop includes a gas furnace for brazing and tempering, various tools for working in iron, steel or brass, and along the walls 30 bench vises, with full sets of machinists' tools. The lecture room on this floor, shown in Fig. 1, may be taken as typical of all the lecture rooms, the equipment consisting of an engine lathe and a bench-tool grinder, both driven by a three-horsepower motor on the ceiling. At the right of the picture may be seen the starting box for the motor and a wall cabinet, which contains all the switches and fuses for the lights and motors on this floor, mounted on a brown slate panel. This board also controls an arc-lamp stereopticon, used in demonstrating before the class. Each of the lecture rooms is provided with a similar stereopticon, and a collection of about a thousand lantern slides of various engineering drawings and machinery pictures aids the instructors materially in their lectures.

The equipment of the woodworking and pattern shop includes 33 12-inch lathes, an eight-inch pattern lathe, four six-inch pattern lathes, two band saws, a circular saw, a vertical boring machine, a 26-inch surfacer, a three-side four-inch molder, scroll saw and gluing bench. The surfacer and other heavy machines are driven by a 15-horsepower motor and the many lighter machines by a 20-horsepower motor. Around the shop are 40 benches with vises, each bench being provided with a complete set of hand tools. The lecture-room equipment consists of a five-foot patternmaker's lathe and a patternmaker's bench, with all necessary tools, the lathe being driven by a three-horsepower motor.

The completeness and modernness of the equipment which characterizes the three shops just described extend also to the foundry, shown in Fig. 3. Here are located a 22-inch Whiting cupola, with a capacity of one ton per hour, a set of forced-draft brass furnaces and a portable core oven. A five-horsepower motor directly drives a blower for the cupola. A one-ton crane with a five-inch air hoist runs the length of the shop. The air compressor for running the hoist, a molding machine, an emery wheel and the blower for the brass furnaces are driven by the five-horsepower motor seen mounted above the tool room in Fig. 3. The shop is divided into floor molding and snap-flask molding, for which there is provided the usual set of flasks, etc. A system of tracks is arranged to take the heavy ladle from the cupola to any part of the floor. An extension on the roof above the elevator shaft, seen in Fig. 2, is provided, so that the elevator may be run up higher than the top floor to charge the cupola. The skylights in the roof of the foundry are arranged on the saw-tooth principle, as seen in Fig. 3.

In the basement under the lecture rooms is located the office of Professor George F. Gebhardt, who has charge of Machinery Hall. The remainder of the basement is used for storage purposes and for the electric elevator equipment, an engine-driven ventilating fan and a Yeomans 2½-horsepower electric motor, direct-connected to a centrifugal house pump. All the current for the power and lighting in the building is supplied at 110 volts from the main power house of the institute, through underground cables, the point of distribution being a marble panel in the basement. The general lighting throughout the building is supplied by 24 enclosed-arc lamps, and about 250 incandescents are used for special lighting. The window lighting of all the rooms is especially good.

The capacity of each shop is about 30 students during a period which lasts three hours. Three periods can be arranged a day, thus giving a capacity for 360 students a day. At present there are 450 students taking shop work, most of whom work only two periods a week. The shops are also used at night by the evening classes, which were recently inaugurated at the Institute and which are well attended and popular. Including the evening classes, the total enrollment of the Armour Institute this year exceeds 1,000 men.

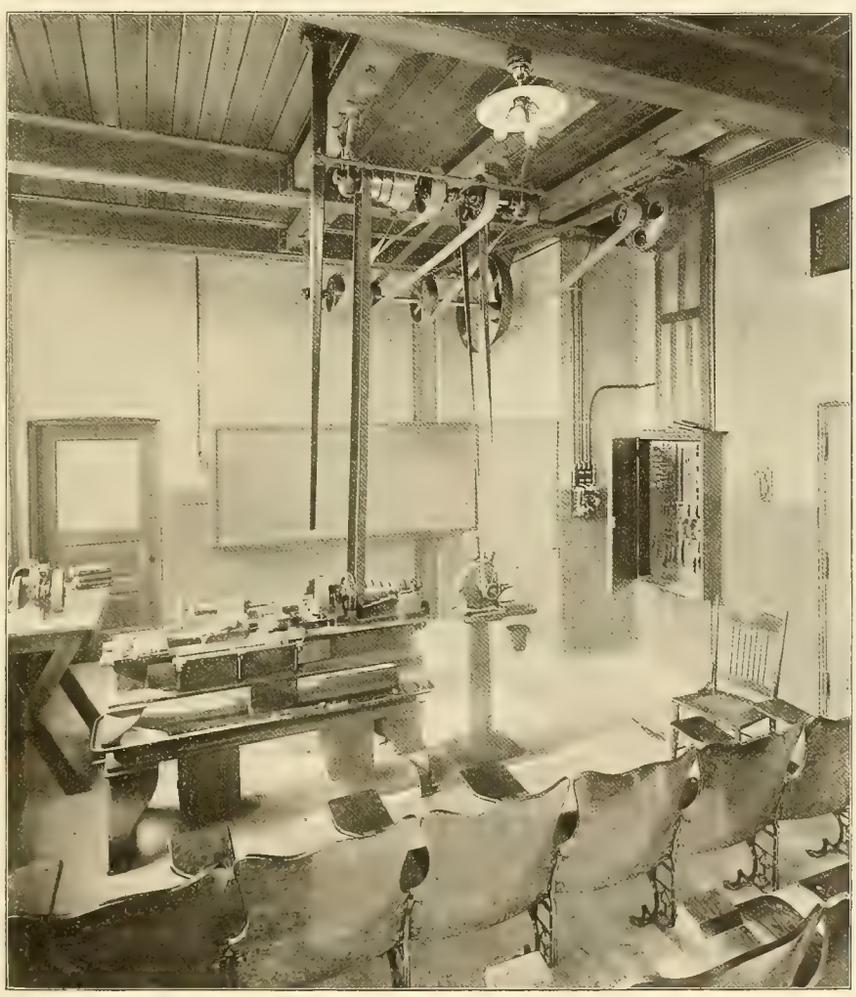


FIG. 1. MACHINERY HALL OF ARMOUR INSTITUTE.—LECTURE ROOM FOR MACHINE SHOP.

A tunnel under the Quirinal in Rome was opened recently with ceremonious display by the Roman Street Railway Society. The tunnel is 350 meters long, and the walls which are being covered with white majolica, are illuminated with eight large electric lamps. On the opening day all the cars entering the tunnel were adorned with flags, and on issuing refreshments were served to all those who took part in the inauguration. Half the fares of the first two days went to the sufferers in Sicily.

Development of a Small Alternating-current Motor.[1]

By H. I. Finch.

The smallest electrical machines that are used commercially are the small electric fan motors which are year by year becoming considered as more of a necessity than a luxury. They have been so perfected that they are sure in operation under very adverse conditions, and both their first cost and also the cost of operation have been brought to a figure that is almost nominal. I will give you this evening a short account of the development of fan motors for alternating-current circuits. While it has not extended over a very long period of time, and has shown comparatively little change in the external appearance of the motors, the character of the working parts has undergone radical changes.

The history of the direct-connected fan motor began in the early '80's. The idea of connecting a "screw propeller" fan to a small motor originated with Dr. S. S. Wheeler, now president of the Crocker-Wheeler Company, while he was developing a motor to be operated from primary batteries in 1885. At that time about the only circuits available for such a motor were the series arc-lighting circuits. But few motors were made and operated from these circuits, and they were both dangerous and uneconomical.

During the next three years the low-potential, constant-current circuits for incandescent lighting were developed, and in 1888 fan motors were very successfully operated from these circuits, each motor taking the place of a lamp. With the general introduction of the central-station current and its availability the fan motor became popular, and by 1890 it had become a regular article of manufacture.

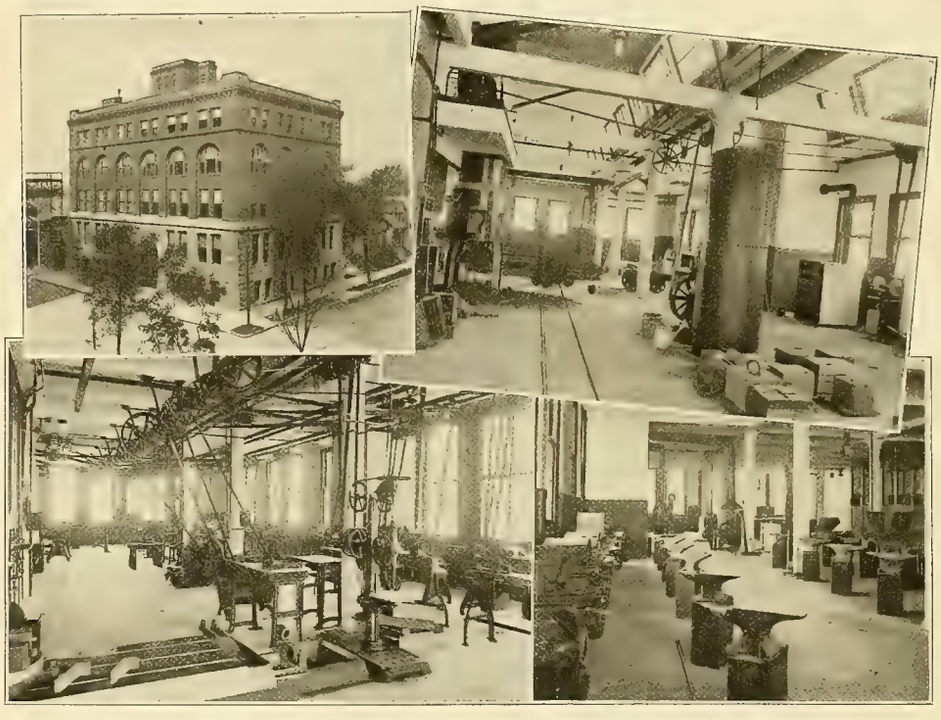


Fig. 2. Exterior View.
Fig. 4. Machine Shop.
Fig. 3. Foundry.
Fig. 5. Forge and Blacksmith Shop.
MACHINERY HALL OF ARMOUR INSTITUTE (PAGE 341.)

While the direct-current fan motors were the pioneers in the field, those for alternating current came soon after. About 1890 the Westinghouse company brought out an induction fan motor, but it was so inefficient that it could hardly be called a commercial success.

In 1891 two types of motors were placed upon the market, both of which were more or less successful. They were designed to operate upon circuits of 133 cycles, which was the most common periodicity at that time. One was of the series motor type, manufactured by the Wagner Electric Manufacturing Company of St. Louis and the other was a magnetic motor of the rotary-field type, manufactured by the Emerson Electric Manufacturing Company, also of St. Louis.

The series motor was of the now well-known type having the field and armature coils connected in series, the same as a series direct-current motor. The armature was wound similarly to a direct-current motor, and a commutator and brushes were necessary. This type of motor was not destined to a permanent success, on account of the sparking at the brushes and consequent commutator troubles, which rendered considerable attention necessary and made repairs expensive. This type of motor was later manufactured by several different companies and a modified motor of this type is still being made.

The magnetic motor was the Meston motor, designed by A. W. and C. R. Meston. Its special feature was its speed regulation, any speed up to 1,650 revolutions per minute being obtainable by movement of the switch lever. It was supplied with carbon brushes and a tempered copper commutator, which was very easily renewed at a slight expense. The motor was fitted with a six-blade 12-inch fan and it threw a very large volume of air with a very low current consumption. The fan was very similar in appearance to the types which are being made at the present time.

The Meston motor was a very unique motor in many ways. The field and armature were, of course, laminated, made up of punchings of sheet iron of the shape shown by Fig. 6 (next page). The field is six-pole and the armature two-pole. The armature was made up of these laminations clamped together and contained no wire or copper. In the recesses on each side were placed connected brass tubes, each of which carried a carbon brush. One of these brushes made contact with a copper plate mounted on the motor cover and connected to one of the binding posts, and the other rotated over a stationary six-segment commutator, of which the diametrically opposite segments were connected together. (Fig. 1.) These cross-connections of the commutator are not shown by the illustration. The diametrically opposite coils of the field were also connected together in pairs, the coils of each pair being in series and so connected to the commutator as to bring each pair into circuit in succession as the armature rotated, giving a perfect rotary field, which pulled the armature along with it.

Fig. 1 shows the coil connections, the two views being the two sides of the motor, with the connections on that side. The current enters from the binding post through the brushes and brush-holder to the commutator, from the commutator to one pair of coils, and back through the pin shown in the view of the binding-post end to the other binding post.

To start the motor the commutator is rotated by moving its lever, the connections being flexible, as shown, to allow this to be done, until the field poles in advance of the armature poles are energized, when the motor starts. As the armature rotates, the brush moves over the commutator, energizing the field poles just in advance of the armature poles, thus drawing on the armature and repeating the cycle. The speed was dependent upon the lead given to the field by the position of the commutator.

This motor would develop from one-twentieth to one-fifteenth actual horsepower, and had a wide speed variation and good starting torque. On account of its speed variation, it was practicable to use it on circuits of almost any frequency, by transforming to the proper relative voltage. Because of the fact that when in operation only two of the six field coils were energized at any one instant, the heating effect of the current was reduced to a minimum, and the efficiency of the motor was a maximum.

As an evidence of the success of this type of motor, the fact may be stated that a large proportion of those made from 1892 to 1897 are still in operation. But, notwithstanding the fact of higher efficiency and perfect speed regulation, with the perfection of the induction motor and the general adoption of 60-cycle current, this type was superseded, principally on account of the inherent spark at the commutator and the necessary occasional renewal.

While the first induction type of fan motors dated back to about 1890, it was several years later before they were sufficiently perfected to be classed as a commercially successful article. At this time the greater proportion of the alternating current available was still of 133 cycles, but current of 60 cycles had come to be recognized superior for power service and fully as satisfactory for lighting service.

The induction fan motors were made with eight poles for 133-cycle current and with four poles for 60 cycles, both having laminated field and squirrel-cage ironclad armatures. (Fig. 5.) This gave a nominal speed of 2,000 revolutions per minute for 133 cycles and of 1,800 revolutions per minute for 60 cycles when running up to synchronism. The speed under efficient load falls from five per cent. to 10 per cent. under this.

The field coils were connected in series and through a switch directly to the binding post of the motor. The armature contained no insulated wire or copper, making it practically indestructible. For starting torque, the split-pole phasing coils were utilized, which made a leading or a lagging pole, depending upon the character of coil used. While this starting torque was weak, still it was quite definite, especially if efficiency were sacrified a little for it.

Fig. 5 shows a standard shape of field and armature punchings for an eight-pole motor for high-frequency current of from 125 to 140 cycles. These punchings are used in the motor for high frequency, which we have before us [indicating]. The slot in the center of the field poles is for the starting or phasing coils, which are wound around one-half of the pole to give a movement to the magnetic pole center, in order to make the motor self-starting.

The main coils are, of course, wound to give alternately north and south poles, and they are connected in series and to the line through a single-pole switch. For speed regulation additional coils wound outside or upon the main coils are sometimes used, but usually a resistance or choking coil is put into the motor base.

The armature is of the ironclad, squirrel-cage type, the round bare copper conductors being headed, and riveted and soldered to copper punchings, which are used for the outside laminations on each side.

As the starting is one of the most important details of the induction fan motor, I will give a short description of the various kinds of phasing coils. None of them gives a full-load start, but for a fan motor this is not necessary, as the load is gradually applied automatically as the fan attains speed.

Perhaps the most common form is the solid ring of copper, entirely uninsulated, which makes a short-circuited secondary around one-half of each pole, that is in circuit continuously. A modification of this form is the use of a comparatively large size of insulated copper wire or strip, wound on one-half of each pole in the same direction as the main coil of that pole, connected all in series and short-circuited through the motor switch in such a way as to allow this circuit to be opened by movement of the switch handle. The efficiency of the motor is considerably increased by the elimination of the losses in the starting coils after speed is attained, but this arrangement has the objection, that if the current is interrupted for a short time, the motor is not self-starting, unless the switch is moved back to the starting point.

Another form is the use of fine-wire coils of the same polarity as the main coils, wound around one-half of the pole, all the coils being in series and connected in multiple with the main coils across the line voltage. This form can also be connected through the motor switch in such a way as to allow of its being open-circuited after the motor has attained speed, thereby eliminating the incident losses. All of these forms of winding give a weak start to the motor, but all give quite definite action with the use of a small additional amount of current.

We have still one other form of winding which gives a strong and positive start, but by the use of a comparatively large amount of current for a few seconds. This form requires a fine-wire coil, but, instead of being wound around one-half of one pole, it includes one-half of each of two poles, being wound from the slot in one pole to the slot in the next. The coils are alternately north and south, and because of their including poles of opposite polarity, their self-induction is zero, and they allow the passage of an abnormal amount of current, which gives an auxiliary field at 90 degrees from the regular working field, and makes the start positive. These coils are all connected in series, and the series is in multiple with the main coils across the line voltage, but connected through an automatic cut-out, which opens the circuit through the fine-wire coils after a certain speed is attained. This is necessary to prevent these coils being burned out by the excessive current which they take. This form of winding is found in the high-frequency motor we have here.

Nearly all of the alternating-current desk fan motors which we find on the market at the present time are of the types and have the forms of windings just described. The 60-cycle or 7,200-alternation current is the standard at the present time, and for this frequency the development has been carried a little farther by the Emerson Electric Manufacturing Company of St. Louis, by the adoption of an ironclad field-pole surface, completely surrounding the ironclad armature, thus giving the maximum area possible to the air gap.

Fig. 4 shows the form of the field and armature punchings. The ironclad field-pole surface is obtained by making the field toothed. The disk is only five inches in diameter, the small size being made practicable by the increased polar surface. There are 24 teeth in this field punching, and, as the motor is made four-pole, this gives six teeth to the pole. The main coil for each pole is wound in three sec-

1. Paper read before the Chicago Electrical Association at Chicago on November 7, 1902. Mr. Finch is assistant superintendent of the Emerson Electric Manufacturing Company of St. Louis, Mo.

tions, the inner section including one tooth, the next section three, and the outer section five. This gives a gradually shaded pole, with a uniform length of air gap. In the usual types the shaded effect is obtained by gradually increasing the length of the gap from the center toward the edges of the pole.

The starting torque is obtained by the use of phasing coils, wound from pole to pole, which give an auxiliary field at 90 degrees from the working field, giving a definite and strong start. Fig. 3 shows the complete wound field and armature of this motor. The outer coils are the main coils, wound in sections, as you see. The auxiliary coils are the starting coils. The armature is of the standard ironclad, squirrel-cage type, having round, bare copper conductors, riveted and soldered to copper punchings, which are used for the outside laminations on each side.

This motor is especially suited for use on circuits of very low frequency, for the character of the field punching allows of its being made into the very best two-pole motor possible, by a simple change in the field winding. It is then suitable for use on current of from 25 to 35 cycles, as a four-pole motor gives too slow a speed with these frequencies to be satisfactory.

In addition to the character of the field iron and winding, this motor has a number of other very valuable and unique features. Both the field-pole surface and the armature surface are ground perfectly smooth and round, thereby making it possible to work with the very smallest clearance, and at the same time giving full, clean iron surfaces, which are of the greatest importance in alternating-current machinery.

Fig. 2 shows the details of the shaft, armature, oiling device and fan hub.

The shaft (M) is a hollow steel tube of an exceptionally large diameter for this class of motor. It is case-hardened and very accurately ground, having a taper of one-half of one-thousandth of an inch to each inch of length. The nominal diameter is one-half inch, or, to be exact, it is 0.485 inch at the front end and 0.487 inch at the back end. This taper allows of very accurate fitting of the armature (P) to the shaft, and gives greater smoothness of operation. In contrast with the usual desk fan-motor shafts of soft steel five-sixteenths inch or three-eighths inch in diameter, the superiority of this construction is marked. The shaft is stationary, being driven rigidly into the hub of the back cover (B) of the motor, the armature revolving upon the shaft and being held in place by a retaining screw (I) and washers (G and H) in the front end of the shaft,

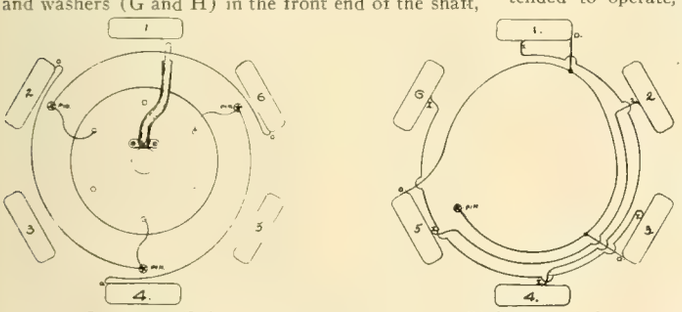


FIG. 1. SMALL ALTERNATING-CURRENT MOTOR. - COIL CONNECTIONS OF MESTON MOTOR.

and working against a rawhide washer (E) at the back.

The bearings (F) are formed in the cast-iron armature hub (O). Experience has shown this combination of cast iron and hardened steel for bearings to be most satisfactory. We have yet to learn of a single case in which the bearings have "stuck," as it is called, while with the various combinations of brass and bronze-bearing bushings, this trouble is a very common one.

The oiling of small fan motors has always been a difficult problem, owing to the tendency of the oil to work out to the fan, and thus get distributed over adjacent objects. This is practically an impossibility with this motor. The armature hub is recessed, as shown, and filled with a lubricating compound sufficient to last for one season. In addition, an oil cup (A) is provided, leading to the center of the hollow shaft. At each bearing small oil holes (L) are provided, through the shaft, leading to oil grooves on the shaft, which thoroughly distribute the oil the full length of the bearings. At the front end of the shaft provision is made (N) for the oil to lubricate the retaining washers, but the fan hub (J) is screwed on the armature hub against a leather washer (K), making an oil-tight joint, so that no oil at all can escape to the fan.

For opening the circuit through the starting coils, a very simple and efficient automatic device is used. It consists of a two-part stationary ring, mounted on the back cover and connected in the starting-coil circuit. Two clips mounted on the armature, but free to move a certain distance in a radial direction, make contact with the stationary ring and close the circuit. As soon as the armature reaches a certain speed, the centrifugal action breaks this contact and opens the circuit.

On examination it will be noted that this is a particularly difficult and expensive motor to make, and it is only by manufacturing in very large quantities that satisfactory motors can be made, without the

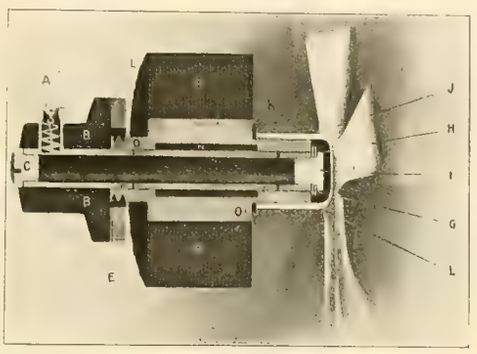


FIG. 2. SMALL ALTERNATING-CURRENT MOTOR. - DETAILS OF SHAFT AND ARMATURE.

cost reaching such a figure as to make it prohibitive.

On account of the small size of these miniature electric machines, the casual observer would say that they are very simple pieces of machinery, and so they are; but their simplicity is the secret of their success and is only the result of a very great amount of thought and experiment.

If one stops to consider it, it is readily seen that the service demanded of fan motors is the most severe. Almost all of them are placed where they receive almost no intelligent attention, being seldom even oiled, and yet they are expected to be ready to operate properly without delay. They are subjected to all kinds of abuse in ignorant hands, and are connected to circuits from which they were never intended to operate, but in order to be a successful commercial article they must withstand almost anything.

It is also necessary to keep the cost at a minimum figure, in order to produce a motor which can be both made and sold on a business basis, which means a reasonable profit. As the quality of the motor cannot be sacrificed, it becomes necessary to improve designs and methods of manufacture to the utmost.

Taking all these things into consideration, it is readily seen that, although the machines are small, their design requires the most careful consideration of the multitude of conditions under which they will have to operate; and their proven durability is the best indication of the success which has been attained.

In conclusion, we have two figures illustrative of the economy of material which is practiced. Fig. 7 shows the punchings obtained from a piece of sheet iron 11½ inches square. The sheet passes through 11 operations, and we have a field punching and an armature punching for a low-frequency ceiling fan motor, a field and an armature punching for a high-frequency desk fan motor, and an armature punching for a low-frequency desk fan motor.

Fig. 8 shows the punchings from a sheet 14 inches square. The sheet passed through 12 operations, and we have a field and armature punching for a high-frequency ceiling fan, a field and an armature punching for a one-half-horsepower motor, and a field and armature punching for a low-frequency desk fan.

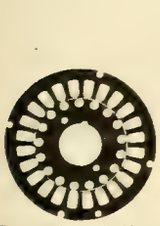


Fig. 4. 60-cycle Motor.

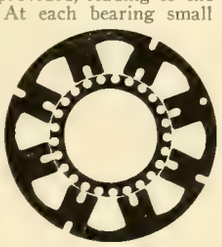


Fig. 5. 133-cycle Eight-pole Motor.

Fig 6 Meston Motor.

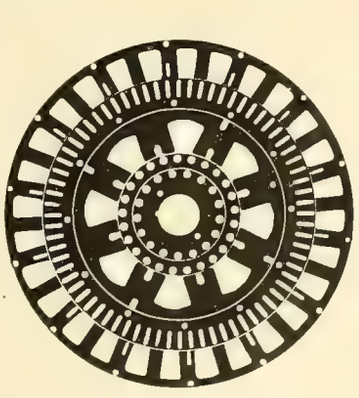


Fig. 7. Combined Punchings from 11¼-inch Disk.

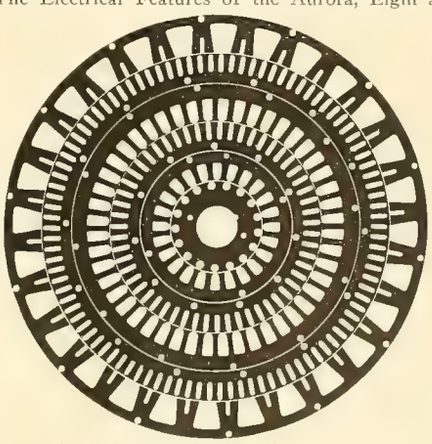


Fig. 8. Combined Punchings from 14-inch Disk.

SMALL ALTERNATING-CURRENT MOTOR.—FIELD AND ARMATURE PUNCHINGS.

Chicago Electrical Association.

The Chicago Electrical Association held its regular meeting at its rooms on November 7th, with President P. B. Woodworth in the chair. After preliminary business the speaker of the evening, H. I. Finch of St. Louis, was introduced. Mr. Finch read a very interesting paper on "The Development of a Small Alternating-current Motor," and illustrated his lecture with stereopticon views. Two recent types of fan motors were exhibited, both in operation and dismantled, for the examination of parts. The paper, which is presented herewith, was discussed by Messrs. Almert, Scheible, Woodworth and others, the most of the discussion taking the form of questions, which were answered by Mr. Finch.

Among the points brought out were that the 60-cycle fan exhibited took about 200 watts at the start on a power factor of 20 per cent., and after it had reached full speed at the end of seven seconds the consumption of current amounted to 55 watts and the power factor was 60 per cent. The efficiency of the motor was between 25 and 30 per cent., while the earlier types of fan motors barely gave an efficiency of one per cent. By means of a choke coil provided in the base of the fan the speed can be varied from 1,200 to 1,650 revolutions a minute. The operating speed is about five to 10 per cent. below synchronous speed.

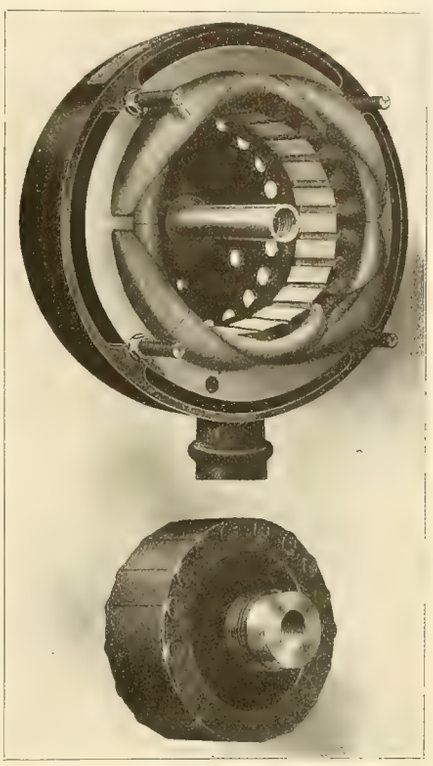


FIG. 3. SMALL ALTERNATING-CURRENT MOTOR.—FIELD AND ARMATURE.

About 60 members and visitors were in attendance at the meeting. The next meeting of the association will be held on November 21st, and a paper on "The Electrical Features of the Aurora, Elgin and Chicago Railway" will be given by Howard Brooks, assistant electrical engineer of this railway.

The Oak Park and Northern Railway Company of Chicago has been incorporated with a capital of $50,000 to operate street railways in Lake and Cook Counties in Illinois. The incorporators are D. L. Morrill, J. S. Murray and R. W. Miller.

Potter Alternating-current Railway System.

The electric-railway inventions of William B. Potter, one of the engineers of the General Electric Company, are exciting much attention. Some of his recent work in alternating-current railway systems, as covered by patents Nos. 712,589, 712,961 and 713,016, is of especial interest. The first of these patents relates to a means for controlling electric motors, which is of particular value in connection with the propulsion of trains. In accordance with the invention, the motors employed are of the type having two relatively rotatable members, one of which is geared to the axle or wheels of the car upon which it is mounted, the other being acted upon by a friction brake or other retarding device which restrains it from rotation to the extent desired. If current be admitted to such a motor and the friction brake be off, the last-mentioned member of the motor will revolve backward without doing any work. If, however, the brake be applied, the motion of this member is restrained until it is ultimately brought to rest. The reaction between the two members of the motor is by this means transmitted to the wheels of the vehicle, thereby setting the vehicle in motion with an acceleration dependent upon the force or abruptness with which the brake is applied.

Fig. 1 is a diagram of a two-car train, showing the electric circuits of the same suitable for use in case multiphase induction or synchronous motors are employed for motive power. Fig. 2 is a detail view of one of the motors and its braking mechanism.

One member of each motor is geared by a reducing gear to the axle upon which it is mounted. The other member of each of the motors differs

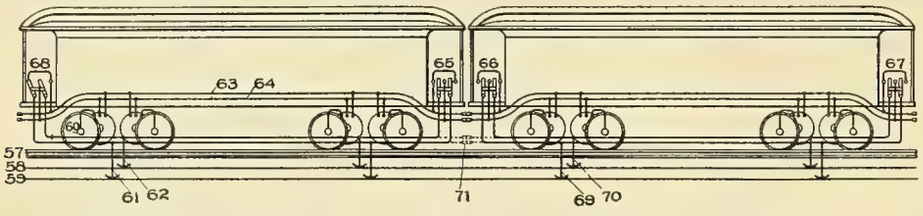


FIG. 1. POTTER ALTERNATING-CURRENT RAILWAY SYSTEM.—DIAGRAM OF TWO CAR TRAIN.

from the motors ordinarily in use for driving cars in that instead of being fixed it is capable of rotation. In the case of the motor, Fig. 2, the shaft (9) is connected to this rotating member of the motor and is provided upon its outer end with a brake cylinder (10). Upon this brake cylinder bear the shoes (11) and (12) of a friction-brake mechanism actuated pneumatically through the agency of brake-applying levers.

The brake shoes (11) and (12) are preferably pivotally mounted upon a brake yoke consisting of two members (13) and (14), pivoted upon a pin, strongly fastened to a supporting yoke, by which the motor is carried on the axle of the car. The two members (13) and (14) of the brake yoke are adapted to be urged together, so as to bring the brake shoes upon the braking cylinder (10), this result being accomplished by means of a bell-crank lever and other mechanism.

The motor is a three-phase alternating-current induction motor, the induced member of which is indicated at (22), this induced member being mounted upon a shaft (23), having one of its bearings supported in a journal (24), formed in a supporting yoke, the other end of the shaft (23) having a bearing formed, as shown at 25, within a revolving portion of the inducing member (26) of the motor. This inducing member has one of its bearings sleeved upon the shaft (23), as shown at (27), the other bearing being carried by the frame (16), as shown at (28). Collector rings (29) serve to convey current to the inducing member (26) of the motor. The inducing member is in this case shown as having the projecting end (30) of its shaft carrying the pinion (31), which gears with a coöperating gear upon the car axle, these gears being contained within the gear casing.

Each motor being provided with a friction brake, some suitable means is required whereby all of the brakes may be applied simultaneously or released simultaneously. This purpose is effected by the use of a pneumatic braking system, which is or may be similar to the pneumatic braking systems in common use for braking trains.

The electric circuits for the motors on the train are indicated in Fig. 1, these circuits corresponding to those required when three-phase motors are employed. Current is transmitted through the rails (57) and the two insulated contact rails (58) and (59), this current being derived in any ordinary manner from a suitable source of supply. The car wheels receive current from the rails, as indicated, for example, at (60), while current from the two remaining branches or mains of the three-phase circuit is collected by means of suitable contact shoes (indicated, for example, at 61 and 62). These contact shoes are connected to conductors which extend to reversing switches located at either end of each car, the co-operating members of the reversing switches being connected to two train conductors (63) (64), which extend the whole length of the train.

In normal operation one terminal of each motor is connected, as shown, for example, at (60), through the framework and wheels of the truck to the rails (57). The other two terminals of each motor are permanently connected to the two train wires (63) (64), the connections being so made as to cause all of the motors to act to propel the car in the same direction when current is supplied to the motors. The direction in which current is supplied to the several windings of the motors is determined by the position of the reversing switches connected betwen the contact shoes and the train wires. In order to insure that the direction of rotation of all the motors shall be the same, only one reversing switch is under the control of the motorman—as, for example, the switch at the head end of the train—the other reversing switches being placed in open-circuit position, as indicated, for example, at (65), (66) and (67). The reversing switch (68) at the head end of the train serves to connect the contact shoes (61 and 62) to the train conductors (63 and 64). In starting the train this reversing switch is thrown in the direction corresponding to that which the train is to take. This causes the motors on the train to start up and run, the pneumatic brakes at this time being in their off position. To start the train, it is only necessary that the pneumatic brakes should be applied, so as to restrain the rotation of the freely-revolving member of each of the motors. Different gradations of speed may be obtained by suitably controlling the engineer's valve, so as to obtain varying degrees of pressure in the train pipe, thereby permitting various degrees of slip of the pneumatic brakes. Full speed is obtained by applying maximum pressure, so as to lock the otherwise freely revolving members of the motors in fixed position.

To obtain the beneficial effect of all of the collecting shoes (61) (62) (69) (70), etc., the conductors of the cars to which these contact shoes are connected may be electrically joined together, if desired,

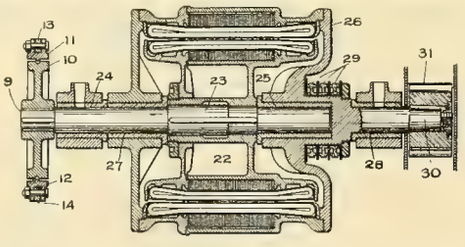


FIG. 2. POTTER ALTERNATING-CURRENT RAILWAY SYSTEM.—DETAIL OF MOTOR.

by the connectors extending between the cars and indicated in Fig. 1 by the dotted lines (71).

Mr. Potter's other two patents relate to methods of current supply for electric railways in general, and with special reference to surface-contact systems, in which it is not desirable to maintain current of high potential permanently upon the working conductors, which are engaged by the collectors carried by the car.

The object of the invention is to provide a sectional-conductor alternating-current railway system in which the surface-conductor sections are normally maintained at a potential not inimical to animal life and in which the potential of these sections can be automatically increased to the desired degree for operating the car motors by the passage of the car which carries the motors. This object is obtained, in conjunction with the advantageous feature of reducing the fixed losses of transformer cores, in the manner described in the patent to Ferranti, No. 409,775, August 27, 1889.

Fig. 3 is a diagrammatic illustration of certain features of the invention. In the particular system illustrated three mains (L) (M) and (N) are shown, which are supplied with current from any suitable source of three-phase alternating current.

In order to avoid the fixed losses in the iron cores of the primary (P) of one of the arrangements shown in the patents, the method illustrated in Fig. 3 has been devised. In this case a small transformer has its primary (p) permanently connected to the mains and its secondary (s) permanently connected to the working conductors. A large transformer has its primary (P) normally disconnected from the mains and its secondary (S) normally electrically independent of the working conductors. Each transformer supplies current to the working conductors

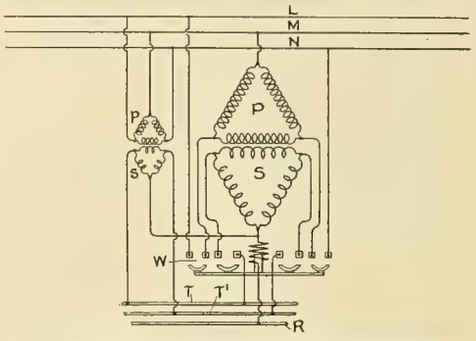


FIG. 3. POTTER ALTERNATING CURRENT RAILWAY SYSTEM.—SURFACE-CONTACT ARRANGEMENT.

at the same high potential, and when the working conductors are engaged by the collectors on the car the electromagnetic switch (W) connects the transformer (PS) with the mains and working conductors, so that the two transformers supply current to the working conductors in parallel. This arrangement has, however, the objection that current of high potential is always supplied to the working conductors, and to obtain the advantages of both the arrangements another one has been devised. In this case the small transformer normally supplies current at lower potential to the working conductors than does the large transformer, and when the working conductors are engaged by the collectors carried by a car the high-potential transformer, which is normally disconnected from the mains and working conductors, is operatively connected therewith and the secondary (s) of the low-potential transformer is cut out.

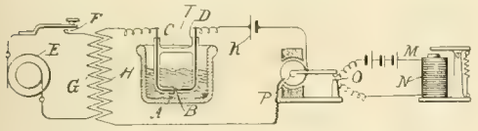
Pupin's Asymmetrical-current Device for Telegraph Circuits.

An apparatus that is especially applicable for use with alternating-current telegraphy and has also other practical applications has been invented by Dr. Michael I. Pupin of Yonkers, N. Y. The device is designed to produce asymmetrical currents from symmetrical alternating electromotive forces, and is covered by two patents, Nos. 713,044 and 713,045, dated November 4th. Dr. Pupin describes an asymmetrical current as a periodic current in which the total number of coulombs flowing in one direction is greater than the total number flowing in the opposite direction. Such a current will deflect a permanent magnet and be deflected by it and will produce electrolysis. It is equivalent to periodic unidirectional impulses equal to the difference between the number of coulombs transmitted in opposite directions.

The inventor's improved method for producing an asymmetrical current in a circuit is to impress an alternating electromotive force upon the circuit and oppose thereto an electromotive reaction which is greater in one direction than in the other. He thus constructs a circuit which will offer an asymmetrical impedance to a simple harmonic electromotive force. This electromotive reaction can be produced by placing in the circuit, as shown in the diagram, a direct-current generator (K) and a reversible, preferably non-cumulative, electrolytic polarization cell (T), the capacity reactance of which for the frequency of the electromotive force to be employed is as large as, or preferably greater than, the other reactances of the circuit. To get rectification of high efficiency, the capacity reactance should be about 100 times as large as any other reactance of the circuit. Upon this circuit is superimposed an alternating electromotive force. The direct-current generator—say a voltaic cell—and a polarization cell, which he calls a simple "electrolytic" cell—say, two platinum electrodes in dilute sulphuric acid—taken together constitute an asymmetrical electrolytic element which possesses an alternating electromotive reaction that is greater in one direction than in the other. Such an element is the equivalent of a cell which has the property of developing a higher counter-electromotive

force when traversed by a current in one direction than when the current is reversed.

This invention is of considerable value in its application to telegraphy by alternating currents, and more particularly to multiplex telegraphy by resonance-receiving circuits. The chief difficulty in using alternating currents for telegraphy is that the magnetizing force of the current transmitted must, generally speaking, be relied on to produce the entire magnetic effect in the receiving instruments, and this magnetizing force, being proportional to the square of the magnetizing current, falls off rapidly when the current is diminished, as it always is in transmission over long lines. With direct currents, however, the currents transmitted can be acted upon at the receiver by strong magnetic fields produced



PUPIN'S ASYMMETRICAL-CURRENT DEVICE.

independently of these currents, as by powerful permanent magnets or electromagnets. Hence, by the aid of this invention much stronger effects can be produced in the receiving apparatus with a given impressed alternating electromotive force than is possible without the aid of the invention.

The application of the invention to telegraphy without employing resonance effects is illustrated in the diagram. In this figure the armature (P), which is placed between the poles of a powerful permanent magnet, operates a circuit-closer (O), which closes a local circuit in which is a battery (M) and a sounder (N).

Dr. Pupin has practiced the invention successfully in rectifying Hertzian oscillation, as well as oscillations of the frequencies produced in ordinary commercial practice. When a circuit is properly adjusted for a given frequency, it will effect even better rectification with all lower frequencies.

New Stanley-Kelly Alternating-current System.

A system of alternating-current generation and distribution that is said to be of peculiar value in connection with systems of high-tension long-distance transmission, in which the power factor varies greatly with the load, has been invented by William Stanley of Great Barrington and John F. Kelly of Pittsfield, Mass. The invention has for its object the production and distribution of alternating currents in such a manner that the pressure is automatically regulated without regard to the nature of the load upon the mains. This is considered a great advance, since in the present transformer system in which a constant-potential generator is used for supplying transformers in multiple arc with lamps in multiple on their secondaries it is necessary that the transformers should not only be made to be used with the potential upon the mains, but they must be adapted to the generator so as to have an insignificant leakage or magnetizing current at no load.

"It is well known," say the inventors in their patent specifications, "that any closed magnetic-circuit transformer which will not burn up on account of core loss when connected to constant-potential mains will be adapted to the generator so as to have such insignificant leakage current and that if the primary and secondary coils are sandwiched or intermingled so that the turns are all in the same homogeneous magnetic atmosphere approximate constancy of potential at the secondary terminals within limits is inherent and that the limit at which the drop in secondary potential exceeds any given amount, or, in other words, the capacity of the transformer depends only upon the resistances of the primary and secondary coils, so that if the cross-section of the wire is increased the capacity will be increased and the approximation to constancy of potential at the secondary terminals for any given load will also be increased. In open magnetic-circuit transformers or other similar phase-displacing devices, however, there is always a large magnetizing current which lags behind its electromotive force, disturbing the ordinary generator and reducing its output by demagnetizing its field magnet. These transformers, therefore, although they may be made to withstand the potential of the mains, are not adapted to the ordinary alternating-current generator and cannot be satisfactorily used in the system at present in use.

"The purpose of our invention is to generate and distribute alternating currents so that when the currents supplied lag or lead because of the nature of the load such lagging or leading currents instead of disturbing the generator shall automatically act to maintain constant the potential on the mains. The advantages of such generation and distribution will be manifest to those who are familiar with the art as now practiced, since it does away with disturbing effects of translating devices, such as motors and open-circuit transformers, which are very troublesome in ordinary systems.

"The principle upon which our improvement depends is that of the inductive action of one alternating current upon another, the two being related as primary and secondary—viz., that if the two circuits be properly disposed if the secondary current lags positively it will react upon the primary circuit increasing the primary current to the extent necessary to maintain the magnetic flux, and if the secondary has a negative lag then it will react upon the primary circuit, reducing the primary current to the amount necessary to maintain the flux.

"In carrying out our invention the lagging or leading currents are the armature currents, which are made to act upon field-energizing circuits carrying alternating currents. The resistance of the field energizing coils is made very low, so that the electromotive forces applied to the terminals of the energizing coils and the counter electromotive forces set up therein will always be substantially equal and the variation of current in the energizing circuits will be controlled practically only by the reaction of the armature currents.

"Fig. 1 is a side elevation of the generator. Fig. 2 is a diagrammatic view of the system employing the generator and various translating devices supplied thereby. Fig. 3 is also diagrammatic. Referring to the drawings, (A) is a generator having

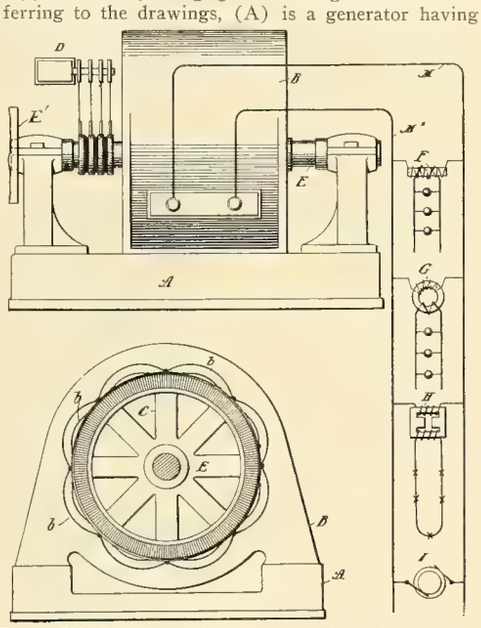


Fig. 1. Side Elevation of Generator. Fig. 2. Diagrammatic View of System.

NEW STANLEY-KELLY ALTERNATING CURRENT SYSTEM.

an armature (B), with its induced windings (b) of such low resistance as to make the full-load resistance drop always practically negligible under normal working conditions.

"(C) is a field structure having windings (c) (c') supplied with the multiphase alternating currents from the small multiphase exciter (D), the windings (c) (c') being so disposed that the multiphase-exciter currents produce in the field (C) revolving magnetic poles or fields of force cutting the armature conductors (b). These windings (c) (c') are of such low resistance that in normal operation their applied and counter electromotive forces are always practically equal. If the desired frequency of the generator is, say, 60 alternations per second, the frequency of the exciter (D) is made much less—say about four alternations per second—producing magnetic fields revolving four times per second. Power is then applied to the generator shaft (E), so as to revolve the field structure (C) at a constant speed of 60 minus four or 56 times a second, thus producing a rotating field revolving 60 times a second, due partly to the mechanical rotation of the field structure (C) relatively to the armature and partly to the rotation of the magnetic poles or fields relative to the field structure.

"The resistance of the field and the exciter circuits being made low, as above described, does not interfere materially with the flow of the alternating currents therein, but leaves them to be controlled by the inductance of the field as modified by the reaction of the armature currents. The inductances of the field circuits must at all times be so high relatively to the resistances that they may determine the exciter currents. The mutual induction between the armature coils and the field coils should also be high, so that the armature currents shall modify the inductances of the field circuits properly, which we accomplish by placing the armature coils as close to the field coils as possible, constructing the field and armature, as shown, with their windings distributed upon the surface of their peripheries and making the magnetic circuit of very low reluctance.

"Now, with such an arrangement, if the potential delivered by the exciter (D) is constant, the potential delivered by the generator is constant so long as the applied and counter electromotive forces of the energizing circuits are substantially equal, independently of any lagging or leading of the current in the armature coils, being determined solely by the electromotive force of the multiphase exciter. Within the limits of operation no manipulation or variation of the electromotive force of the exciter is necessary, as the exciter and generator reacted upon by the currents in the mains will automatically adjust the value of the exciting currents to produce a constant electromotive force at the main-generator terminals. The changes in the exciting currents are instantaneous, and consequently the electromotive force of the main generator never varies because of changes in the power factor of the circuits which it supplies.

"The armature circuit is so related to the field circuits that it is acted upon as a secondary by the alternating currents in the field, and when the current in the mains lags reduces the inductance of the field circuits, thereby permitting more energizing current to flow and maintaining the field magnetism. This is in marked contrast with the ordinary system, in which the lagging current simply demagnetizes the field of the generator, the energizing current not being affected by any reduction of inductance, and therefore not increasing so as to counteract the demagnetizing effect. In our improvement if the current leads—i. e., lags negatively instead of positively—such lead places the armature coil in a position to assist or increase the magnetizing effect of the field windings by reacting upon them as a primary, and consequently increases the inductance of the exciter circuit and reduces the exciter currents correspondingly, thus again maintaining the field constant and preventing a change in the electromotive force at the main-generator terminals.

"In the system shown in Fig. 2, (A) is the generator, having the constant-potential multiphase exciter (D) and the circuits (M) (M') leading therefrom, with various translating devices in multiple arc—to wit, an open-circuit transformer (F), with lamps in parallel on its secondary; a closed magnetic circuit transformer (G), with lamps in parallel on its secondary; a transformer (H), with lamps in series on its secondary, and an alternating-current induction motor (I), which devices it has never before been possible to use on the same generator without expensive and unsatisfactory local devices for preventing the evil effects due to lagging currents, which are produced because of the phase-displacing properties of open magnetic transformers and similar apparatus and the circuit of which they form a part.

"With our improvement, however, lagging or leading currents do not produce such evil effects, and therefore no adaptation such as has heretofore been necessary need exist; but the devices can be used indiscriminately so long as they are made to be used with the voltage and frequency employed. The low frequency of the exciter permits the use of a small exciter, and thus makes a practicable system.

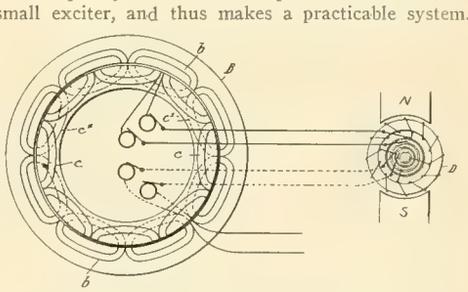


FIG. 3. NEW STANLEY-KELLY ALTERNATING-CURRENT SYSTEM.—DIAGRAMMATIC VIEW OF GENERATOR.

The frequency should be as low as is compatible with the desired regulation. The self-induction of the field-exciting coils must be high relatively to their resistance, though not necessarily high in an absolute sense, so that as in an ordinary transformer the flow of current will be made to vary inversely with the inductance and be substantially independent of the resistance.

"The desired results are attained by energizing the generator by impressing alternating electromotive forces of low frequency on the field-coil terminals and maintaining at these terminals counter electromotive forces always substantially equal to the impressed, and from the currents thus produced and by

motion due to external mechanical power inducing currents of normal frequency in the armature, which if they lag or lead react so as to control the flow of the low-frequency energizing currents, so as to maintain a substantially constant inducing field and consequent constant potential at the generator terminals."

The invention of Messrs. Stanley and Kelly is embraced in two patents (Nos. 712,613 and 712,614) granted on November 4th, the dates of application being respectively April 5 and June 25, 1902.

Bids for Chicago Government Building Contracts.

Bids for the interior furnishings, the electrical switchboards, conduit and wiring, and the heating system of the Chicago government building were opened in Washington, D. C., on November 8th. There were six bids submitted for the electrical switchboards, conduit and wiring (see Western Electrician of October 18, 1902, page 275) as follows:

Chicago Edison Company, Chicago, $89,516; time required, 180 days.
Cuthbert & Black, Chicago, $87,476; time, 325 days.
Arthur Frantzen Company, Chicago, $69,838; time, 270 days.
F. E. Newberry & Co., St. Louis, $77,434.
J. F. Buchanan & Co., Philadelphia, $104,000; time, 200 days.
McKay Engineering Company, Baltimore, $78,434; time, 180 days.

Proposals offered for the heating system were:

S. Faith & Co., Philadelphia, $99,700; time required, 410 days.
Robert Gordon, Chicago, $129,779; time, 338 days.
Edward Joy, Syracuse, $112,798; time, 350 days.
C. B. Kruse Heating Company, Milwaukee, $101,590; time, 410 days.
William A. Pope, Chicago, $118,811; time, 351 days.
L. H. Prentice Company, Chicago, $130,100; time, 280 days.
Thomas & Smith, Chicago, $99,346; time, 252 days.

As soon as the government officials can assure themselves of the reliability of the bidders and decide the question arising from the length of time stated in the bids, the contracts will be awarded.

Use of 133-cycle Single-phase Motors on 60 Cycles.

At the time the Memphis Electric Light and Power Company changed over its alternating circuits from 133 to 60 cycles, a few months ago, H. G. Prout, the electrical engineer of the company, very ingeniously adapted all of the Wagner single-phase 133-cycle motors on the system to the new frequency of 60 cycles in the following manner:

The transformer connections were so modified as to feed 208-volt motors on 104 volts, and 104-volt motors on 50 volts. This kept the magnetic induction at practically the same figure on the new frequency as on the old. Slight mechanical modifications were made in the motors, and the pulleys changed to take care of the speed reduction from 1,950 to 850 revolutions. In every instance the changes were so completely successful that the new service has given entire satisfaction.

The change of frequency was made all over the city of Memphis one morning, without providing single-phase motor customers with relay-motor service. Before evening all the single-phase motors were operating successfully on 60-cycle distribution.

Cascades at St. Louis Fair.

In planning the main "picture" of the Louisiana Purchase Exposition at St. Louis the most interesting development of the work is in the cascades and the cascade gardens. This composition, which is calculated to be the culmination of the decorative climax of the exposition, will be a concave hillside 1,600 feet across, covered with cascades, winding walks, gardens and sculpture. It will be situated at the junction of the avenues that radiate like the ribs of a fan. The components of this feature will be:

1. Three magnificent cascades that will dwarf any waterfall ever designed by man, making the cascade of the Trocadero at the Paris Exposition, the cascade at St. Cloud and the Chateau d'Eau of Marseilles look small in comparison.

2. The main cascade basin, semi-circular in shape, 600 feet in diameter, one of the most imposing artificial basins on earth.

3. Four magnificent jets of water or fountains rising with a diameter of three inches in the main basin on each side of the smaller cascades, and on a quiet day attaining a height of 75 feet.

The three cascades will issue from appropriate sculptures at the top of the hill, and by a series of descents plunge into a basin of titanic proportions. As all the buildings and avenues of the exposition will radiate from this feature, the glint and sparkle of the downpouring waters will be visible, and their rush and splash will be audible from all the raidating avenues of the main picture.

The main cascade issues from a pipe 30 inches in diameter at the rate of 45,000 gallons a minute. It has 14 falls; the first one of 25 feet, the second of four feet, the third of 20 feet, the fourth of eight feet, and the rest of four feet each, coupled in groups of two, and ending in the grand basin. At the first fall the water is 11 inches deep over a 40-foot ledge. At the last fall the water is three inches deep over a 140-foot ledge. The divergence of the line of sight thus obtained will exaggerate the perspective and make the cascade seem even larger than it is in fact.

Behind the second fall, through the veil of water, will be seen sculptured groups of nymphs and naiads in a grotto lined with quartz crystals. The visitors will be allowed to enter this grotto and to refresh themselves with the coolness of the spray-laden air. This grotto will be electrically illuminated at night by means of special contrivances, and the effect of the lights through the water reflected from the multitudinous facets of the quartz crystals will make a spectacle of great brilliance.

The two side cascades are symmetrical and somewhat smaller than the center cascade. They issue from 12-inch pipes under a pressure of 90 pounds to the square inch. Each has 12 separate falls, coupled in twos. The first is 22 feet high, the second 12 feet, the rest, except the last, three feet, and the last 15 feet. Each of these cascades will discharge 18,000 gallons of water a minute.

All along the edges of these cascades will be powerful vertical and horizontal jets of water issuing from appropriate sculptures, and falling into the cascade basins. These jets will serve the double purpose of agitating the water, and thus adding to its picturesqueness and of reinforcing the supply of water as it spreads over the widening ledges.

King Edward is said to have submitted to 16 treatments with X-rays for a rodent cancer at the root of the nose. The treatments took place in the early part of last September and were entirely successful. Dr. Arthur B. Blacker, who conducted the treatments, afterward fell victim to a more aggravated form of the disease, and recently died of it.

Mountain Electric Railway at the Cape.

A modern electric railway with up-to-date equipment, steep grades and picturesque scenery is that of the Camps Bay, Cape Town and Sea Point Tramways, recently constructed at Cape Town, South Africa. It is one of the most important railway systems now operating in the English colonies and possesses several interesting characteristics. The system as it exists to-day is a natural extension of the previously existing Cape Town line, although the Camps Bay section is owned by a separate financial organization. The construction of this railway would have presented numerous difficulties under ordinary circumstances, but these were considerably enhanced, as the whole of the work was carried out during the progress of the Boer war. Not only did the course of the war prevent easy shipping facilities, but serious trouble arose from the difficulty of obtaining adequate labor. Yet, in spite of these drawbacks, the railway system, comprising nine miles of difficult track work, has been completed without any serious delay. The whole of the materials for the system, and a good deal of the supervision necessary in erection, were supplied and carried out by Dick, Kerr & Co. of London, England, whose experience in the construction of foreign railways has been unique as far as an English company is concerned.

A clear idea of the ramifications of the system will be obtained from the map shown in Fig. 1. Beginning at the Round Church, Sea Point, on the southwest of Cape Town, where connection is made with Cape railway, the line commences on an easy ascent, but though gradual, it has reached at the end of the first mile an altitude of nearly 300 feet, and grades of one in 12, or 8.33 per cent., have been encountered. Continuing southward, Upper Clifton is reached, and at this point a magnificent view is obtained of Camps Bay and the range of mountains, to wit, the Twelve Apostles, stand out clear and distinct. Continuing in a scarcely perceptible descent, the line passes the Old Toll House, and at Camps Bay the track leaves the roadway and continues its course over land purchased by the company. Some three-quarters of a mile distant stands the power house, shown in Fig. 2.

After passing the power house the railway leaves the existing roadway, and is laid over the private estate of a local land company. Following a new roadway which has recently been made for the purpose, the most southerly point of the railway is reached at Oudekraal. Here the line diverges in a northeasterly direction, and after encountering the heaviest grades (one in nine) of the system, the highest altitude is reached at Kloof Nek. At this point, some 800 feet above sea level, there is obtained one of the finest views in the colony. The terminus of the road is at Burnside Road, 1¼ miles farther on and seven miles from Round Church. A general view of the road is shown in Fig. 3

The building of the road involved unusual difficulties, a large amount of blasting, culverts and retaining walls being necessary. The excavated rock, however, was suitable for concrete and also for ballasting. The track is laid with 90-pound girder rails with four-foot, 8½-inch gauge, on concrete foundation. Karri wood paving extends to a width of one foot 10 inches on each side of the track.

The side-wire system was adopted for the overhead construction, the trolley wire (No. 0 B. W. G.) being carried at the height of 18 feet six inches above the rail level. The poles are of mild steel with ornamental base castings and brackets. The arms vary in length from six feet six inches to 15 feet, according to the width of the road. Owing to the tortuous character of the route, it was necessary to run the trolley wire partly on one side and partly on the other to allow of the poles being fixed in the most suitable positions. The road as a whole is believed to be one of the most tortuous and heavily graded railways equipped on the overhead system.

The generating station and car shed is situated at Camps Bay, from which water is drawn for con-

Fig. 1.

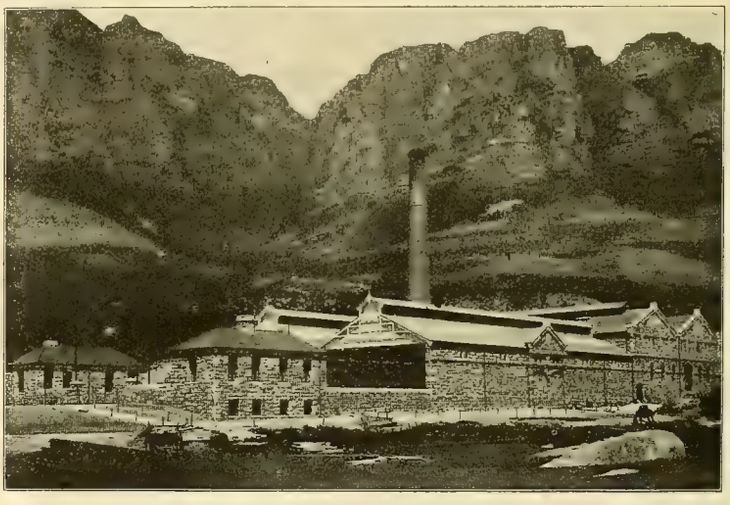


Fig. 2. Generating Station and Car Shed.

MOUNTAIN ELECTRIC RAILWAY AT THE CAPE.

FIG. 3. MOUNTAIN ELECTRIC RAILWAY AT THE CAPE.—CAR ASCENDING FROM CAMPS BAY.

densing purposes. A continuous supply of fresh water for boiler-feed purposes is obtainable from a small stream flowing down Table Mountain. The engine room is 94 feet by 42 feet, and consists of two floors and a condenser pit. An overhead traveling crane, arranged for hand power and capable of lifting 10 tons, runs the whole length of the engine room, and has a lift of 16 feet. The boiler house is 94 feet long by 43 feet five inches wide. The car shed, which is also part of the same buildings, is 136 feet long by 94 feet wide, with eight lines of track, four of which have pits running their entire length. At the entrance to the car shed are offices, messroom and stores. A plan of the building is shown in Fig. 4.

The generating plant consists of two direct-coupled 400-kilowatt sets. The engines, constructed by Yates & Thom, are of the cross-compound type, developing 720 brake horsepower, with a steam pressure of 150 pounds at the cylinders when running at 90 revolutions per minute. The generators were built at the works of the English Electric Manufacturing Company, Preston, England, and have an output of 400 kilowatts at 550 volts. They are compound-wound and have high-permeability, cast-iron magnet frames with laminated-steel pole pieces and laminated armatures.

The switchboard consists of nine panels, of which three are generator panels, three feeder panels, one station panel, one lighting panel and one leakage panel. Two of the generator panels only are in use, the other being a spare panel. Each is fitted with a positive and negative quick-breaking switch capable of carrying 1,000 amperes, a magnetic circuit-breaker, and an ammeter reading from zero to 1,200 amperes. Two of the feeder panels are in use, the other being a spare one. Each is fitted with an automatic circuit-breaker of the same type as those used on the generator panels, an ammeter reading up to 500 amperes, and a quick-break switch for connecting feeder to bus-bar. The main station panel is fitted with a main ammeter reading up to 3,000

FIG. 5. MOUNTAIN ELECTRIC RAILWAY AT THE CAPE.—COMBINATION CAR.

amperes, on which the total output of the station is constantly shown, and a recording wattmeter. It is also fitted with a recording voltmeter with a working pressure of 550 volts. The leakage panel contains all the instruments necessary for testing for leakage, etc. The lighting panel is arranged for six 50-ampere, double-pole circuit switches with fuses and throw-over switches.

In the condenser pit are two surface condensers with combined air and circulating pumps. These are of the Admiralty type, and are specially devised for using sea water. In the boiler house are two water-tube boilers, each with a heating surface of 3,654 square feet and capable of evaporating 12,000 pounds of water per hour under normal conditions. Each boiler is fitted with a dead-weight safety valve and a spring valve set to blow off at 160 pounds pressure. Before being pumped into the boilers the feed water is passed through a fuel economizer containing 288 pipes fixed in the main flue. The chimney stack is 125 feet in height and five feet inside diameter at the top.

The works are equipped with the necessary machine tools for the purpose of carrying out the repairs, and comprise a large screw-cutting gap lathe, wheel lathe, wheel press, drilling machines, grindstone, smiths' hearth and fan, the whole being driven by an electric motor.

The feed cables are lead-covered and insulated with paper and vulcanized rubber. They are laid in cast-iron troughs, 18 inches below the surface and surrounded with bitumen. The main cables are laid in half-mile sections, and at the junction of each section a feeder pillar is placed in which the cables are connected to a bus-bar, and from thence to the trolley wires in the usual manner.

It is natural that climatic conditions should, to a great extent, determine the type of cars, and a variety has been necessary in the case of Cape Town. The cars are of the single-deck, double-truck type; part are what are known as gridiron open cars and part are of the combined type. The former have a seating capacity of 65 passengers, and the latter (Fig. 5) of 54. The length of the car is 40 feet, width seven feet six inches, and height inside eight feet. They were built for Dick, Kerr & Co. by the Electric Tramway Carriage Works of Preston, and shipped to Cape Town completely finished, the only work to be done before they could commence to run being to mount them on the trucks, connect the wiring and fix the trolley poles. In passing, it may be observed that, so popular has Camps Bay already become that the company anticipates that the present equipment of cars will shortly be found too few to cope with the traffic. The car bodies are mounted on double trucks, each truck carrying two motors, one on each side.

Departing somewhat from the usual English practice, the equipment of the cars comprises four motors, each of 25 horsepower, so that each car is capable of developing 100 horsepower. Four-motor equipments with long cars are considered imperative where grades are heavy, and in the case of Camps Bay the gradients are unusually severe. Not only, however, is a proper distribution of power necessary, but the question of braking and retardation is of prime importance. The brakes, therefore, on these cars have received very careful consideration, three brakes having been fitted, viz., a hand brake, with a brake block on each of the eight wheels, an air brake, acting in conjunction with the hand brake, and an auxiliary slipper brake. In addition to these, it is also possible, by throwing over the reversing switch, to convert the motors into generators, thus enabling them to act as a powerful emergency brake. The cars are operated from either end, by means of special controllers, designed for four-motor equipments.

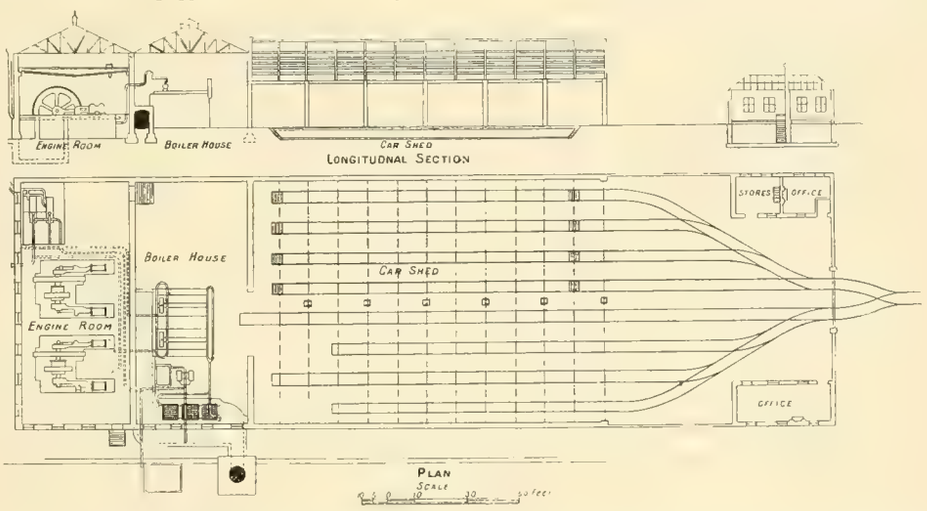


FIG. 4. MOUNTAIN ELECTRIC RAILWAY AT THE CAPE.—POWER HOUSE AND CAR SHED.

Space Telegraphy on the Atlantic and the Pacific.

It is again announced that space-telegraph messages have been transmitted across the Atlantic Ocean with the Marconi apparatus. This time the news comes from Commander Martin of the Italian warship Carlo Alberto, which is now lying in Sydney Harbor, Nova Scotia. The information given out by Commander Martin was neither affirmed nor denied by Mr. Marconi in a recent interview. The inventor did say, however, that an official statement would be made in a few days.

The report credited to the commander of the Carlo Alberto is to the effect that, on Saturday, November 1st, while the ship was cruising off Sunny Harbor, a message was received on board, through the ship's apparatus, which came from Poldhu, England. This message is by far the longest yet transmitted by space telegraphy. The distance from the harbor to Poldhu is greater than that from Tablehead, where the new station is being built. The Carlo Alberto can send messages only 150 miles, but receives at any distance. The message was received in the Morse code.

Additional information of interest, concerning Marconi and his work, is that the Marconi Wireless Telegraph Company of America is now enabled to outline its plan for a Pacific and Alaska space-telegraph service. All the important points on the Pacific Coast will be connected, with San Francisco, Cal., as a base of operations. For this purpose San Francisco will have a very complete installation, and a station like the one at Glace Bay, on the Atlantic will be erected. Land sites have already been secured for the stations, it is said, and some negotiations with the government are now pending. The Hawaiian Islands may also be brought into communication with San Francisco. The islands now have stations in operation which are owned by the Marconi company. It is also considered possible to take in Guam and other points necessary to reaching the Philippines. A projected line from western Alaska will connect the Yukon River country with Seattle, Wash. The rates in all cases, it is said, will be cheaper than those of the telegraph and cable companies, owing to the cheapness of construction and maintenance in a space-telegraph system.

The Modern Electric Light Company of Lincoln, Ill., is constructing an electric-light plant in Lincoln,

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Machinery Hall of Armour Institute. Illustrated.....341, 342
Development of a Small Alternating-current Motor. By H. I. Finch. Illustrated. (Chicago Electrical Association).....342, 343
Chicago Electrical Association.....343
Potter Alternating-current Railway System. Illustrated....344
Pupin's Asymmetrical-current Device for Telegraph Circuits. Illustrated.....344, 345
New Stanley-Kelly Alternating-current System. Illustrated.....345, 346
Bids for Chicago Government Building Contracts.....346
Use of 133-cycle Single-phase Motors on 60 Cycles.....346
Cascades at St. Louis Fair.....346
Mountain Electric Railway at the Cape. Illustrated....346, 347
Space Telegraphy on the Atlantic and the Pacific.....347
Editorial.....348
Steinmetz Method of Compounding Alternators. Illustrated.....349
Submarine Boats in Modern Navies.....349
Telegraphing Around the World.....349
Thomson Direct-current Potential Changer. Illustrated....349
Berlin-Zossen Trials Resumed.....349
Development of the Telephone Field.....350, 351
Louisville Telephone Meeting.....350
Chicago Telephone Company's Extensions.....350
Federal Telephone Properties.....350
American Plant for Large Exchange in St. Petersburg.....350
Telephone News from the Northwest.....350
Southern Telephone Developments.....350, 351
Indiana Telephone Items.....351
Ohio Telephone Notes.....351
Michigan.....351
Bell Telephone Output.....351
Pay-station Service.....351
Kewanee, Ill., to Have Central-energy Telephone System.351
Improvements in Salt Lake City.....351
Trusts Must Advertise.....351
Arbitrators Decide in Favor of Union Traction Employes....351
The Work of the Signal Corps. Part I.....352, 353
Sanitary District Wins in Canal-power Suit.....353
Power Plant for London Underground Roads.....353

DEPARTMENTS.

Correspondence.....353, 354, 355
New York Notes.....353
New England News.....353, 354
Southern Developments.....354
Canadian Intelligence.....354
Information from Indiana.....354
From the Buckeye State.....354
Texas and Mexico.....354, 355
Detroit, Mich.....355
Northwestern Notations.....355
Among the Rockies.....355
Personal.....355
Electric Lighting.....355, 356
Electric Railways.....356
Power Transmission.....356
Miscellaneous.....356
Trade News.....356
Business.....356
Illustrated Electrical Patent Record.....356, 357, 358

DATES AHEAD.

Interstate Independent Telephone Association, Auditorium Hotel, Chicago, December 9th, 10th and 11th.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

WITH characteristic inaccuracy, some of the daily papers have been publishing statements to the effect that one D. O. Stockbridge of Boston nas just completed "a unique journey from Chicago to Boston, making the entire trip by trolley car." Another account says that he used trolley cars for the entire distance with the exception of five gaps. Both statements are misleading. The gentleman is said to have traveled through Muskegon, Grand Rapids, Jackson, Ann Arbor, Detroit, Toledo, Cleveland, Painesville, Buffalo, Lockport, Auburn, Syracuse, Schenectady, Albany, New York, Bridgeport, New Haven, Hartford, Springfield and Worcester. Instead of five gaps in this route, there are at least eight, which must be traveled by boat, steam train or some conveyance other than electric railway. However, the gaps in Michigan and Ohio, and some of those in the East, are being rapidly filled in by electric lines now under construction, and it will not be long before it will be true that a man may travel from Chicago or even a more western city by trolley the entire distance to Boston.

Now it is New Orleans that is experiencing inconvenience by the restrictions of a "Jim Crow" law in street-railway service. As in the case of Richmond, the segregation of the races appears to bear more heavily on the whites than on the negroes. A recent dispatch from New Orleans states that a large number of affidavits have been sworn to against President Pearson and the other officials of the New Orleans Railways Company, resulting from their failure to place screens or partitions in the street cars to separate the white and negro races. The law was passed last July, and the company was allowed 120 days in which to arrange the screens. The law is bearing harshly on the whites, owing to the inadequate number of cars that are being operated during the rush hours. In the North street-railway managers have their own troubles with franchise problems and city authorities, but they have reason to congratulate themselves that their woes are not further enhanced by handling crowds of varied-hued passengers that must, in any rush, be sorted by the colors of their skins and carried in separate compartments.

OCCASION appears to have arisen in England for the promulgation by the Institution of Electrical Engineers of a "standard of professional etiquette for consulting electrical engineers." This code is as follows:

1. No consulting engineer should solicit employment as consulting engineer verbally, by letter, by agent paid by commission or otherwise, or by any other means.
2. No consulting engineer should answer advertisements for consulting engineers.
3. No consulting engineer should advertise for employment.
4. No consulting engineer should pay by commission or otherwise anyone who introduces clients.
5. No consulting engineer should receive trade or other discount, or surreptitious commissions or allowances in connection with any works which he superintends.
6. A consulting engineer who is also directly or indirectly interested in any contracting or manufacturing business should inform his client in writing what his connection is with such contractor.

The reformation indicated by the formal adoption of these rules is directed against what is said to have become a serious abuse in the electrical engineering profession in England, by which the business methods of manufacturers and the professional work of consulting engineers have become sadly confused. There is no question that a man who essays professional work should be not only willing but eager to abide by professional standards. Usually these standards are "unwritten law," but in the case of the electrical industry in England the precisely printed rules are no doubt desirable, although they seem somewhat startling at first.

KENTUCKY, if the statistics of the Independents be accurate, shows a remarkable increase in the number of opposition telephones in use during the year ended October 1, 1902. In 38 towns and counties, according to President Bishop of the Kentucky Telephone Association, there were 6,672 Independent telephones in use on October 1, 1901, and 16,224 on October 1, 1902—an increase of 9,552, or about 150 per cent. In addition, in the towns and counties mentioned, there were more Independent telephones in use on October 1, 1902, than Bell telephones, the exact figures given by Mr. Bishop being, Independent, 16,224; Bell, 10,580. This does not mean, of course, that the number of Independent telephones exceeds that of Bell instruments in the entire state. Indeed, one would suppose that the Bell company must have nearly as many stations in Louisville as are given to it for the 38 towns and counties. But the statement does show, certainly, that the Independent movement, of later date in Kentucky than in some other states, has been received with great approval by the inhabitants of the Bluegrass State.

Two states there are, however, in which, according to the latest available statistics, the number of Independent subscribers actually exceeds the number of Bell subscribers. These states are Indiana and Ohio, for which an Independent authority gives these figures: Indiana—Bell, 35,000; Independent, 65,300. Ohio—Bell, 79,500; Independent, 106,344. In the case of the Bell companies operating in these states the figures are estimated by competitors, but as both states are strongholds of the Independents, there seems little doubt that the opposition companies have more subscribers of all classes than the old companies, and have had for some time.

SIGNAL CORPS officers in Alaska and the Philippines should be regarded with admiration by the present administration—and no doubt they are—for they indeed lead "the strenuous life" if anyone does. General Greely's report as chief signal officer of the United States Army gives a vivid idea of the exertions and sacrifices of these men in extending those indispensable adjuncts of civilization, the telephone and the telegraph, in the countries named. It is all in the line of duty, of course, but no one who reads the account of the hardships and perils undergone by the brave men who are stretching the lines of electrical communication in these remote regions can fail to share the commander's enthusiasm for the work of his subordinates. Like the pathfinders of another era, the American soldiers engaged in this task are the precursors of the smiling arts of peace that will surely follow their work, being, indeed, made possible by it. An abstract of General Greely's report of considerable length is begun in this issue of the Western Electrician, and all who sympathize with the successful efforts of soldier-pioneers in extending through arctic and tropical wildernesses the tingling nerves of twentieth-century life should read it and rejoice.

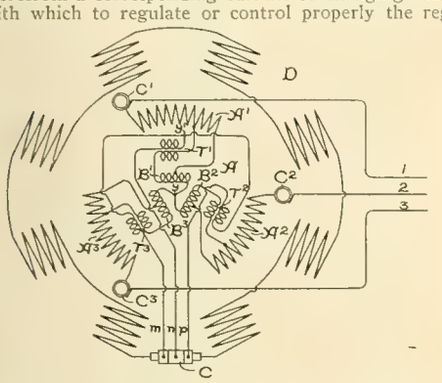
WHAT is the average life of wires used as line conductors in railway signaling? This was one of the interesting questions discussed in a report presented to the recent convention of the Railway Signaling Club in Pittsburg. As the answers should have a large application, they will be of interest to the general electrical reader. They were received from signal representatives of many railroad companies. In relation to galvanized wire, one put the average life at four years; two at eight years. One said double-galvanized wire should give service for 10 years; another extended the term to 12 years. Bare copper, one said, will last 11 years; two said 10 years. Another man places insulated iron at 12 years. One man asserted that his road has double-galvanized insulated iron, which will last 15 years, with the exception of the joints, which are renewed in 10 years. Still another says that insulated copper is practically indestructible. Another man states the average life of a bare No. 8 B. W. G. wire (presumably iron) on railroad lines as from 15 to 18 years, while on public roads the same wire will last 30 years. It is understood, however, he says, that if extraordinary conditions exist, such as crossing tracks, passing near limekilns, zinc works, coke ovens or large furnaces, the iron wires do not last more than five years. Copper wires, as a rule, last four times longer than the same gauge in iron. Still another answer advises, along seacoasts, galvanized-iron wire, to last about eight years; insulated copper, one to two years; interior and mountain districts, iron and copper to last 15 to 20 years.

This is certainly a diversified body of opinion, and is the more puzzling, as railway signaling by electricity has been in use long enough to result in observations of some uniform value. Signal wires along railroad tracks are subject to hard usage, apparently, for some of the estimates of the life of line wires are ridiculously low. However, on the other hand, some consider insulated copper to be practically indestructible, so that one has a wide range of choice. So far as general line construction goes, the symposium appears to be more interesting than valuable.

Steinmetz Method of Compounding Alternators.

The object of a recent invention of Charles P. Steinmetz of Schenectady, N. Y., is to provide an efficient means for regulating alternating-current generators of one or more phases, both for changes of load and changes of phase relation between current and electromotive force in the main circuit. The field excitation of the generator should increase with increased load and with lagging current and decrease with diminished load and with leading current.

As a regulating means the inventor has aimed to secure an electromotive force or electromotive forces which will rise or fall in value with changes of load and which will also rise when the main current lags and fall if the main current leads in a ratio corresponding with the changes of load or phase displacement. Having secured such an electromotive force or electromotive forces, he is enabled to derive therefrom a corresponding current of changing value with which to regulate or control properly the regulation of the generator. As the load changes the current will correspondingly change, and from the current one can in a variety of ways secure an electromotive force varying with the load, to this extent realizing the object of the invention. Going a step farther, if an auxiliary electromotive force changing in value and phase with corresponding changes of current is combined with an electromotive force developed in a coil on the generator, and if the phase relation of the electromotive forces so combined is such that the auxiliary electromotive force leads the generator electromotive force by a proper angle, such that when the current lags the two electromotive forces shift more nearly in phase, and vice versa when the current leads, then the resultant electromotive force due to the combination will tend to increase in value with lagging currents and to decrease with leading currents, thereby securing an electromotive force changing both with the load and with the phase displacement, which renders possible in practice the desired regulation. Mr. Steinmetz has therefore provided means for deriving an auxiliary electromotive force of the character described, coupled with means for combining such an electromotive force with a generator electromotive force having the proper relative phase relation and means for regulating or controlling the regulation directly or indirectly of the generator by the resultant electromotive force and current so obtained.



STEINMETZ METHOD OF COMPOUNDING ALTERNATORS.

Describing more specifically some of the ways of practicing the invention, one method is to provide transformer devices, either compensators or ordinary two-coil transformers, in the circuit of the generator current. The current will induce in the transformer device a secondary transformed electromotive force changing in value and phase with the current and practically in quadrature with the main generator electromotive force at non-inductive load, though this value varies with lag and lead of the current. This supplies the auxiliary electromotive force, which, as already explained, is combined with a generator electromotive force, thus furnishing resultant electromotive force and current having the desired characteristics. A second method is to employ reactive coils or other inductive impedances in place of the transformer devices. Electromotive forces will thereby be induced practically 90 degrees behind the current, and in a three-phase machine these electromotive forces will consequently be 30 degrees ahead of the electromotive forces developed, respectively, in the generator coils of the preceding phase. Then by combining the electromotive forces generated in the impedances with the generator electromotive forces of the preceding phase, resultant electromotive forces and currents will also be secured, rising and falling in value in the necessary and proper ratio.

In the accompanying diagram the invention is shown as applied to a three-phase machine. (D) is the field-magnet-exciting circuit, wound in the ordinary way. The armature coils (A′) (A²) (A³) have, respectively, one terminal connected to the circuit mains (1) (2) (3) through collector rings (C′) (C²) (C³). The other terminals of the coils are connected to intermediate points in the windings of three corresponding compensators (B′) (B²) (B³). One of the terminals of each of these compensators is connected to a common joint at (y), so that in effect the armature coils are Y-connected, but include portions of the compensator windings between the coils and the common joint. The other terminal of compensator (B′) is connected to a point in the generator winding (A′). In this circuit is included the primary of an ordinary two-coil transformer (T′). Similarly, compensator (B²) has one terminal connected to armature coil (A²) through the primary of transformer (T²), and compensator (B³) is connected to armature coil (A³) through the primary of transformer (T³). The secondaries of transformers (T′) (T²) (T³) are interconnected (as shown in the drawings Y-connected at a common joint y′) and the free terminals are connected by leads (m) (n) (p) to a rectifying commutator (C), properly constructed to rectify the current in the secondary transformer circuits and deliver the rectified current to the field-magnet winding of the machine.

Mr. Steinmetz's invention is explained in more detail in the specifications of two patents (Nos. 712,737 and 713,022) granted on November 4th and assigned to the General Electric Company.

Submarine Boats in Modern Navies.

Naval circles of all the important countries of the world are at present very much interested in the possible future of the submarine boat as an adjunct to the modern navy. Tests are being made by the United States, France, England and other powers with these boats, and the one point which seems to be of the most interest is as to the motive power. Different types of submarines use gasoline motors when afloat and electric motors when submerged, while others employ electricity at all times. This latter type are, of course, limited as to the distance they may travel from a source of power supply.

The United States navy officials are awaiting with interest the results of the forthcoming tests of the new submarine torpedo boats, Mocassin and Adder, which will be held some time during this month, probably in Peconic Bay, Long Island Sound. Care has been taken by the officers in charge to make these tests as comprehensive and as rigorous as is fair to the contractors. The tests will be for endurance, speed, stability, dirigibility, torpedo discharge and general performance. Much depends on the results obtained, and the contractors are confident they will demonstrate the practicability of the submarine torpedo boat beyond question and its necessity to the complete navy.

Rear-admiral George W. Melville, chief of the Bureau of Steam Engineering, who is the most pronounced opponent to the diving type of the submarine boat, has called the attention of the officers of the navy to what they may expect if the tests prove successful, and has sounded a note of warning in an article in which he says: "If the boat has any military or strategic value we should change our policy of ship construction, for nothing could justify the building of so many battleships if the submarine boats possess even a portion of the advantages that their advocates claim. In the indifference of naval officers to this question there is great danger. The boats are either valuable or they are worthless for military purposes. From the time the Senate and House naval committees look with favor upon these boats there will be a decreased construction of battleships, and the action of the Congress in striking out of the naval appropriation bill of 1901 all authorization for battleships and cruisers can certainly, in part, be traced to the belief that the submarine possesses many of the qualities claimed by its advocates."

The new boats to be tested are patterned after the old Holland, although of greatly improved design. Gasoline is used as a motive power for surface work and electricity when submerged.

Interesting experiments were made recently with French submarine boats which were submitted to conditions of actual warfare. The boats were employed in a recent naval sham battle. A defending squadron was blockaded in a roadstead, and the submarines were despatched to its aid. They lifted the blockade by theoretically torpedoing three of the attacking squadron's ships without their presence being discovered. The submarines Gymnote and Gustave Zédé are propelled by electricity. Everything worked properly and up to all expectations.

The submarine torpedo boat Protector, just finished, was launched recently at Bridgeport, Conn. The Protector is designed for harbor defense. She is 60 feet long, 11 feet beam, and has a displacement of 65 tons submerged. She is equipped with a running gear to enable her to travel on the bottom of the sea. Her motive power is electricity when submerged, and gasoline when cruising awash. A trap door in her bow will admit of a diver leaving the boat and cutting cables or mine connections, and her builders believe that she can destroy the submarine defenses of any harbor in the world.

Telegraphing Around the World.

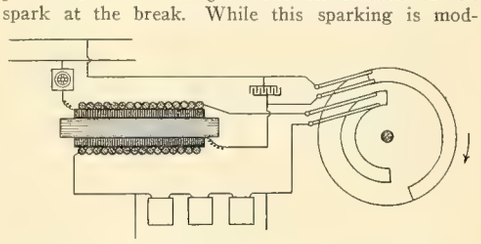
Charles J. Glidden, formerly president of the Erie Telephone Company and an ex-telegraph operator, sent the first telegraphic message around the world upon the completion of the British Pacific cable. Mr. Glidden filed the following message at the Postal Telegraph office in the Hotel Touraine, Boston, at 9:15 a. m., November 1st: "Boston, November 1. To Glidden, Boston, Mass., via Vancouver British cable to Australia. Around the world." At 12:35 a. m. November 2d, the message was received at the Boston Western Union telegraph office. It was dated Southport, Australia, November 2d. It encircled the earth in 39 hours and 20 minutes.

Thomson Direct-current Potential-changer.

Professor Elihu Thomson of Swampscott, Mass., was granted a patent (No. 712,741) on November 4th, for an "Apparatus for Transferring Electric Energy." The invention relates to an apparatus for inductively transferring electric energy from a circuit in which flows a unidirectional current at one potential to another circuit at different potential, generally lower. The mode of operation consists in energizing a core by a winding traversed for a period by the current, then interrupting the current flow by a break-piece or contact-maker at the end of a given time, during which the magnetizable core has reached a considerable degree of magnetization, at or about the same time closing a circuit secondary to the first winding, which is virtually a closed-circuit secondary. In this latter circuit a current is induced which may be utilized in any desired way by other devices.

The apparatus consists, in its simplest form, of a magnetizable iron core with two windings, as shown in the diagram, one of which is the energizing primary put into circuit with a source of continuous current at intervals for magnetizing the core. The other winding is a secondary to the first, which as employed is practically though not completely a short-circuit, and is closed immediately the first circuit is opened, either before or a little later than the opening of the first circuit. A suitable break-piece is furnished to close and open the circuits at proper intervals. The inventor is thus enabled to take energy from a circuit the potential of which is, for example, 100 volts (or even much higher), and transfer that energy at a different potential to the secondary circuit for doing work.

In his patent specification Professor Thomson says: "It is well known that considerable difficulty arises in the operation of an interrupted primary from such potentials as 100 to 500 volts on account of the spark at the break. While this sparking is modified by the use of condensers, it is not easy to get rid entirely of its bad effects. For this reason induction coils have generally been fed at potentials ranging from six to 10 volts, for in this case the potential is not high enough to give rise to difficulties in breaking, especially when a condenser is used. In my invention, however, the presence of a closed secondary circuit closed at or about the moment of the opening of the primary circuit virtually transfers the current from the primary to the secondary and avoids the inductive spark at the break-piece in the former circuit. To effect this, however, the secondary used should be not merely an ordinary secondary circuit, but a circuit the nature and proportions of which in relation to the work are such that it is virtually closed, or much the same as if the secondary had been formed of a conductor closed upon itself. If, for example, the finer or primary coil be energized from a 110-volt circuit, the secondary might be wound so as to give an average potential of 15 volts at its terminals, and in such case it could be connected to charge a battery, giving a counter-electromotive force of four volts, leaving 11 volts as the voltage giving the current through the secondary circuit. In such case the secondary, if of very low resistance relatively, works as if it were on closed circuit, which it is the object of my invention to secure."



THOMSON DIRECT-CURRENT POTENTIAL-CHANGER.

Berlin-Zossen Trials Resumed.

The electric high-speed trials on the Berlin-Zossen military railway have been resumed with a new type of motor designed by Siemens & Halske of Berlin. The heavy transformers previously used to reduce the pressure of the current from 10,000 volts to 2,000 volts are now dispensed with entirely. Current is delivered to the motors at the line potential, 10,000 volts. This and a reduction in the size of the motors will have the important effect of lessening the dead weight of the car. The experimental track has been relaid with heavier rails, and it is anticipated that these and other alterations in the conditions of the previous trials will allow of a higher rate of speed being attained, approaching 125 miles an hour.

DEVELOPMENT OF THE TELEPHONE FIELD.

Louisville Telephone Meeting.

The fourth annual meeting of the Kentucky Telephone Association and the third annual meeting of the Independent Telephone Association of Southern Indiana, held jointly in Louisville last month and referred to briefly in the Western Electrician of last week, was of much interest. President R. V. Bishop of Cynthiana, Ky., of the Kentucky association and President G. A. Kienle of Huntingburgh, Ind., of the Indiana association, presided jointly. James Maret of Mt. Vernon, Ky., performed his duties as secretary. Colonel H. L. Stone of Louisville made the address of welcome. Among other things, he gave the history of the Louisville Home Telephone Company. H. K. Cole of Owensboro, Ky., and Mr. Kienle responded.

S. P. Sheerin of Indianapolis read a paper on "The Independent Telephone Association of the United States." He dwelt principally on the defense of patent suits instituted on the Berliner patent.

D. L. Pendleton of Winchester, Ky., read his paper on "Rates," and a discussion by Mr. Cole and others followed.

Mr. Cole then presented a fine paper on "Long-distance Toll Lines and Connections." The subject was thoroughly handled in a business way and was well received by the meeting. In the discussion J. S. Brailey of the Long-distance Company of Kentucky said that it appeared a long time to wait for a good thing, but it was bound to come. He then spoke of lines already extending from Louisville in five different directions, for distances of 50 to 150 miles into the Kentucky field and also into Indiana. These are copper lines and there are plenty of circuits to accommodate the business, while extensions are being pushed to reach all parts of the state of Kentucky and make connections with long-distance companies of other states.

Before reading his paper on "The Interstate Telephone Association," E. M. Coleman, secretary of the Louisville Home Telephone Company, made announcement of two entertainments—one a smoker at the Louisville Hotel that evening (October 28th) tendered by his company and the other a visit to Fountain Ferry Park, with refreshments, for the next evening, the hosts being J. F. Clark, Jr., & Co. Both of these social features were given and proved very enjoyable.

Mr. Chambers of Maysville spoke of the advisability of making connection with the city of Cincinnati by Bell lines. The matter was referred to a committee.

On Wednesday morning (October 29th) A. L. Têtu, superintendent of the Louisville Home Telephone Company, read an excellent paper on "Operating and Governing Telephone Plants." President Bishop next introduced James S. Brailey of Toledo, Ohio, who gave an address on the subject of "Merging of Independent Telephone Plants." President Kienle then addressed the meeting on "Our Relation Toward the National Association."

Kentucky Telephone Statistics.

The following interesting statement was submitted by President Bishop relative to the telephone situation in 38 towns and counties in Kentucky:

Amount of capital invested October 1, 1901	$1,228,000
Amount of capital invested October 1, 1902	2,338,000
Increase	$1,110,000
Number of telephones in use October 1, 1901	6,672
Number of telephones in use October 1, 1902	16,224
Increase	9,552
Miles of toll lines October 1, 1901	1,500
Miles of toll lines October 1, 1902	2,600
Increase	9,552
Number of Independent telephones in use October 1, 1902	16,224
Number of Bell telephones in use October 1, 1902	10,580
Difference in favor of Independents	5,644

Election of Officers.

The Independent Telephone Association of Southern Indiana re-elected G. A. Kienle as president and E. W. Pickhardt, also of Huntingburgh, Ind., as secretary and treasurer.

New officers of the Kentucky Telephone Association were elected as follows:

President—D. L. Pendleton, Winchester.

Vice-president—H. K. Cole, Owensboro.

Secretary and treasurer—James Maret, Mt. Vernon.

Executive committee—David Prewitt, Pine Grove; J. A. Armstrong, Louisville; R. V. Bishop, Cynthiana.

After adjournment the delegates inspected the building and plant of the Louisville Home Telephone Company, and were greatly pleased with what they saw.

The attendance was about 150.

Chicago Telephone Company's Extensions.

The Chicago Telephone Company is negotiating for a lease on ground under what is known as the Forbes Block, at 191 to 197 Washington Street, Chicago. An annual rental of $10,000 will be paid for the lease, which is to extend over a period of 99 years. This land is adjacent to the telephone company's main downtown building at the northeast corner of Washington and Franklin Streets. It will ultimately be improved, if all goes well, with a fine structure comprising an addition to the company's present quarters. The company will then have a total frontage of 160 feet on Washington Street and an even more imposing building than at present. The present building is eight stories high, and fronts 80¾ feet on Washington Street, having a depth of 90 feet on Franklin. It was erected in two different sections at different times, but, nevertheless, presents an excellent appearance, the front being constructed with pressed brick.

The property under consideration has a frontage of 80 feet and a depth of 191 feet, and is improved with two buildings, both erected in 1872. One is a four-story affair with a stone front, and the other is only a two-story structure. These two buildings will ultimately be removed to make way for a large new one, but just at present nothing will be done with the four-story one, which occupies the front of the plot. The two-story building in the rear will be torn down to make a place for the erection of a warehouse. It is also likely that warehouse quarters will be provided for the Central Union Telephone Company. A steel fireproof structure will be erected if the necessary material can be secured at once. The board of directors of the Chicago Telephone Company has consented to the leasing of the property.

The Chicago Telephone Company is reported to have gained 2,940 subscribers during the month of October, giving the company a total list of subscribers numbering in all approximately 57,000. The gain in October was 30 per cent. more than in any previous month this year. For the last two years the gain has amounted to 29,000 subscribers. It is understood that, in spite of the recent reductions in downtown rental receipts, which cut off about $4,000 weekly from the company's earnings, the receipts from the five-cent slot machines—about $20,000 weekly—have been large enough to show net increases.

Federal Telephone Properties.

President F. S. Dickson of the Federal Telephone Company, in an interview with the Cleveland representative of the Western Electrician, said that he and the other officers of the company have been making a "round-up" of the constituent properties and trying to ascertain what will be needed to put them in paying condition. He, with James B. Hoge and others, returned from a trip over the state late last week for this purpose. Mr. Dickson said there are now 16 properties belonging to the company, and that most of them are in very good condition, although extensions and improvements are needed in some places. The worst feature of the situation is that most of the companies are not getting enough for the service, the plants having been made so much larger than at first intended that the cost of maintaining them is out of proportion to the price received for the service. However, Mr. Dickson said that he believed that the town councils where these plants are located will be willing to amend the franchise privileges so that a higher price may be charged. The people are getting more service than they expected in all of them, and should be willing to allow the company to charge enough more to enable it to make the necessary improvements and extensions, and at the same time pay a fair dividend on the money invested.

American Plant for Large Exchange in St. Petersburg.

According to the October 23d issue of Novoye Vremia of St. Petersburg, perhaps Russia's best-known newspaper, the city authorities of St. Petersburg have awarded to an American firm with a branch in Antwerp contracts for the erection and installation of an additional telephone exchange in that city with capacity for 40,000 subscribers. The same journal adds that the plant will be ready for service some time next year and that the exchange will cost 375,000 rubles ($193,125).

The Novoye Vremia does not give the name of the successful bidder, but in telephone circles in Chicago it is reported that the Kellogg Switchboard and Supply Company has the contract.

Harry C. Dodge, the well-known Independent telephone man, has formed a connection with the American Electric Telephone Company of Chicago, and is now promoting the formation of Independent exchange companies and placing bond issues.

Telephone News from the Northwest.

The Interurban Telephone Exchange Company has bought the local exchange at Alexandria, Minn., from the Park Region Telephone Company, taking it over November 1st.

The Emmons Telephone Company of Emmons, Minn., has installed instruments of the Stromberg-Carlson make.

The Brownsville and Hokah Telephone Company has been formed at Hokah, Minn., to build a line between the towns named in the title.

The Twin City Telephone Company of Minneapolis and St. Paul announces to stockholders that its income August 1st was on the basis of $216,820 annually. By September 1st it had increased to an annual basis of $226,426; October 1st it showed a further gain to $232,134, and November 1st to $254,742. The new switchboard has been installed for the main exchange in St. Paul after many delays, and is a duplicate of the Minneapolis board.

The Northwestern Telephone Exchange Company will rebuild the exchange at Owatonna, Minn., to a metallic-circuit system.

The underground-wire ordinance in St. Paul has been changed by the council committee so that it will not require the removal of messenger calls from the tops of buildings. Dead wires and those carrying high voltage are now the only wires that must be removed.

The Iron Range Telephone Company of Northern Minnesota made quite a hit by distributing election returns over its system.

The Consolidated Telephone and Telegraph Company is constructing long-distance lines to Henderson and New Prague, Minn., and is adding to the towns which can be reached over Independent lines to the Twin Cities.

The Bell interests in Iowa are continuing their plan of forming alliances with Independent telephone lines where the company comes in competition with large Independents. In Northern Iowa the company has departed from its rule of requiring allied companies to use its instruments. Thomas Way has had an arrangement with the Bell company and has used Bell instruments. He has acquired a number of exchanges and toll lines equipped with other instruments, and has merged them with his properties, continuing the old instruments, and also continuing his connections with the Bell system.

The Davenport and Tipton Independent Telephone Company has filed amendments to its articles at Davenport, Iowa, increasing the capital stock from $20,000 to $60,000.

The Central Iowa Telephone Company, successor of the Hawkeye Telephone Company, is in trouble at Hampton, Iowa. The franchise of the Hawkeye company provides that in the event of a transfer of title, the successor must file an acceptance of the provisions and conditions of the franchise. This the Central company failed to do, and the council proceeded to declare the franchise forfeited. The company will now have to appeal for a new franchise.

The Republican state committee at Des Moines yielded to the demand of the labor unions and removed the instrument of the Iowa Telephone Company from its office, thus cutting off long-distance connection with the county committees through the state. The unions have a boycott on the Iowa company.

The Humboldt Home Mutual Telephone Company of Humboldt, Iowa, has consolidated with the Rural Union Telephone Company of Ottosen, Bradgate and Livermore, Iowa. The latter company has over 400 rural and exchange connections and numerous long-distance connections.

The Iron Range Telephone Company will install a central-energy switchboard of 1,000 connections for its Crookston (Minn.) office in the spring. The company's present board has a capacity of 400 connections, and there are already 365 subscribers, with more coming steadily.

The Northwestern Telephone Exchange Company furnished election returns to the Twin Cities from the eastern states, the Minnesota returns and the local vote in excellent shape, handling the work rapidly and accurately. R.

Southern Telephone Developments.

One of the biggest deals in some time is reported from Newberry, S. C., by which the Southern Bell Telephone Company absorbs the Independent system of exchanges at Newberry, Spartanburg, Greenville, Union and other points. L. W. Floyd of Newberry will continue as manager of these interests for the Bell company. These exchanges were formerly operated by Philadelphia capitalists.

The city of Augusta, Ga., has voted a 50-year franchise to the Southern Bell Telephone Company to place its wires underground. The Bell company is also preparing to erect a new building in Augusta, to be used as a central station.

The Richmond (Va.) Telephone Company will begin the work of placing its wires underground about November 20th. An order has been placed for 200,000 feet of conduit material.

The Southern Bell at Danville, Va., states that long-distance lines will soon be put in operation to Martinsville and South Boston, Va. The concession from the company was secured through the Business Men's League.

Telephone lines are being built in all directions to the farms in the section about Knoxville, Tenn.,

and, it is said, that every progressive farmer within 10 miles of that city will soon be supplied with telephones.

The Bell company has laid a 4,000-foot cable across the channel to South Jacksonville, Fla., to connect with the Bell lines to St. Augustine and Palatka. The St. Augustine-Palatka line has recently been completed. L.

Indiana Telephone Items.

The telephone system and service between Mishawaka and a score of northern Indiana towns and cities was completed during the past week, thus making complete the telephone loop from central Indiana cities to near the Michigan line.

The Lafayette Telephone Company has filed a mortgage for $150,000 on its plant, system and franchise, for the purpose of making extensive improvements and extensions in the system. A complete common-battery multiple system will be installed and other modern improvements made. The Lafayette Loan and Trust Company will act as receiver for the bondholders, the mortgage being executed by the company in favor of the bondholders.

A band of bold wire thieves has been arrested at Muncie. Three linemen, employed in the construction of a new telephone line into Muncie, and a junk dealer have been placed in jail charged with stealing copper wire. They have confessed to making a business of stealing copper wire from telephone and traction companies.

It is estimated that the receipts of the telegraph companies last week were only about half what they were two years ago in the matter of collecting election returns. The telephone companies gave excellent service and reached to nearly every point in the state. F.

Ohio Telephone Notes.

Workmen on the Tuscarawas Telephone Company's line near Canal Dover, were driven away from their work by five farmers last week, and a number of poles which they had erected were cut down by the men, who objected to the line being built in front of their farms, which adjoin each other. Manager O'Betz secured warrants and had the men arrested, after which the poles were erected and the wires were strung. The men will be given a trial later on.

The Cleveland Telephone Company and the Barber Asphalt Company had some trouble over the building of conduits last week, and the trenches dug by the telephone company were filled up by their opponents, but the matter has been settled, and the telephone company is again at work.

The Home Telephone Company has opened its East Side Exchange at Toledo, and 300 subscribers are now furnished service from there. The exchange has a capacity of 840 drops.

A. S. Bell has been chosen secretary of the Madison-Clark Telephone Company, to succeed J. C. McMillan, who resigned a short time since.

The Champaign Telephone Company of Rosewood, Champaign County, has been incorporated with a capital stock of $15,000. O. M. C.

Michigan.

Chairman S. T. Douglass and Secretary C. F. Hammond of the Michigan Telephone minority-interest committee have had a conference with President Fish of the American Telephone and Telegraph Company and representatives of the Boston majority-interest and bondholders' committee, and have satisfied themselves that the minority interests will be respected. Steps will now be taken to complete the organization of the minority interests and secure the deposit of stock, for the purpose of being in a position to deal more definitely with the Bell people in the near future.

The Michigan Telephone Company is at present the only telephone company doing business in the city of Detroit, but the council is about to consider the franchise of the Consolidated Telephone Company. In January, 1901, a franchise was granted to J. W. Martin of Pontiac and subsequently transferred to the Everett-Moore syndicate, which partially built a new system before its failure. Last February Hamilton Carrhart and others were given a franchise for the Co-operative Telephone Company, and a number of people invested in it. Now it is proposed to amalgamate the Everett-Moore company, known as the People's Telephone Company, with the Co-operative company, thus forming the Consolidated company. W.

Bell Telephone Output.

The following is the report of the American Telephone and Telegraph Company for periods ended October 20th:

October:	1902.	1901.	1900.	1899.
Gross output	92,601	95,655	67,198	50,861
Returned	37,155	23,374	30,737	18,044
Net output	55,446	72,281	36,461	32,817
December 21st to October 20th:				
Gross output	900,935	778,826	524,362	539,598
Returned	383,844	324,663	220,698	163,271
Net output	517,091	451,163	303,664	376,327
Outstanding Oct. 20th	3,042,697	2,406,979	1,881,169	1,501,577

The electrical employes' strike against the Rocky Mountain Bell Telephone Company at Boise, Idaho, has been called off, the employes getting all they asked for.

Pay-station Service.

Telephone companies, Independent as well as Bell, are giving more attention to pay-station service. On this important subject G. H. Morgenstern of the Chicago Pay Station Company says: "The various concerns manufacturing pay-station apparatus are expressing their pleasure at the bright outlook of this service for the future. This, of course, is practically a new form of service and requires considerable 'missionary work.' Many of the large exchange companies are going into it in an encouraging manner, and the results they are obtaining are not only gratifying to themselves but also to the manufacturers of this apparatus. It has been proven time and time again that wherever these stations have been placed at convenient points in a territory and have been advertised in the list of subscribers in an attractive form so as to bring them to the attention of the public, the service is thoroughly appreciated for the reason that a stranger or patron who would like to hold conversation with a person who has no telephone can locate him through the telephone company and hold conversation from some convenient pay station. This, of course, avoids annoyance that many patrons of telephone service suffer by having strangers enter their places of business, and in some cases residences, for the purpose of using the telephone. This abuse or misuse of the telephone results in nothing but a loss of time to the telephone company (which is equivalent to money) and inconvenience to the patron.

"Besides the use of pay stations in exchanges many companies are using them as a toll-station equipment in the more remote sections. In the South many large plantations have a 'coin collector' in connection with the instrument so that it not only serves the purpose of a private telephone, but strangers are compelled to deposit the proper amount of money before holding conversation. This reduces the chances for loss to a minimum.

"I have noticed that where this service is properly conducted it also serves as an incentive for people not having telephones to have them installed, as where pay stations are available a lady will not go to the trouble of appearing in a public place to use the telephone merely because she does not desire to go to the expense of having one in her own home. It is readily seen that where a charge of five cents is made for local service a non-subscriber using the telephone regularly would see that it would be to his advantage to have a telephone installed at any rate decided upon. Pay stations are an educator, and a generous use of them results in a very satisfactory advertisement for the company. I have been informed that the revenue in most every case exceeds the maximum income resulting from flat-rate service."

Kewanee, Ill., to Have Central-energy Telephone System.

The City Council of Kewanee, Ill., recently granted a 25-year franchise to the American Electric Telephone Company, represented by H. C. Dodge, to install and operate a central-energy telephone system in Kewanee, Ill. The company agrees to furnish the city 25 telephones free and allow the fire and police-alarm wires to be run on its poles. All wires within the fire limits are to be underground with the exception of the outlets in each block where a distributing pole will be placed. The system is to be metallic circuit with long-distance transmitters, and the company is to post a bond of $3,000, to liberate the city from any damages that may arise. The prices fixed for service are as follows: For independent circuits for business houses, $2.50 a month; for residence independent circuits, $1.50 a month; for four-party business telephones, $1.50 a month, and for four-party residence telephones, $1 a month.

The new company is granted 60 days within which to accept the franchise, and during that time its employes will solicit subscribers. Kewanee already has a telephone system, owned and operated by the Central Union Telephone Company, which company has about 500 subscribers. This company says it will remain "right where it is," although bad service is reported to have been the cause of the council's action favoring a second system in the town. The new company agrees to allow all country lines to enter its central exchange at a reasonable figure, a disagreement on that figure to be settled by an arbitration board, whose decision shall be final. The council vote stood five to four.

Improvements in Salt Lake City.

On November 2d a complete change of switchboards in the Salt Lake City office of the Rocky Mountain Bell Telephone Company's system was made, and the lines have now been connected with the new board and telephones working successfully throughout the entire system, which is operated by central energy. Salt Lake has been a "back number" in telephone service for years, and this change is much appreciated by merchants and others who have long since become accustomed to the use of up-to-date eastern telephones. Manager Murray is having all cranks removed from telephones, and during the next 30 days the new-style instruments will replace those at present in use. This will require 3,500 new instruments.

A new telephone system is to be installed at New Decatur, Ala., by James S. Brailey and others.

Trusts Must Advertise.

[From the Chicago Record-Herald.]

Not all persons who have watched the rise and decline of the "bicycle craze" will agree with Colonel Pope in his contention that the bicycle could be restored to its former popularity or that the yearly output of wheels could be brought to the high-water mark of five years ago through a resumption of the extended and liberal advertising campaigns which marked the wonderful development of this industry.

At the same time, there is little doubt that publicity would go far toward retrieving the losses incident to the formation of the bicycle trust, in which the individuality of each particular make of wheel gradually disappeared from public view and the appropriations for advertising were naturally curtailed.

The bicycle has become a utilitarian vehicle in every city and town where the street pavements will permit of its use. One only needs to visit such cities as Washington and Buffalo, where asphalt paving prevails, to fully realize this fact. That the bicycle is the swiftest, most convenient and economical vehicle for transit over short distances ever devised is now generally conceded. In cities with asphalt or macadamized streets children ride on bicycles to and from school, workmen ride to and from factories, and clerks utilize them to get to and from the stores. The status of the bicycle as a utilitarian vehicle in such cities is fixed. Nothing can disturb it.

The bicycle business therefore is not "dead." From a social fad or pastime wheeling has reached a utilitarian basis. What is needed now is a revival of the old-time competition between the different makes and styles of wheels, which was practically destroyed by the formation of the trust. It was the advertising incident to this keen competition that popularized the wheel. The only way, therefore, to impress the public with the utilitarian value of the wheel is to again inaugurate a vigorous and extended campaign of publicity.

It was thought at the beginning of the present era of combines that one of the first items in the cost of distribution to be cut off in each consolidated industry would be the appropriation for advertising. But with nearly every other portion of the old machinery of distribution cut off the combines have found themselves more dependent upon the agencies of publicity than before.

Forming a combine may cut down the cost of production and distribution, but it does not market the product of the consolidated plants. The goods must be sold. And in the absence of the ordinary channels of distribution, the appropriations for advertising and the thought and skill displayed in its preparation must be increased rather than diminished.

Colonel Pope is not the only head of an industrial combine who has learned this fact.

Arbitrators Decide in Favor of Union Traction Employes.

The board of arbitration which has been considering the claims of the employes of the Union and Consolidated Traction Companies of Chicago for better pay and improved working conditions handed in its decision on November 6th. The decision is in favor of the employes, as the trainmen of both companies get an increase in pay varying from 10 to 20 per cent., and the board recommends that Union No. 2, the benevolent association formed by the companies, be abolished, as it is found to "create dissatisfaction among the men and to affect the efficiency of the service."

The sessions of the board of arbitration extended over six weeks, and the decision was given unanimously. The members of the board were: Arbiter, W. J. Onahan of the Home Savings Bank; representative of the companies, Wallace Heckman, attorney; representative of the union, Clarence S. Darrow, attorney. The findings of the board were as follows:

The wages of motormen and conductors running electric cars on the Union Traction lines and conductors of grip cars or trains shall be 24 cents an hour, except as hereinafter provided.

The wages of gripmen and conductors operating more than one car, including combination grip cars, on the Union Traction lines shall be 25 cents an hour.

The wages of the motormen and conductors of the Consolidated Traction Company shall be 23 cents an hour.

Employes who have served the company for less time than six months shall receive the same wages as are now paid, provided the company shall not discriminate so as to discharge old employes and take on new ones for the purpose of hiring at the lower rate.

Trippers shall receive $1.75 a day, excepting such trippers as have not been in the employ of the company for a period of six months; and as to such trippers, the rate shall be the same as now fixed.

Night men on the West Side shall receive 40 cents an hour; night men on the North Side shall receive $2.50 a night, for such men as now receive $2.25, and $2.65 a night for such men as now receive $2.40.

This scale of wages shall be in force and effect from September 15, 1902, to May 31, 1904.

The decision affects 650 men on the Consolidated system; 1,900 on the West Side and 850 on the North Side Union Traction systems, and means an additional expenditure of $350,000 a year by the company. The agreement was ratified at an enthusiastic meeting of the union.

The Hampton (Va.) Telephone Company has been reorganized. Most of the company's stock recently changed hands. The new company's officers are as follows: President, W. T. Gentry of Atlanta, Ga.; vice-president, Col. Hunt Chipley; secretary and treasurer, S. Gordon Cummings.

The Work of the Signal Corps.

PART I.

Washington, D. C., November 5.—The annual report of Brigadier-general A. W. Greely, chief signal officer of the United States Army, shows what advances have been made by the Signal Corps, in the practical applications of electricity to its interesting work.

The report covers the operations in Alaska, Cuba, the Philippines and the United States, and in speaking of the work in Alaska attention is called to the fact that, in view of the remoteness of that region, it has been found necessary to continue in force the appropriations made available under the act of Congress of May 26, 1900. Not only the remoteness of the region, but in addition to this the shortness of the summers and the extreme physical difficulties of transportation and line construction naturally rendered it impossible to complete this work during the fiscal year of 1901. In fact, it is not expected that this work will be completed before 1903. Owing to the fact that officers of the War Department who were originally in charge of this work have been transferred to the Philippines, it has been necessary to continue operations under the direct supervision of General Greely, as the only officer of the Signal Service who was sufficiently familiar with the work to carry it on successfully under the peculiar existing conditions.

ALASKA.

As originally planed, the Alaskan telegraph system simply brought the territorial military posts in communication with each other and with the commanding general of the department, then stationed at St. Michael, but did not afford means of telegraphic communication outside of the territory of Alaska.

Through conference between the Canadian government at Toronto and the chief signal officer of the United States Army co-operation in telegraphic work between the Alaskan and Canadian systems was established. The distinguished premier of Canada, Sir Wilfrid Laurier, in consenting to recommend favorable action on this co-operation to the Canadian Parliament, expressed personally to the chief signal officer of the army his desire to further any plan which would bring the United States and Canada into closer and more cordial relations, especially in Northwest America. The Canadian Parliament, having made an appropriation, therefore, its own system was extended from Ashcroft, on the Canadian Pacific Railroad, to the international boundary line, between Dawson and Fort Egbert.

As a result of this co-operative work, the telegraph line between these two points was completed on May 5, 1901, placing the American territory on the Upper Yukon in direct telegraphic communication with Skagway, whence by steamer telegrams could reach Washington in ordinary conditions in four days. On September 4, 1901, the Canadian line between Dawson and Ashcroft was completed, thus bringing the Upper Yukon region of the United States in direct telegraphic communication with Washington and the rest of the commercial world.

In the Department of Alaska Brigadier-general George M. Randall, the commanding general, has shown not only an unusual official interest in the construction of lines during the period of his service at St. Michael, but his personal advice and activity, invaluable to the Signal Corps of the Army, have been maintained since the transfer of headquarters to the Department of the Columbia, Vancouver Barracks, Wash. The same spirit of helpfulness and assistance has been experienced at the hands of the officers of his staff, and, with very rare exceptions, from the commanding officers of posts.

It was considered, in view of the extremely conflicting opinions as to the possibility of such a line, best for the chief signal officer to make a preliminary reconnaissance of the route in person, and this was done in 1900. This not only afforded invaluable knowledge to the chief signal officer of the army as to the topographical features of the line construction, it also confirmed his belief that such a line could be built and operated, despite the predictions of many persons of Alaskan experience, that such work was impossible of execution. It was considered best by General Greely, to bring as speedily as possible as many posts into communication with each other and with the adjoining telegraphic stations as practicable, so that practical results might the more speedily be obtained, thus leaving the graver and more difficult parts of the problem for later solution.

Efforts were therefore directed, first, to connecting Fort Egbert with Dawson City; second, to connecting Fort Davis, near Nome City, Alaska, with Fort St. Michael, and the headquarters of the commanding general of the department; third, to connect Fort Liscum, Prince William Sound, with Fort Egbert, over what is popularly known as the all-American route to the Klondike; fourth, to connecting department headquarters at Fort St. Michael with Fort Gibbon at the mouth of the Tanana River; fifth, to connecting the military post at Skagway with Juneau, the capital of Alaska; sixth, to connecting Fort Gibbon with Fort Egbert, either via Rampart, or, seventh, along the Tanana River by such route as developments might make advisable.

By the extraordinary energy and activity of officers and men of the Signal Corps, heartily seconded by the officers and men of the line in Alaska, the first six lines have been completed, leaving only the seventh for the coming fiscal year.

The connection between Fort Egbert and Dawson was completed on May 5, 1901. The connection of Fort Davis, at Nome, with Fort St. Michael, was originally contemplated to be by a direct cable, but consideration of the usual ice condition of Norton Sound, and in deference to general consensus of opinion, confirmed by a personal inspection of the terrain near Nome City, caused General Greely to believe that a cable thus laid could not survive the action of the polar pack along the coast of the open roadstead of Nome. In consequence, it was decided to lay a cable between St. Michael and Safety Harbor, where the cable, laid in the middle of the channel, would be at least partly protected from the polar pack, and thence reach Fort Davis and Nome by a land line.

A first-class telegraph line on iron poles, was constructed under the supervision of Major John T. Van Orsdale, Seventh Infantry, from Nome City, through Fort Davis, to Safety Harbor.

In laying the cable between St. Michael and Safety Harbor, the general decided to follow the same lines of operation as is pursued by commercial cable companies, and consequently invited proposals looking to the laying of the cable under the usual conditions, whereby payment is only made after it shall have been in successful operation for 30 days.

The award was made to W. R. Brixey of New York, but unfortunately the steamer Orizaba, engaged in laying the cable, was wrecked near St. Michael, Alaska, on September 17, 1900. The lateness of the season made it impossible to obtain any outside aid. Eventually, the cable was reclaimed and laid by the Alaska Commercial Company, and communication opened between Nome and St. Michael on October 17, 1900.

After having to be again repaired by the contractor, the cable was received by the government and was operated during the following summer and autumn, when it was again interrupted by the polar pack on November 24, 1901. It therefore seemed advisable to try other means of communication. The achievements of wireless telegraphy having been strongly advanced, recourse was had thereto, in the hopes that one of the commercial systems might prove to be satisfactory. Proposals were invited, and on the recommendation of a board of signal officers the award was made to the lowest bidder, Queen & Co. of Philadelphia, who guaranteed to establish, in working order, between Nome and St. Michael, the Fessenden system by October 1, 1902. It became evident some weeks since that the contract could not be completed without an extension of time, which the company has lately urged on the Signal Office.

As soon as delay in the wireless system became evident, General Randall urgently requested that an attempt should be made to repair the Nome-St. Michael cable this autumn. The general found that the only possible chance of compliance with this request would be in sending signal experts by steamer, and, accordingly, with only three hours' notice, Captain Walter L. Clarke, with two skilled Signal Corps' men, left for Alaska, leaving San Francisco on September 10, 1902. However, it seems more than probable that the cable will not live in Norton Sound, unless it is taken up and transferred considerably to the eastward, so as to run into Golovin Sound, which would require the extension of the land line some miles to the eastward. This may possibly be done during the summer of 1903, unless in the meantime a system of wireless telegraphy can be installed satisfactorily. While there is an uncertain outcome, yet this action is in keeping with the policy of meeting the demands of the line of the army in grave emergencies.

The Yukon line extends from the department headquarters at Fort St. Michael to Fort Gibbon in the Yukon Valley. At the end of the summer of 1901, 222 miles of this line had been built, of which 138 miles were constructed under the officers and non-commissioned officers of the Signal Corps, and 84 miles under the supervision of five officers of the army. Notwithstanding the urgent orders of General Randall, the work done under the officers of the line progressed very slowly. These officers, however, labored under very many disadvantages, not being technically trained in construction work, and being, in addition, loaded down with multifarious duties. Signal Corps' detachments from the Philippines were diverted to this work, and the officers in charge were increased from two to four, and this caused men fresh from the tropical climate being sent directly into an Alaskan winter. Lieutenant Gibbs applied himself to the work of construction in the Lower Yukon with great energy, and his efforts were so well directed that the line was opened to Fort Gibbon on November 18, 1901. This placed in direct communication with one another Nome, St. Michael and Fort Gibbon by combined land line and cable system of 408 miles in length. The importance and value of this connection may be estimated by the fact that the ordinary mail time between these two points is 29 days.

A line 420 miles in length has been constructed running from Fort Liscum through Keystone Canyon to Copper River Valley, with stations at Copper Center and Chistochina, through Mantasta Pass, across the Tanana Valley to Kechumstock, near the headwaters of Forty Mile Creek; thence into Eagle City and Fort Egbert. Of this line, about 280 miles were built by Captain Burnell, about 125 miles by First-lieutenant William Mitchell, Signal Corps, and the balance of 35 miles by an officer from Fort Egbert. The road is one of remarkable solidity.

The toil and hardships experienced by these and all other working parties—enlisted men of the line, the Signal Corps and civilian employes—cannot be fairly appreciated by anyone unfamiliar with Alaskan trails. Suffice it to say that every pound of food, forage, tentage, etc., wire, insulators, or line material, has to be moved by pack animals over a trail so rough that an animal cannot travel over 15 miles a day. Cold and rapid glacial streams, swampy morasses, tangled underbrush, steep declivities, narrow canyons, thick timber, and sharp ridges alternate to tax the strength of man and beast to the utmost. It is certain that no body of men in Alaska render more faithful and valuable service to the country than do the enlisted men of the army, especially to the telegraph trails.

The line built along the Yukon from Fort Gibbon to Rampart City was constructed with a view of reaching Fort Egbert by a direct route across country to Circle City, and thence following the river. Captain Greene was unremitting in his efforts to find a suitable route, adhering to the opinion that it was the most direct, and, indeed, the only practicable way. The outcome was so unsatisfactory that General Greely stopped the line at Rampart City, and adopted the Tanana route. This was only done after four expeditions had undertaken the work.

The line from Fort Gibbon to Rampart City was completed in January, 1902, by Lieutenant George S. Gibbs, to whom and to his party special credit is due, owing to the adverse conditions of climate and country.

The location of a military post at Skagway, contiguous to the poorly defined boundary between Alaska and Canada, made it of primary importance that there should be telegraphic communication between Juneau and the federal forces at that point. It seemed best to make this connection by cable instead of by land wire. The award for the laying of this submarine cable between Juneau and Skagway was made to W. R. Brixey, under the usual condition of no payment until the cable had been in successful operation for 30 days. The cable was installed on August 22, 1901, but was interrupted after working a few days. Diligent efforts were made by the contractor to restore communication, which were unsuccessful last year, owing to the lateness of the season and the prevalance of inclement weather. The cable was, however, placed in good working order and opened to business on June 2, 1902. Ignoring the military value of this cable, its commercial importance to Southeastern Alaska is apparent from the fact that the combined governmental and commercial tariffs for June, 1902, exceeded $500.

The Tanana section is yet under construction, and such steps have been taken as will, it is hoped, secure its completion before the end of the present fiscal year.

The difficulties attendant on the connection of the Egbert-Liscum line with the Gibbon-St. Michael line have occupied the attention of the Signal Office for the last two years. There are three routes under consideration, the first via the Yukon Flats; the second, via the Tanana Valley, and the third from Rampart City via Beaver Creek to Circle City, and thence to Fort Egbert. The matter has been the subject of several expert opinions by the heads of the exploring parties, and fearing that the delay would be most prejudicial to the public interests, General Greely made the matter one of personal attention, carefully supplementing his own knowledge on the subject of Alaska by all sources of information available at Washington. As a result, he concluded that the Tanana Valley afforded the only route over which a telegraph line could be constructed and maintained, and on February 7, 1902, issued telegraphic instructions accordingly. This route presented the obvious advantages of easy transportation in summer by boat as far at least as Bates Rapids. Orders were therefore given to construct the line by this route as far as Bates Rapids, and thence across the Delta River should Captain Burnell find that route to be practicable. Later examinations showed that the latter would not be practicable, and it was decided to build the line from Bates Rapids along the northern bank to Tanana Junction, on the Egbert-Liscum line. The outcome has fully justified the wisdom of these decisions. Work was commenced in February, 1902, and First-lieutenant Gibbs has prosecuted it with such judgment and energy that at last advice no less than 100 miles of permanent line had been constructed, while the wires for a temporary line had been extended 150 miles beyond. It is expected that the field work will continue all winter unless the weather conditions should prove exceedingly adverse.

The lines completed up to August 24, 1902, were as follows: Nome to Fort Davis and Port Safety, 24 miles; cable, Port Safety to Fort St. Michael, 123 miles; St. Michael to Fort Gibbon, 251 miles; Fort Gibbon to Rampart City, 61 miles; Fort Egbert to International Boundary, 11 miles; Fort Liscum to Fort Egbert, 420 miles; cable, Juneau to Skagway military post, 121 miles, Fort Gibbon up Tanana Valley, 100 miles, making a total length of line completed up to the date named of 1,121 miles.

The connection of the new post at Haines Mission with Skagway by either cable or land line should be completed in the spring of 1903. The accomplishment of the construction of these 1,121 miles of land and submarine cables within 24 months would be most creditable to the officers and men concerned therein, if Alaska was an ordinary country, for this work included not only surveying, construction and installation of this length of line, but also involved the manufacture and inspection of enormous

quantities of material, instruments, etc., many hundred tons in weight, and their transportation over distances ranging from 4,000 to 7,000 miles.

When one considers, however, the exceedingly difficult physical conditions within the territory, the work must be considered simply phenomenal. In all the parts of Alaska traversed by this great length of line there are not a dozen miles of wagon road. The region through the Tanana Valley, where hundreds of miles of wire have been laid, is marked upon most charts as an unexplored region, and there was in existence until reconnaissances were made by the Signal Corps' officers no accurate map of the valley. In line building all work, apart from the Yukon River, has been made by pack animals. On the Valdes section all the wire, insulators, nails, etc., have been carried on mules' backs, some of it a distance of 100 miles, and great quantities of it a distance of 50 miles and over.

It has fallen to the lot of the chief signal officer of the army, in his official career, to be charged with duties more or less arduous in character, but there has been none which in the extent and scope of its difficulties has exceeded those connected with the construction of this great system of public works in the wilds of Alaska.

The labors and hardships of officers and men can never be duly appreciated save by those having personally known the conditions of Alaskan trails, and the work in question does not appeal to the public imagination as that of China, Cuba and the Philippines. Timber is locally abundant, but everything else has to be supplied—food, shelter, and human society. One officer forcibly writes that what appalled him was the enormous distances from one handful of humanity to another in the valley of the Yukon.

It may be added that the Signal Corps is applying to the difficult task of telegraph maintenance and operation in Alaska the most improved devices in the way of equipment and instruments. As representative of this equipment, a combined buzzer and telegraph set has been devised by Captain Edgar Russel, Signal Corps. With this instrument, unless the wire is actually broken, messages can be transmitted despite electrical leakages caused by imperfect grounds.

CUBA.

The operations of the Signal Corps of the army in Cuba terminated with the evacuation of the island on May 20, 1902. The Signal Corps' duties, including the operation of the entire telegraphic system of the island, were supervised during the fiscal year by Captain Otto A. Nesmith. The great increase in commercial business testifies to the growing utility of the entire system.

There were comparatively short extensions—230 miles—of the telegraphic lines during the last year, yet the labor of repair and maintenance was very considerable. The new lines constructed were as follows: Caibarien-Yaguajay, 11 miles; Palmarita and Mayari, 40 miles; Santiago City, 40 miles, and Guantanamo toward Sagua de Tanamo, 102 miles. A submarine cable, 16 miles in length, was laid between Caibarien and Cayo Frances, with a connecting land line of 6¾ miles. For artillery rifle-range practice temporary lines are built at Columbia Barracks and land lines between Vedado and Santa Clara.

Through Captain Nesmith's vigilance, efforts on the part of private persons or corporations to establish telephone lines unauthorized by law was prevented, thus subserving the rights of the government of Cuba, in which, by law, all telegraphic and telephonic rights are vested.

In formulating regulations regarding private lines, a proper discrimination was exercised toward persons operating private telephone lines from which no revenue was derived, and for which informal authority had been previously granted by Spanish officials for their construction and operation.

The efficient character of the work done by the Signal Corps in the construction of the Cuban telegraphic system is illustrated by practically uninterrupted telegraphic transmission throughout the year. Despite the unfavorable climatic conditions and topographical difficulties, there was but one occasion during the year, for a period of five hours only, when the wires between Havana and Santiago were completely interrupted. This occurred during the violent hurricane of September 13th to 14th.

The volume of commercial business increased to such an extent that additional wires were necessarily strung on many miles of poles during the year. In order to avoid further expense in this direction, a most satisfactory test of duplex instruments was made during March, 1902, and, contrary to the pessimistic views of many operators, the instruments worked with great success. Steps were promptly taken to duplex the entire line between Havana and Santiago, but owing to unexpected delays, the installation had not been perfected when the transfer of the lines to the Cuban government took place.

Cordial relations continued between the Signal Corps and the various commercial cable companies operating on the island, although, under instructions from superior authority, it became necessary to decline to accept from, or tender to, the French Cable Company any message to or from any point in the United States, Europe or beyond. The International Ocean Telegraph Company continued its courteous co-operation in the time service, transmitting regularly for the Signal Corps time signals from the Naval Observatory in Washington at 12 noon of each day, in connection with which was operated the time ball by the captain of the port. Time was furnished with such accuracy and regularity to the U. S. S. Eagle and the U. S. S. Yankton as to facilitate their surveys and elicit complimentary acknowledgment.

The policy of substituting Cuban for foreign employes was steadily pursued during the year, so that on April 30, 1902, but 18 per cent. was foreign against 82 per cent. Cuban.

One of the most important of minor improvements was the establishment of free delivery of messages, the messengers having been accustomed from time immemorial to exact a fee for delivery.

There were handled during the first nine months of the fiscal year 206,294 commercial and 121,226 official messages, which for an entire year would make proportionately about 440,000. As compared with the previous year, it is worthy of remark that there was an increase of over 20 per cent. in commercial messages as against one per cent. in official messages.

The receipts for commercial messages during the 10 months ending April 30, 1902, amounted to $80,436.63, as against $64,755.11, for the same period of the previous year, an increase of 25 per cent. The value of official messages at the regular tariff rates amounted to $95,151.53. Captain Nesmith says: "At the time of transfer a stable and permanent system had been constructed. The length of telegraph wires in operation on the island amounted to nearly 3,500 miles, extending from San Juan y Martinez, on the western end of the island, to Cape Maysi, on the extreme eastern end, with every point or seaport of business importance on the island electrically connected, while, in addition to the telegraph lines, important telephone systems of many miles in extent were constructed and maintained where necessary for the proper transaction of public business. The government cables were repaired and renewed and kept in operation, and new cables, of which the cable from Caibarien to the Cayo Frances was the most important, laid as the best interests of the island required. On May 20, 1902, there were 90 offices in operation and open for business, while the employes numbered 316."

Besides giving Captain Nesmith much praise for his work in Cuba, General Greely calls attention to the work of Colonel H. H. C. Dunwoody of the Signal Corps, and to the other officers and men of the Signal Corps who were engaged in the work.

[*To be continued.*]

Sanitary District Wins in Canal-power Suit.

Judge R. W. Hilscher in the Circuit Court of Will County, Ill., handed down a decision on November 7th dismissing the condemnation suit brought by the so-called Gaylord syndicate, which sought to condemn the property of the Sanitary District for the purpose of creating a waterpower below Joliet on the Desplaines River. The court held that Chicago's public waterway must not be diverted to private use.

The decision is considered a great victory for the sanitary trustees and, incidentally, for the city of Chicago. It is construed by the trustees as preserving the waterpower to the Sanitary District and protecting it henceforth from the encroachments of outsiders. It is believed that it will make possible the plan of the trustees eventually to develop and utilize sufficient power to light the city of Chicago. The case will be appealed and carried to the Supreme Court.

It is announced that the work of the Sanitary District on the power development at Joliet, which was stopped by an injunction suit, will be soon taken up again, together with that at Lockport. William H. Baker, one of the trustees of the district, has two plans to give the waterpower of the drainage channel at Lockport and Joliet to the city of Chicago. One is for the board to ask the Legislature to pass a measure authorizing the drainage board to develop the waterpower for the city and the other is to have the city develop the power itself.

Power Plant for London Underground Roads.

The Underground Electric Railways Company of London, England, is pushing the work on its great power plant. The building is to be located close to Battersea bridge on the banks of the Thames. It is to be completed and ready for use in the early part of the year 1904. The company now has 320 men working on the foundations with 15 steam cranes and pile drivers. The main building will be 453 feet long and 175 feet wide. A small building for offices will be located near by. The electrical plant will generate 80,000 normal horsepower, with the maximum capacity much greater. In addition to the main station 20 sub-stations will be erected, but these will be but small affairs and will be stored away under sidewalks or under street corners.

Towering above the power house will be four chimneys 275 feet high, with an internal diameter at the base of 19 feet. Two of the chimneys' foundations are practically completed. The machinery for this plant is now in various stages of construction at different places.

The Jackson and Battle Creek (Mich.) Traction Company certifies to an increase in capital stock from $900,000 to $1,500,000.

CORRESPONDENCE.

New York Notes.

New York, November 8.—The Pennsylvania tunnel franchise, as revised by the Rapid Transit Commission, has been accepted by the railroad company and is now in the hands of the aldermen. The revised franchise differs from the original one on the following points, and to these the railroad company subscribes: First, to give the city the use of the tunnel for fire and police-telegraph wires; second, to substitute a fixed limit of time within which the franchise must be availed of, and, generally, so as to limit, by a fixed date, the indefinite power of extension of time, reserved in the first franchise to the Rapid Transit Commission; third, sanitary control of the tunnel by the Board of Health; fourth, to make it clear that at each new period of valuation, the authorities of the city and of the railroad company of that day can adopt any basis of compensation that may then be agreed upon; fifth, to provide that if at any time it is proposed to grant under this franchise the right to do local traffic, the terms upon which such right is granted shall have the approval of the Rapid Transit Commission, the aldermen and the mayor, and sixth, to provide that the franchise shall always be controlled by some company organized under the laws of the state of New York. Neither the original nor the amended franchise contains the eight-hour labor clause, and this is the main cause of the opposition to the ratification of the document by the Board of Aldermen.

A local paper recently stated that H. H. Vreeland, president and manager of the Metropolitan Street Railway Company had been offered and had accepted the management of the Yerkes system of underground railways in London, England. The statement has been officially denied by Mr. Vreeland, who says he has no present intention of leaving the Metropolitan company.

A petition in involuntary bankruptcy has been filed against the American Union Electric Company, manufacturer of rail bonds, trolley wheels, fare registers, etc., of 15 Cortlandt Street, by the following-named creditors: John A. Roebling's Sons Company, $388; Dannan & Davis, $226, and the Steele & Johnson Manufacturing Company of Waterbury, Conn., $78. It was alleged that the company is insolvent, permitted the appointment of a receiver, to whom it transferred part of its property, on October 27th, transferred a part of its property to the Garvin Machine Company, and allowed creditors to obtain preference by judgments.

An order was signed last week authorizing the sale of the Hoboken (N. J.) plant of the American Electric Vehicle Company for $15,000 cash. The order was issued on the recommendation of Charles J. Roe, who was appointed receiver soon after the assignment of J. Herbert Ballantine, who was largely interested in the enterprise. The prospective purchaser is George T. Lyster, formerly vice-president and general manager of the company.

On the evening of October 31st the eightieth birthday of Mr. John Fritz, the dean of American ironmasters, a dinner and reception were tendered him at the Waldorf-Astoria. The evening was one to be remembered. In token of the appreciation of Mr. Fritz's work, the four leading engineering societies of the United States—American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers—have decided to co-operate in the establishment of a medal to bear the name of John Fritz and to be awarded annually for distinguished work in the iron and steel industries. Mr. John Thomson presented the first Fritz medal to John Fritz on the same evening. Letters and telegrams were read by the chairman of the dinner committee, Mr. T C. Martin, from Hon. A. S. Hewitt, Andrew Carnegie, Charles M. Schwab, Irving M. Scott and others

The remains of the late Professor Sidney H. Short have been brought to this city and will be buried at Woodlawn Cemetery on Tuesday next. Services will be held at 2:30 p. m. at the Church of the Messiah, East Thirty-fourth Street and Park Avenue. After the services a special car on the Harlem branch of the New York Central will carry to Woodlawn all who desire to see the body committed to the receiving vault there.

The following incorporations were made during the week:

Queretaro Power Company, Brooklyn, N. Y.; capital, $300,000.

Davis Electric Manufacturing Company, No. 15 Exchange Place, Jersey City; capital, $50,000; incorporators, Raymond Newman, Horace S. Gould, K. K. McLaren.

Marvel Patents Company of Brooklyn, to deal in electrical specialties and novelties. The capital stock is $10,000 and the first board of directors is made up of Elbert Snedeker, Walter S. Crowe and Annie E. Crowe. O.

New England News.

Boston, November 7.—The Watertown and Litchfield Tramway Company has completed the surveys for an electric railway between Watertown and Litchfield, Conn., and will soon award the contract for its construction. The proposed line will pass through a section of Litchfield County that is not reached by an electric railway. At Watertown it will connect with the Connecticut Railway and Light-

ing Company's proposed branch from Waterbury, Conn.

William G. Smith of Waterbury, Conn., a civil engineer, who accompanied the Connecticut railroad commissioners during their recent inspecting tour, has made his report, in which he recommends efficient and reliable visual signals at each turnout on single-track electric railways over which heavy cars are run at high rates of speed. He urges the adoption of the railroad method of "carrying signals" by cars which are closely followed by other cars, recommending the use of a conspicuous light for this purpose.

William D. Smith of Bangor, Maine, has taken the contract to build an electric railway between York Beach, Maine, and Dover, N. H.

The Todd Electric Manufacturing Company has filed a certificate of organization with the Connecticut secretary of state. It has a capital of $30,000 and will make a specialty of the manufacture of the Todd X-ray machines.

The Hartford Street Railway Company's annual report shows gross earnings $780,558, net earnings $243,677, dividend payments $60,000, passengers carried 19,160,216, cars run 4,291,760 miles.

The South Norwalk (Conn.) city government has voted to appropriate $15,000 for the enlargement of the municipal electric-lighting plant and $5,000 for equipping the system with meters. The plant has shown a profit of $5,550 during the last year.

The Lexington and Boston and the Boston Elevated Railway Companies have made an arrangement whereby cars will be run from Sullivan Square, Charlestown District, Boston, to Lowell, Mass., a distance of some 30 miles. The fare is 25 cents. The crews will be changed at Arlington Heights, the end of the Lexington and Boston line.

Euclid Madden, the motorman, and James T. Kelley, the conductor, of the car which ran into President Roosevelt's carriage at Pittsfield on September 3d, were arraigned in the District Court at Pittsfield, November 3d. They waived a hearing and were held for the January grand jury. Madden's bail is $5,000 and Kelley's bail is $2,500.

Robert Dobson of Robert Dobson & Co., owners of the Pioneer Woolen Mills at Pittsfield, Maine, is considering the feasibility of building a dam and using the waterpower for generating electricity for that village.

The Stanley Instrument Company is contemplating another addition to its shop at Great Barrington, Mass. An addition is now nearing completion.

The Pawtucket Electric Company will supply the power for the new plant of the Mossberg and Granville Manufacturing Company, which will be built at Pawtucket, R. I. B.

Southern Developments.

Charlotte, N. C., November 8.—A new power house will be erected and 18 cars will be purchased by the Electric Railway Company of Rome, Ga. The improvements, including a six-mile extension to Lindale, will cost $250,000. Seymour Cunningham of Washington, D. C., is president of the company.

A syndicate is being organized by Frank D. Sweeten of Philadelphia, Pa., to buy the Alabama Light and Power Company at Opelika, Ala., and also to build an electric line to Auburn, 7½ miles. The new company will be capitalized at $200,000. An option has been secured by the new company.

The electric plant being built by an Atlanta, Ga., company on the Chattahoochee River will cost $1,500,000. The concrete dam will be 1,100 feet long from shore to shore, and will be 65 feet wide at the base. About 20,000 horsepower will be developed.

The Atlanta (Ga.) Railway and Electric Company will, in December, inaugurate an increased scale of wages on an average of one cent per hour. Extra pay is also promised men who serve a stated term of years.

The plant of the Staunton (Va.) Light and Power Company, now in the hands of the receiver, R. D. Anderson, will be purchased by Edgar M. Funkhouser and associates.

The Amalgamated Association of Street Railway Employes of Richmond, Va., has begun a number of meetings for the schooling of members regarding their obligations to the public, their employers and the union. L.

Canadian Intelligence.

Ottawa, Ont., November 8.—The government cable steamer Tyrian is laying a cable in the Gulf of St. Lawrence, from Grosse Island to Bryan Island, and from the latter island to Heath Point, Anticosti. This cable will be 114 miles in length. The government's engineer, Mr. Kelley, states that the wireless stations at Belle Isle Strait are doing satisfactory work. He expects that all the government signal stations in the gulf will shortly be equipped with wireless apparatus.

The Montreal electric street railway is now receiving 5,000 horsepower from Chambly. This is the beginning of a contract with the Light, Heat and Power Company of that city. Improvements at the Chambly Falls have been completed, and the total capacity of the power company will be 20,000 horsepower. Next spring there will be a further development of 10,000 horsepower at St. Therese Falls.

In connection with the report that a cable ring is in co-operation with certain Australian governments to place the all-British Pacific cable in a disadvantageous position in competing for Australian business, and that it will ultimately be absorbed by the Eastern Telegraph Company, Sir Sandford Fleming of Ottawa, says that there is an element of truth in the statement. If the Eastern Extension Company is allowed to have its own way, he is quite sure its desire is to make the Pacific cable so unproductive that the governments interested in it will be induced to transfer it to the company.

A large staff of workmen is busily engaged in the completion of the building in which the Ottawa Electric Railway Company will install its large storage battery. The battery is supplied by the Electric Storage Battery Company of Philadelphia, Pa., and is expected to arrive in Ottawa in the course of a few days. When the new storage battery is in operation the Ottawa electric railway, with its present modern hydraulic plant and its auxiliary steam plant, will have a power equipment second to none in the world.

The Montreal street railway carried last year 50,000,000 passengers and showed gross earnings of $2,046,000. Ten years ago the road carried but 11,631,386 passengers and its earnings were only $564,406. The net earnings for the year were $911,032, as compared with $795,413 last year. During the year the company paid the city of Montreal in taxes $127,257, and for snow cleaning $50,771, making a total of $178,029. W.

Information from Indiana.

Indianapolis, November 10.—A meeting will be held in Muncie on Thursday to revive the project to build an electric line from Muncie through New Castle to Cambridge City. E. T. Ice of New Castle is again promoting this enterprise, but the Coulter Brothers of Chicago are announced to be behind the new line. The former attempt, which included an extension to Alexandria, failed because the Union Traction Company of Indiana immediately began the construction of an extension from Muncie to Alexandria. Mr. Ice has already secured the right-of-way from Muncie to New Castle.

The Wabash and Logansport Traction Company has awarded to the New England Engineering Company the contract for changing the electrical system on its line between Wabash and Peru and installing the new system from Peru to Logansport on the extension to the latter place. The direct current now being used will be displaced by alternating current. A large addition will be built to the power house at Rich Valley, one new engine and boiler will be added and sub-stations put in at Peru and just east of Logansport. New equipment is being contracted for and cars will be running from Wabash to Logansport yet this year. The improvements will cost upwards of $350,000.

According to the Lebanon Reporter a conference was held in Lebanon last week looking to the merging or consolidation of the Indianapolis, Lebanon and Frankfort Traction Company, the Lafayette and Indianapolis Rapid Railway Company and the Crawfordsville Company. There is, however, considerable doubt expressed concerning the above report.

The Indianapolis Street Railway Company has received a number of new cars which are similar in pattern and finish to the last big cars bought, except they are not quite so long. The company is extending a number of city lines and has almost completed the College Avenue improvement. The Central Avenue line will be next improved with heavy iron to accommodate the heavy interurban cars of the Indianapolis and Northern line.

The electrical workers of Indianapolis are making an effort to secure the international convention of the Electrical Workers Union next year. They will try to have the vote rescinded which selected Salt Lake City, on the ground that the selected place is too far west. They say that on the application of five of the general officers of the Union a reconsideration and another referendum vote may be taken. These applications can be had, and, with the help promised by the civic societies and the city, Indianapolis can be selected, they say. F.

From the Buckeye State.

Cleveland, Ohio, November 8.—It is said that the village of Middlefield, with a population of about 500 people, is the smallest incorporated town in the state to have an electric-light plant. The plant is operated by a pail factory, which put in a plant for its own use, and then extended it for the people of the village. The town also has two electric roads and another is being built.

The passenger earnings of the Lake Shore Electric for October were $40,636, or $8,000 more than for the corresponding month of last year. There has been an increase in the freight receipts also.

The National Carbon Company has declared a dividend of 1¾ per cent. on its capital stock.

Harry Gallagher of Xenia has asked for a franchise allowing him to operate an electric-light plant in that city. He proposes to organize a company and furnish lights at a much lower price than is at present paid.

It is said that the Supreme Court at Havana has confirmed the franchises granted the Havana and Jamianatas Railway Company, in which Cleveland Youngstown and New York capitalists are interested, and the work of developing the original plans will begin at once. For this purpose, L. W. Pryor, Harry Hayes and George York of Cleveland, George F. Penhale and H. W. Whipple of New York, and W. H. Park and Attorney M. A. Norris of Youngstown will go to Havana at once. Besides the railroads, these gentlemen are interested in a cotton-transportation scheme and the Bahonda Colonization Company. In all, they expect to invest something like $10,000,000.

The Cincinnati, Newport and Covington Traction and Light Company has decided to build a traction depot on Third Street, Covington. The plans have been completed, and it is stated that the construction work will be begun in a short time. The building will be of fire-flashed pressed brick, with white trimmings, and the interior will be fitted up for the offices of the company, waiting rooms and rooms for the employes of the roads using it.

The Suburban Traction Company, the Cincinnati and Eastern Railway Company and the Rapid Railway Company, all of Cincinnati, and all Scrugham interests, have filed articles of consolidation with the secretary of state under the new Chamberlain law passed last winter, which provides that roads which do not compete with each other and which may use the same power house, may be consolidated. It will hereafter be known as the Interurban Railway and Terminal Company, the stockholders having purchased the property of the Scrugham Terminal Company, which now has a building under construction in Cincinnati. The capital stock is to be $2,500,000, with a bond issue of the same amount. The combined roads represent a mileage of about 96 miles, all through good territory. Mr. Scrugham estimates that they will carry about 300,000 passengers monthly into Cincinnati. The officers of the new company are as follows: President, G. H. Scrugham; first vice-president, Lee H. Brooks; second vice-president and general manager, Ellis G. Kinkead; secretary, John M. Kennedy; treasurer, William E. Hutton. Charles H. Davis and Guy Mallon of Cincinnati and George H. Worthington of Cleveland complete the board of directors.

It is reported that the Western Ohio Railway Company, a Mandelbaum road, will be combined with the Cincinnati, Dayton and Toledo Traction Company within a short time and that the Morgan-Widener-Elkins syndicate will be heavily interested in the deal. This is the first move toward the consolidation of the interests of the two syndicates in the state, aside from what has been reported in relation to Cincinnati. O. M. C.

Texas and Mexico.

Austin, Texas, November 7.—Governor Sayers of this state appointed a board a few days ago to investigate the feasibility of the state purchasing the old electric-light and power and waterworks plant of the city of Austin for the purpose of supplying the several state eleemosynary institutions and the capitol building in this city with water, light and power. The city has no use for this plant, as it has a new and up-to-date plant of its own. There are four large state eleemosynary institutions located here, and only one of them has its own power plant. The present cost of providing these institutions and the state-capitol building with water, light and power is almost $75,000 per annum. It is believed that this cost will be greatly reduced by the state owning a central plant.

The action of the Union Traction Company of Cleveland, Ohio, in entering the Texas field with a proposition to build an interurban electric railway between Sherman and Austin, a distance of about 250 miles, has aroused the other interurban electric-railway interests in this state, and hardly a day passes that announcement is not made of other projects of this character in different parts of the state. The most important of these announcements is that the Northern Texas Traction Company, which operates an interurban electric line between Fort Worth and Dallas, is to build immediately 125 miles of interurban lines, making Fort Worth the hub for this extensive system. The lines which are to be built by this company are as follows: Fort Worth to Weatherford, a distance of 31 miles; Fort Worth to Denton, 35 miles; Fort Worth to Cleburne, 28 miles; Fort Worth to McKinney, 40 miles. It is estimated that the cost of building and equipping these lines will exceed $3,000,000. The Northern Texas Traction Company is composed of Ohio capitalists, but it is asserted that it has no connection with the Union Traction Company, also of that state.

The representatives of the Union Traction Company are meeting with great success in securing subscriptions to stock in the company which it is organizing to build the Texas road. Several hundred thousand dollars of stock has already been subscribed by citizens of the cities and towns through which the line will pass, and, in addition to this, the free right-of-way is being given through the counties and valuable franchises donated by the cities and towns. Branch lines are projected from Hillsboro to Itasca, Brandon and other towns in that county.

It is announced that the survey for the proposed interurban electric road between Beaumont and Houston, a distance of about 80 miles, which has been in progress for some time, will be completed by the first of the coming year. Construction work is expected to begin soon thereafter. This line will connect the Beaumont and Sour Lake oil fields with Houston and will handle both freight and passenger traffic.

The largest electrical enterprise in Mexico is being undertaken by the Jalisco Development Company, which was recently organized, and has its principal office in the city of Guadalajara, Mexico. This company has already completed the survey for an electric railway which it proposes to construct

between Guadalajara and Chapala, a well-known watering place, situated on the lake of that name. The distance is about 30 miles. This road will pass through a number of thriving towns. The company has also taken steps to supply electric lights and power to the towns and villages situated within a radius of 30 to 60 miles of Guadalajara. These towns and villages have a population aggregating 60,000 people. The company has entered into a contract with the Fuentes Electric Company, which has a great electric power-generating plant situated on the Rio Grande, near Guadalajara. This company is now capable of supplying 10,000 horsepower. This can be increased to 50,000 horsepower when occasion demands the additional improvement. The officers of the Jalisco Development Company are: President, J. M. Chavez; vice-president, J. M. Zermeno; treasurer, Ernesto Mora.

Francisco Belden of Monterey, Mexico, president of the Empresa Company, which owns and operates an extensive system of street railways in that city, states that there will be a general meeting of the stockholders of the company held at an early day to consider the proposition of either equipping the system with electric power or to sell it to the syndicate of Baltimore (Md.) capitalists who recently bought out the Slayden street-car system in the same city, and was granted a concession and franchise to build an extensive addition to that system, all of which is to be operated by electric power.

An electric street railway, one mile long, is being constructed at Cananea, Mexico.

The Guadalajara Tramvias Company and the Electric Light Company, both of the city of Guadalajara, Mexico, have consolidated their interests. The object of this fusion is to convert the tramway system into electric lines and to utilize the surplus power of the consolidated plants for other purposes. The consolidation deal is to be ratified at a meeting of the stockholders, to be held at Guadalajara, on November 8th.

The Mexican government has just granted a concession to prominent mining men of Temascaltepec, Mexico, to install a plant to utilize 2,000 liters of water per second from the Rio Verde, in that district. This plant is to be used for generating electric power.

A number of large electric plants are being installed in mines in Mexico. It is stated that there is more electrical machinery going into that country now than ever known before.

There is a prospect of the great dam across the Colorado River at Austin, which was destroyed by the flood three years ago, being rebuilt by private capital. H.

Detroit, Mich.

Detroit, November 8.—General Manager C. M. Hayes of the Grand Trunk Railway has confirmed the report that the Detroit and Toledo Shore Line has been purchased by his road, in conjunction with Clover Leaf interests, and will be operated as a steam road in order to gain access to the Ohio coal fields.

In the recent automobile races in Detroit, the electric machine Torpedo, owned by W. C. Baker, made a new world's record for 10 miles by covering the course in 17:58. Mr. Baker also broke the world's record for five miles.

The Windsor, Sandwich and Amherstburg street railway is being extended from Ojibwa to Amherstburg, Ont. American capital controls the road, and American engineers oversee the work, but Canadians will be preferred for hire in the balance of the construction work.

The Michigan Central Traction Company has been incorporated with $200,000 capital to build an electric line between Lansing and Battle Creek.

An electric-railway company, the general office of which is to be in Detroit, has been incorporated and will build a road from London, Ont., to Port Burwell. The road will be called the London, Aylmer and North Shore, and will extend a distance of 45 miles through the counties of Elgin and Middlesex, connecting with the Canadian Pacific at London. Dr. F. Hassler and Dr. F. Hitchcock of Detroit, with New York and Aylmer capitalists, are the incorporators. They will form a construction company and work will be begun at once. The road is expected to be in operation by July 1, 1903.

A novel feature of one of the electric railways building south from Saginaw to Frankenmuth is that all employes must be stockholders. Applicants for the positions of conductor or motorman are being asked to take $100 worth of stock.

Commissioner Bishop of the Massachusetts Railway Commission is expected in Detroit soon to inspect the methods of handling the interurban service and the adoption of electricity to the operation of railroads. The recent convention of the American Street Railway Association in Detroit has done much to arouse the interest of the East in western electrical methods. Much newspaper comment has been made in the East on this convention and its probable effect on electrical railroading all over the country, and the eastern papers, with one accord, declare the western service superior to that anywhere else in the United States.

The Detroit United has ordered of the St. Louis Car Company 25 new vestibuled box cars. These cars will be similar to those in use on the Metropolitan street railway of New York, except that they will have the extended rear platform divided by a guard rail from the passageway. C. G. W.

Northwestern Notations.

Minneapolis, November 8.—Roy Holly of Clarkfield, Minn., has gone to Dawson, Minn., where he takes charge of the electric-light plant.

The Keokuk (Iowa) Electric Railway and Power Company will erect a large new power house, which will be fireproof. The engine room is to be rebuilt of brick. The system of line shafting is to be replaced by direct belting. A new switchboard will be installed and the system of wiring in the power house will be rearranged.

The municipal lighting plant of Barnesville, Minn., is to be improved by the erection of a new power house and the addition of new machinery, at a cost of $7,000.

The purchase by the city of the electric-light plant at Hastings, Minn., is under consideration.

Work has been started at Washington, Iowa, for the construction of the municipal electric-light plant, for which the contract was let some time ago.

The council of New Ulm, Minn., has reduced the rate for lighting from 12½ cents per thousand watts to 10 cents, and has done away with a minimum charge. The council also concluded to install meters without charging meter rent. The council has started a war for business with the private company, which has a plant in the city.

A committee of the council of Lake Linden, Mich., is considering the cost and the advisability of installing an electric-lighting plant.

The Western Union Telegraph Company is at outs with the Minneapolis Chamber of Commerce, resulting in the former withdrawing its offices and wires from the trading floor, and the cutting off of all quotations of the Minneapolis market over the Western Union system. R.

Among the Rockies.

Salt Lake City, Utah, November 8.—A suit has been filed by S. W. Riter against the Logan (Utah) City Council to prevent the latter from issuing the $35,000 worth of electric bonds voted for that purpose by the citizens this year. Opponents of the bonds have contended that the city has no legal right to issue bonds for more than $28,000. The state land board, which purchased the entire issue, was satisfied as to the legality of the bond issue, but in order to be perfectly safe, decided that the question should be passed upon by the courts. The suit was therefore brought, and after being passed upon by the District Court, will be at once appealed to the Supreme Court.

A petition was presented to the board of county commissioners of Salt Lake County, Utah, this week by the Salt Lake and Suburban Railway Company, asking for a franchise through sections of the county which were not included in the former franchise and abandoning parts of the road which had been contemplated on account of the route passing through parts of the country not well adapted for street-railway purposes nor so thickly populated as the sections indicated in the present application.

At a meeting of the street committee of the City Council of Salt Lake City this week an ordinance was passed requiring the street railways operating cars through Salt Lake and suburbs to provide fenders for all cars within 60 days after the passage of the ordinance. A penalty of $50 to $150 fine is to be imposed for each offense. The City Council of Salt Lake extended the time for the placing of the fenders to six months and reduced the penalty for lack of application within the specified time to a minimum fine of $10, also granting to the company the right to select the design of fenders to be applied.

At a meeting held here last week by the passenger agents representing various railroads having offices in Salt Lake City, it was decided that electrical railroads have been and are a benefit financially to the regular railroad systems in that they have displaced suburban railroad depots and thus permitted railroads to give better express service for long distances and obtain more revenue from this source, also in building up suburban traffic to a point never reached before, much of this traffic being obtained by steam railroads when competition for it is possible.

All Salt Lake City and suburban street cars were equipped this week with mail boxes, enabling residents living at a long distance from the postoffice to have their letters in the hands of the postoffice people within a short time after they are mailed.

The new power drills at the Bingham and New Haven Mining Company's properties at Bingham, Utah, are now in place and are being run by electricity. It is intended to light the entire plant by the same power.

The machinery is now all installed for the Tonopah (Nev.) Light and Power Company's new plant, and with an 80-horsepower engine and a two-phase generator the company can furnish lighting facilities for 1,000 lights and have left floor room sufficient to double the capacity of the plant in case the increased growth of the town demands it. A.

PERSONAL.

G. M. Basford, editor of the American Engineer and Railroad Journal, is in Chicago.

W. N. Matthews, the well-known dealer in electrical supplies in St. Louis, was among the Chicago visitors last week.

Manager Benson of the General Electric Company at Salt Lake City, Utah, who has been seriously ill for some weeks past, is rapidly recovering, and Mr. Crouch of the Denver office, who has been handling the work for Mr. Benson, will soon be able to return to his Colorado office.

The crown prince of Siam, his brother and members of his suite visited the General Electric Company's plant at Lynn, Mass., last week.

George F. McCulloch, president of the Union Traction Company of Indiana, arrived home from Europe last week, and will hereafter reside in Indianapolis.

W. B. Hibbard of Colorado Springs, Colo., died on November 1st. He was an old-time telegrapher and was superintendent for the Western Union in the early '70's, with headquarters in Salt Lake City.

The body of John W. Mackay, who died in London on July 20th, was shipped to the United States from London on November 5th. Mrs. Mackay and her daughter, the Princess Colonna, accompanied the remains.

George L. Cragg, the Chicago patent lawyer, announces that the entrance to his offices will be at Room No. 1453, Monadnock Building, being the north suite in the space formerly occupied by Charles A. Brown & Cragg.

President T. J. Carling of the Macon (Ga.) Electric Light and Railway Company, upon the dissolution of that company recently, was presented a handsome silver service by the board of directors as a token of esteem and friendship.

John Garden of Wheeling, W. Va., has been appointed chief electrician of the Wheeling (Va.) Steel and Iron Company, to succeed W. S. Kirker, resigned, who goes to Pittsburg, Pa., to superintend the manufacture of a new type of gas engine patented by him.

George F. Porter, for the last 10 years secretary and treasurer of the National Electric Light Association, has been appointed manager of sales for the Atlantic Insulated Wire and Cable Company, Stamford, Conn. Mr. Porter will have headquarters at 120 Liberty Street, New York city.

Eugene N. Foss, manager of the B. F. Sturtevant Company of Boston, was defeated in the congressional election of November 4th, greatly to the regret of his friends. At the same election, however, Mr. Foss' brother, the Hon. George Edmund Foss, was again returned to Congress from a North Side district in Chicago.

C. S. Powell, manager of the Cleveland office of the Westinghouse Electric and Manufacturing Company, will go to England next month in the interests of the company. He will be accompanied by Charles F. Scott, chief electrician of the company, and A. M. Mattice, chief engineer. Mr. Powell and Mr. Scott returned from England only a short time since.

Edward B. Maltby, ex-president of the Boston Electric Light Company and a director of the Edison Electric Illuminating Company of Boston, died of paralysis at his home in Boston, on October 30th. He was 61 years old. He was vice-president of the Copper Range Consolidated Company, and the New England Cotton Yarn Company, and a director in many other corporations.

Dr. R. N. Tooker, one of the leading homeopathic physicians of Chicago, died suddenly on the morning of November 9th at his residence on Dearborn Street. Dr. Tooker was 61 years of age and leaves a wife and three children. He was a man of admirable parts, and, in addition to his medical labors, found time to study in the mechanical and electrical fields. Dr. Tooker was the inventor of the automatic door on fire-alarm boxes, which is in use in most of the principal cities of the world.

Henry A. Everett has been elected president of the Toledo Railways and Light Company, to succeed Albion E. Lang, who has resigned and will retire from the street-railway business other than to retain his holdings in the properties. Mr. Lang, who is an ex-president of the American Street Railway Association, and has been a prominent street-railway man, will take a trip abroad as soon as he is relieved of the receivership of the Lake Shore electric road, which will occur when the plan for refinancing the company is put in operation. This work is progressing as rapidly as could be expected, and will likely be completed by the end of the year. Mr. Everett and his family will spend about five weeks in New York and the East also, as he wishes to rest up a little before taking hold of the work, which will be turned over to him when the railroad properties are all refinanced.

ELECTRIC LIGHTING.

The City Electric Lighting Company of Vincennes, Ind., is to be reorganized with C. G. Waldo as general manager.

The Chattanooga (Tenn.) Light and Power Company has been awarded a contract for lighting the city during a period of two years.

The Central Heat and Power Company has been granted a franchise by the City Council of Rockford, Ill., for the installation of an electric-lighting plant.

A controlling interest in the Centralia (Ill.) Light and Power Company is said to have been sold to a syndicate which is buying up gas and electric-light plants throughout southern Illinois. The new management proposes greatly to improve and extend both the gas and electric-light plants. It is also inti-

mated that the same people are contemplating the purchasing of the Centralia street-railway system.

The People's Light, Heat and Power Company of Salina, Kan., has prepared plans for the remodeling of its electric-lighting plant. New machinery and necessary supplies will be bought to put the plant in first-class shape.

The Chicago Yaryan Company has been granted a 20-year franchise by the City Council of Chicago to furnish steam heat and electric light in Austin, the cost to consumers being one-third of one cent per cubic foot per year for heat and 10 cents per kilowatt for current for incandescent lamps. The company furnishes the city with 100 arc lamps at $40 a lamp and hands over 10 per cent. of the gross receipts.

ELECTRIC RAILWAYS.

The City Council of St. Thomas, Ont., Canada, recently voted to buy over the St. Thomas electric railway, which has not been operated for the last two months or so. The system will become city property on November 17th.

At the last meeting of the Chicago City Council the ordinance granting a franchise to the Chicago Northern Railway Company from Peterson Avenue to the city limits in the Twenty-seventh ward was passed. This line is the city link for the freight line running through Skokie Valley.

The Jackson and Battle Creek (Mich.) Traction Company of the Boland electric-railway system, now in course of construction and nearly completed, last week filed a mortgage to the Savings and Trust Company of Cleveland, Ohio, in the sum of $1,200,000, to secure a like amount of five per cent. bonds payable in 1923. The line between the two towns will be in operation by the first of the year, it is said.

Oak Park, Ill., a suburb of Chicago, is having trouble with the Lake Street Elevated Railroad Company. The railroad company has for the past stored a large number of cars on sidings in Oak Park, much to the disgust of the suburbanites, who said the street along which the cars stood was spoiled by their presence. The company was asked to remove them and refused, threatening to discontinue the fast "express" service to the suburb if compelled to do so. Injunction proceedings were filed against the company by the village of Oak Park to compel it to remove the cars. As a result the express service has been discontinued.

The local transportation committee of the Chicago City Council has resolved not to allow trolley cars on the Evanston division of the Chicago, Milwaukee and St. Paul Railroad south of Wilson Avenue, where the Northwestern elevated road terminates. The company wants to change its motive power from steam to electricity on this line. It is now understood that negotiations have been resumed between the Northwestern Elevated and Chicago, Milwaukee and St. Paul roads regarding an agreement and joint use of tracks for Evanston traffic. The transfer decision affecting the Chicago Union Traction Company has had the effect of greatly increasing the North Shore surface traffic, and the elevated road is naturally eager to improve its facilities, in consequence.

At the City Council meeting in Chicago on November 10th an order was introduced directing the committee on local transportation to prepare an ordinance making it a finable offense for any person to sell or give away a street-car transfer or attempt to use a transfer which has been improperly secured. The order, also, directed the committee to report to the council whether the one-hour time limit of a transfer is a proper limit, recommend such changes as it may deem wise, and prepare a comprehensive transfer schedule, based on the recent decision of the Supreme Court. The order went to the transportation committee. An order was also passed directing the corporation counsel to report what compliance, if any, the Union Traction Company was making with the court's decision.

Contracts were signed last week between a syndicate of Quincy (Ill.) capitalists and Bracey, Howard & Co. of Chicago for the building of an interurban electric railway from Quincy to Beardstown, Ill., and from Quincy to Niota, Ill. The road will be standard gauge, and at Beardstown will connect with the Baltimore and Ohio Southwestern, and at Niota with the Santa Fe system. The line to Beardstown is to be running by June next. The total capital for financing the enterprise has been practicallly arranged for. It will require $3,000,000 for construction and equipment. The Quincy, Rushville and Beardstown line is 70 miles long and the Niota, or East Fort Madison, Iowa, is 60 miles. A line south through Pike and Calhoun Counties to St. Louis, Mo., will be built, it is said, immediately upon the completion of these lines.

POWER TRANSMISSION.

The Rapid City Power, Light and Woolen Manufacturing Company of Rapid City, Man., Canada, has been incorporated with a capital of $25,000 to transmit electricity for power and light purposes from a plant to be established on the Little Saskatchewan River.

It is said that government experts will visit the Menominee River next spring to study the river and its tributary streams for the purpose of advising the development of water power. The government engineers will visit Chappee and White Rapids, where the water power is said to be the best in that section.

It is said that engineers are being sent from Boston, Mass., to Tacoma and Seattle, Wash., to begin work on a project which has for its chief aim the harnessing of the waters of the Puyallup Glacier on Mount Ranier, located in the southern part of the state of Washington. It is said that if successful this will be the first instance where glacial waters have been used directly to provide power. Stone & Webster, Boston engineers, are undertaking the work in order to provide the cities of Tacoma and Seattle with electric light and power. The plan is to construct from the glacier a flume 14 miles long, through which a head of water will flow sufficient to generate 50,000 horsepower. The water in running through the flume will drop 600 feet and through penstocks will be diverted into turbines connected with electric generators. A three-phase alternating current will be transmitted at high voltage to Tacoma and Seattle.

PUBLICATIONS.

Pass & Seymour of Solvay, N. Y., call attention to their Little Gem porcelain rosettes in an attractive pamphlet.

The engineers of the Nernst Lamp Company have studied carefully the problem of the correct distribution of light, and their conclusions are incorporated in a booklet that is distributed to the trade by the company. The light-distribution advantages of the Nernst lamp are well set forth in the publication.

The Shelby Electric Company of Shelby, Ohio, is distributing to the trade a little pamphlet which contains some interesting information in regard to loss of illumination in incandescent lamps. Comparisons are made by means of illustrations of the effective vertical illumination cast by the Shelby and other types of lamps.

The Telephone Magazine of Chicago has passed under the control of the newly organized Telephone Magazine Publishing Company, of which John R. Dare is president. It announces that no one engaged in the manufacture or sale of telephone apparatus, either directly or indirectly, has any financial interest in the Telephone Magazine. C. E. Kammeyer continues as editor.

MISCELLANEOUS.

In the quarterly fire report of the electrical bureau of the National Board of Fire Underwriters for the quarter ended October 10th, there are reported 164 electrical fires, with losses aggregating $152,609. Thirty-four fires, losses aggregating $300,437, were reported as due to electricity, but were found to be due to other causes.

The largest trust deed ever filed in Los Angeles, Cal., is said to have been that recorded recently of the Edison Electric Company of Evanston, Wyo., and Los Angeles, Cal., to the Los Angeles Trust Company and the United States Mortgage Trust Company of New York city for $1,000,000. The company will issue $1,000,000 five-per cent. bonds maturing in 20 years. The proceeds are to be used in improvements and extensions.

Professor Borchers of Aix-la-Chapelle, Prussia, is reported to have discovered an electrolytic method for producing metllic calcium. The perfected process was attained only after many failures. It is very simple, calcium chloride being the only compound used. The scheme gives promise of reducing the price of calcium from nearly $2,000 a pound to, it is said, less than a dollar. The metal produced is softer than lead and rapidly oxidizes into lime on exposure to the air.

TRADE NEWS.

The Electric Railway Switch Company of Detroit, Mich., has been incorporated with a capital of $100,000.

Thaddeus Cahill of Washington, D. C., has leased 7,000 square feet of floor space from the Holyoke (Mass.) Water Power Company for manufacturing electrical machinery.

The Philadelphia (Pa.) Electric Company, an incorporation of New Jersey, has been incorporated under the laws of Pennsylvania with a capital of $100,000.

The Las Animas Electric Company of Denver, Colo. has been incorporated with a capital of $25,000. The incorporators are Tom J. Gardner, P. G. Scott and others.

The Reed-Squire Electric Company of Kansas City, Mo., has been incorporated with a capital stock of $40,000. The incorporators are E. N. Reed, W. J. Squire, Louis O. Crooker and H. M. Squire.

The Phœnix Glass Company announces that it has removed its Chicago office and salesroom to 206 Wabash Avenue, on the southeast corner of Adams Street. At this location the company will carry a complete line of samples, and all in the trade are invited to visit the salesroom. E. H. Fox is western agent for the company.

The McGuire Manufacturing Electric Company, rheostat builder of Chicago, has just sent out to the trade a very complete and illustrated "handy catalogue" of its various types of rheostats. The McGuire Manufacturing Electric Company began the manufacture of rheostats a year or so ago. Since commencing this new department of its business the company has progressed remarkably. The new catalogue contains list prices and illustrations of various types of ordinary rheostats, motor starters, speed regulators, dynamo field regulators, theater dimmers, etc. Attention is called to the fact that the company is in line to build rheostats to specification. Many of the McGuire rheostats are now in use throughout the United States, and quite a number of the McGuire motor starters and regulators are in use controlling some of the largest newspaper presses in the country. As is well known, the excellency of the manufacture of a rheostat is vital to the electrical manufacturer who couples it with, say, a dynamo or motor. A defect in the rheostat would be attributed to the dynamo, and as a consequence the good reputation of the McGuire products has had to be earned. The McGuire Manufacturing Electric Company has a large factory behind it, and the future prospects are excellent.

BUSINESS.

The Electric Appliance Company of Chicago has issued a "Chain of Evidence" about two yards long giving extracts of letters received from users of Packard incandescent lamps. Every user of incandescent lamps will find it of interest. It will be sent upon request.

The Steam and Electrical Equipment Company of Pittsburg reports the sale of one 300-kilowatt General Electric street-railway generator, direct-connected to a Wetherill tandem Corliss engine, one Russell boiler, and one Corliss engine. This company calls attention to its Cosmopolitan condensers, which are condensing a pound of steam with a pound of condensing water, it is said.

The Chicago House Wrecking Company, Chicago, announces that it has purchased at a recent sale 150,000 new incandescent lamps of standard make which it is offering at bargain prices. The lamps can be furnished in any candlepower from eight to 25 and any voltage from 100 to 120, with Edison, Thomson-Houston or Westinghouse base. The company has issued a new catalogue, which gives full information concerning these lamps and other bargains in electrical and mechanical machinery.

With the purpose of helping to abate the smoke nuisance in Providence, R. I., the Rhode Island and Suburban Railway Company of that city has contracted for a large equipment of Roney mechanical stokers for its new boiler plant. The plant will have an ultimate boiler capacity of 8,300 horsepower. Another large concern, the Naragansett Electric Lighting Company, is also installing a complete equipment of Roney stokers, comprising 12 stokers of the quadruplex type, operating under Babcock & Wilcox boilers of 4,500-horsepower capacity. A third industrial plant employing these stokers is the Brown & Sharpe Manufacturing Company, where Roney stokers under two batteries of Babcock & Wilcox boilers have been in use for some time with excellent results.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, November 4, 1902.

712,477. Brush-holder. Norman C. Bassett, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 24, 1902.

The brush-holder has a flange inclined to the radius of the commutator, and a carbon brush lies against the face of the flange. A coiled spring in the rear of the brush has one end connected directly with the upper end of the brush and the other end with the brush-holder.

712,513. Outlet Bushing for Conduits. Frederick W. Erickson, Boston, Mass. Application filed March 15, 1902.

The bushing is composed of two similar hollow parts provided with an enlarged head and a smaller rearward portion, the head having a suitable orifice.

712,514. Interior-conduit Outlet Box. Frederick W. Erickson, Boston, Mass. Application filed March 26, 1902.

The box is cast from molten metal and is provided with openings for the insertion of conduits or bushings which are closed with disks whose peripheries are formed into ridges and furrows.

712,521. Regulator for Alternating Series Arc-light Systems. Josef H. Hallberg, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed November 27, 1901.

The regulator comprises an elastically suspended magnet coil in series with the generator and lamps, and a balanced core.

712,522. Regulator for Alternating Series Arc-light Systems. Josef H. Hallberg, New York, N. Y., assignor to the General Incandescent Arc Light

Company, New York, N. Y. Application filed January 29, 1902.

This regulator comprises a device responsive to any increase of current upon the line within predetermined limits, and which will act when energized to introduce an impedance upon the line proportional to any decrease in load upon such line, and means for automatically banging the ratio of the current transformation through the device, whereby the power factor of the system will be maintained practically constant from zero to full load. (See cut.)

712,523. Regulator for Alternating Series Arc-light Systems. Josef H. Hallberg, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed January 29, 1902.

The inventor describes a device normally responsive to an increase of current upon the line and which will act when energized to introduce an impedance upon the line proportional to any decrease of load. A second similarly acting device normally irresponsive is arranged to be cut into the circuit when the current upon the line exceeds a predetermined amount.

712,524. Regulator for Alternating Series Arc-light Systems. Josef H. Hallberg, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed January 29, 1902.

This invention is very similar to the preceding one.

712,535. Method of Constructing Electric Switches. George H. Hill, Glenridge, N. J., assignor to the Sprague Electric Company, New York, N. Y. Original application filed August 10, 1901. Divided and this application filed January 24, 1902.

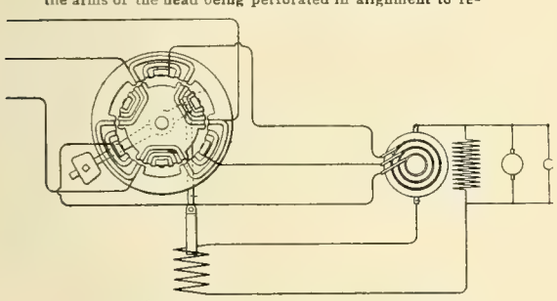
The method consists in first applying a skin or film of insulating material to the contact support, and then applying under the action of heat an insulating compound over the skin or film-covered portion of the support.

712,537. Electric Grinding Device. Charles S. Hisey, Dayton, Ky., assignor to the Hisey-Wolf Machine Company, Cincinnati, Ohio. Application filed May 7, 1902.

An electric attachment for machine tools is described. It comprises an electric motor, a housing for it, an armature shaft, bearings for it in the housing, a grinding wheel mounted on one of its ends, an indexing rest projecting from the motor-housing to support toothed work, and means whereby the same is supported on the motor-housing in a manner to be adjustable with reference to the grinding wheel.

712,539. Trolley. Newton Hublinger, Barberton, Ohio. Application filed July 3, 1902.

The trolley consists of a horizontally bifurcated head, the arms of the head being perforated in alignment to receive a shaft, a shaft mounted therein, a sleeve mounted on the shaft having sloping arms, a trolley wheel mounted between the arms, and means for revolving the sleeve on the shaft to bring the trolley in alignment with the wire.



NO. 712,639.—REGULATING ROTARY CONVERTERS.

712,549. Motor-controller. George E. Krause and Arthur L. Bolen, Indianapolis, Ind. Application filed October 7, 1901.

In the motor-controller are combined a number of electrical resistances forming part of the motor circuit, a pair of terminals for each of the resistances, and means for changing bridging connections between the terminals, whereby the resistances may be placed in series or any number of the resistances placed in parallel with the remaining series-arranged resistances.

712,551. Electric Lamp. Anton Kusebauch, Edgewood Park, Pa., assignor to George Westinghouse, Pittsburg, Pa. Application filed March 21, 1902.

An opaque, weatherproof housing for the operating mechanism of an electric lamp is described. It comprises a cap having holes containing insulating bushings for the circuit wires, a body portion movable a limited distance longitudinally with reference to the cap, adjustable means for fastening the parts together and means for supporting the body portion in its lowered position.

712,559. Coin-controlled Apparatus for Telephones. Edward G. Lewis, St. Louis, Mo., assignor to the Coin Controller Company, St. Louis, Mo. Application filed February 1, 1901.

Combined with the receiver hook of a telephone are an arm for locking the same, a coin-controlled mechanism co-operating with the arm, an armature, means in operative relation to the armature for actuating the coin-controlled mechanism, and a magnet in the telephone circuit which when energized attracts the armature to permit operation of the means for actuating the coin-controlled mechanism.

712,561. Regulation of Dynamo-electric Machines. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 17, 1900.

The method of governing the speed of an inverted rotary converter employed for transforming direct current to alternating current is described. It consists in exciting the field of the converter by the resultant effect of two electromotive forces, one of which is definitely related to the impressed electromotive force on the direct-current mains, the other to the wattless component of current flowing in the alternating-current mains.

712,568. Cable Joint. William M. Murphy, New York, N. Y., assignor of one-half to Orville R. Hayes, Boston, Mass., and Josiah F. Gooding, Brookline, Mass. Application filed January 13, 1902.

A covering for the joints or splices of electric cables comprises a jacket or sleeve capable of being fitted over and cemented to the covering of the cable, and a section of cementing material carried on the sleeve or jacket to permit cementing it in place.

712,584. Winding for Electrical Transformers. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed March 21, 1902.

A parallel circuit winding for electrical transformers comprises a number of coils which are subjected to unequal induction, the coils being divided into as many equal sections as there are coils and the sections being so cross-connected that the induction is uniform for the several parallel circuits.

712,589. System of Motor Control. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 1, 1900.

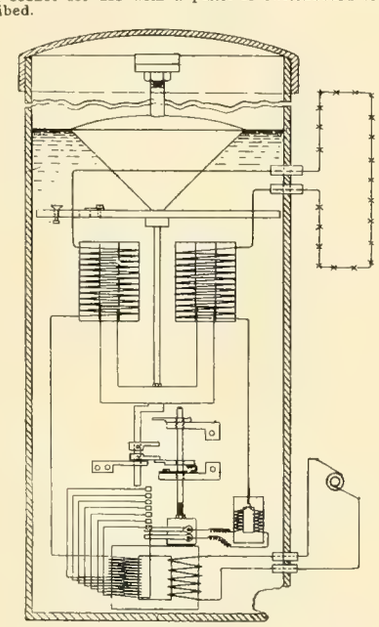
See page 344.

712,591. Commutator Brush. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 9, 1901.

The brush consists of a prism of conducting material having one end cut away so as to reduce one of its lateral dimensions without reducing the other.

712,600. Switchboard Socket. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 5, 1901.

A socket for use with a panel or switchboard is described.



NO. 712,522.—REGULATOR FOR ALTERNATING SERIES ARC-LIGHT SYSTEMS.

712,613. Alternating-current Dynamo-electric Machine and System of Distribution. William Stanley, Great Barrington, and John F. Kelly, Pittsfield, Mass. Application filed April 5, 1902.

For this and succeeding patent see page 345.

712,614. Electrical Generation and Distribution. William Stanley, Great Barrington, and John F. Kelly, Pittsfield, Mass. Application filed June 25, 1902.

712,618. Protecting Device for Electric Circuits. Percy H. Thomas, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed November 27, 1899.

The device comprises one or more series gaps, one or more gaps shunting one or more infusible and non-polarizable, current-limiting bodies and a non-polarizable, current-limiting body in series with all the gaps.

712,619. Electrical Relay. Arthur T. M. Thomson, County of Middlesex, England. Application filed February 4, 1901.

A device adapted to effect the object of calling subscribers through telephone exchanges for an automatically limited period of time is combined with a further device, adapted to prevent an unintentional repetition of the calling signal by providing an alternative circuit through the battery and relay magnet which causes the termination of the period of calling, consisting of a spring contact plate on the armature of such terminating relay magnet and a contact point in electrical connection with the coil surrounding such magnet, these two being adapted to complete an electrical circuit through a battery after such magnet has otherwise become energized and has attracted its armature.

712,620. Electric Meter. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 27, 1898.

In the meter are combined a motor-generator and means, controlled by the current generated thereby, for opening the supply circuit of the motor-generator when its armature reaches a rate of rotation corresponding to the energy to be measured.

712,630. High or Low-water Alarm. Charles E. Zimmermann, Syracuse, N. Y. Application filed December 5, 1901.

Combined with the float-guiding arm and pivoted shaft attached to the arm are two electric poles fastened to the shaft, a movable electric terminal disposed to drop by its gravity into the paths of the poles, and an electric alarm in circuit with the terminal and poles.

712,634. Exercising Apparatus. Richard Aronstein, Goldfield, Colo. Application filed June 18, 1902.

One claim reads: In an exercising apparatus for drill-striking practice the combination of an electric generator, being either attached to the apparatus or independent of the same, an insulated wire circuit connection from the positive pole of the generator to the lower end of the drill-steel, the insulation of the drill-holder by a rubber sheet, a circuit connection from the negative pole of the generator to the ground plate and the copper strip fastened to the handle of the drill-striking hammer.

712,639. Regulating Rotary Converters. Ernst J. Berg, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 20, 1899.

The method of regulating the electromotive force on the direct-current system supplied by a rotary converter consists in maintaining the field excitation of the rotary converter constant and automatically decreasing the phase angle between current and electromotive force on the alternating-current mains as the load on the rotary converter increases. (See cut.)

712,650. Brake Shoe. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 30, 1897.

A number of car-axles are each provided with a dynamo-electric machine and with an electrically actuated braking device, means whereby the dynamo-electric machines may supply current to operate the braking devices, and means whereby any one of the braking devices will be released whenever the speed of rotation of its axle becomes substantially less than that of another axle.

712,652. Interchangeable Hood Support for High-tension Electric-lamp Service. John H. B. Conger and Charles J. Eichhorn, Newark, N. J., assignors to the Tea Tray Company, Newark, N. J. Application filed January 24, 1902.

Combined with the support are a footpiece, arms and collar, forming a frame, a grooved insulation arranged in the frame and movable pivotally therein, and an electric lamp supported by the insulation.

712,668. Gravity Battery. Wilfred N. Gove, Philadelphia, Pa. Application filed January 16, 1902.

The battery is composed of a solution, blue stone, zinc and babbitt metal.

712,673. Process of Operating Electric Motors. Jesse Harris, Rensselaer, N. Y. Application filed January 23, 1902.

The method described consists in passing an electric current into separated bodies of fluid conductors; conducting the current from the separate bodies of fluid conductors through recurring paths; a plurality of the paths being always in electrical connection with a plurality of the fluid bodies, the paths cutting a magnetic field.

712,685 and 712,686. Socket for Incandescent Lamps. Owen E. Kenney, Toledo, Ohio, assignor to the Yost-Miller Company, Toledo, Ohio. Application filed May 31, 1902.

Sheet-metal shells are used for the casings of the sockets.

712,715. Electromedical Apparatus. Louis Petich, New York, N. Y. Application filed March 11, 1901.

An electrical device for treating the human body is self-contained in compact form, and includes a battery, an induction coil, and opposite terminals consisting of inclosing shells, together with a holder upon one of the terminals, and divers attachments, each having a like handle to fit separately in the holder.

712,717. Electric Motor. Oscar H. Pieper, Rochester, N. Y. Application filed December 4, 1901.

Combined with an electric motor having field magnets and coils, an armature commutator and commutator brushes is a transformer independent of the field coils or magnets, having its primary connected in series with one of the windings of the motor and its secondary in series with the other.

712,737. Compounding Alternator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 20, 1897.

See page 349.

712,739. Electric-spark Generator. Joshua Struthers, Des Moines, Iowa, assignor to J. F. Crosby, Des Moines, Iowa. Application filed March 10, 1902.

A metallic bar is mounted on the machine frame and is capable of engaging both binding posts of the machine at the same time. A centrifugal governor is on the armature shaft, and when it is thrown outwardly by centrifugal force, the bar will be moved into position in engagement with both binding posts.

712,741. Apparatus for Transferring Electric Energy. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 27, 1897.

See page 349.

712,742. Alternating-current Meter. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 10, 1901.

In the meter there are a field-magnet system provided with a single winding consisting of a number of coils connected to form a closed circuit, and connections from the single winding to a series and to a potential circuit, the connections being so arranged that the electromotive forces induced in the winding, due to the series current, constitute a balanced system in so far as the potential circuit is concerned and vice versa. (See cut on next page.)

712,749. Rheostat. George H. Whittingham, New York, N. Y. Application filed January 21, 1902.

The device comprises an insulating sleeve, a resistance coil surrounding the sleeve, and an electrical conductor connected to one end of the coil and extending through the coil and through the sleeve, the two terminals of the coil being thereby at the same end of the coil.

712,754. Railway Signal. Rollin A. Baldwin, South Norwalk, Conn. Application filed December 9, 1901.

The signal combines a signal-arm, a disk or plate pivoted at the middle of one edge and adapted to move the arm, and two solenoids whose armatures are adapted to strike the plate on opposite sides of its pivot to oscillate it.

712,764. Receiver for Wireless Telegraphy. Angel de Castro, New York, N. Y., assignor to the United States Wireless Message Company. Application filed December 4, 1901.

In the system are a receiver consisting of a wave-receiving wire, a magnetic device composed of a magnet, an adjustable fine steel wire, a sounding-box and steel particles in the field, a split circuit, a sensitive tube in the circuit, a condenser in one branch circuit, a battery, a relay, and electromagnet in the other branch circuit, an armature with contact-point on the electromagnet, a second contact-point corresponding to the first, a grounded condenser connecting with the armature and a magnetic needle near the magnetic device. (See cut.)

712,766. Composite Transmission Over Loaded Electric Circuits. Edwin H. Colpitts, Boston, Mass., assignor to the American Telephone and Telegraph Company. Application filed June 13, 1902.

Combined with a metallic telephone circuit divided at a terminal station into line and instrument circuit sections and a transformer associated with the circuit at the terminal station and interposed between the circuit sections are conductive connections having high inductance uniting the conductors of each section to the corresponding conductors of the other, and conductively discontinuous inductostatic connections, one for each of the circuit-sections, including the two windings of the transformer respectively, and extending each between the conductors of its own section to complete the same inductively.

712,780. Coin-controlled Stereopticon. Francis Duwe, New York, N. Y. Application filed August 6, 1901.

An electric light provided with a variable resistance is used to illuminate the picture.

712,781. Coin-controlled Electric Battery. Francis Duwe, New York, N. Y. Application filed August 6, 1901.

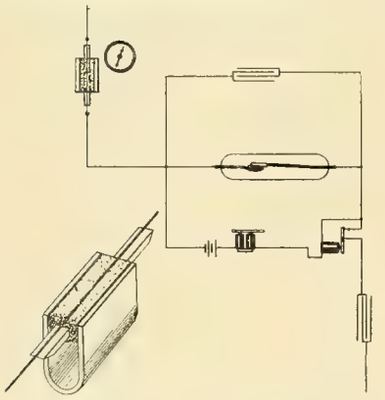
The apparatus is provided with a solenoid having a movable core and mechanism connecting the core with one of the poles, so that when the pole is moved the core will be moved to vary the strength of the current.

712,801. Switchboard and Supervisory Signal Circuit. David S. Hulfish, Chicago, Ill., assignor to the American Telephone and Telegraph Company, Boston, Mass. Application filed July 1, 1902.

One claim reads: In a telephone-system switchboard apparatus, the combination of answering and companion switch-plugs, united by a switch-cord comprising a main-circuit loop and a local signal-circuit conductor for each plug; a supervisory relay included in the main circuit loop of each plug; a supervisory signal for each plug in the local circuit thereof; a shunt circuit around the answering-plug signal and including the switch-points of the answering-plug relay, and means controlled by the companion-plug relay and operating pursuant to the excitement thereof to connect both of the supervisory signals in parallel branches of the answering-plug local circuit, and to connect the switch-points of both supervisory relays in series in the shunt-circuit, whereby both signals are rendered responsive to the de-energization of either relay.

712,814. Battery Installation for Submarine Boats. Simon Lake, Bridgeport, Conn. Application filed March 4, 1902.

Combined with the metallic hull of a submarine boat is a system of storage batteries of which each individual cell is set in and has its lower portion surrounded by a bed of cement impervious to moisture and thereby insulated each from the other and from the hull. (See cut.)



NO 712,764.—RECEIVER FOR WIRELESS TELEGRAPHY.

712,822. Electrical Warp Stop Motion. Vincenz Macku, Brünn, Austria-Hungary. Application filed January 12, 1901.

The electrical stop motion is arranged so that when a warp-thread breaks the beveled ends of the heads will force them sidewise when the leash drops, and insure a good contact between the lower head and the main and auxiliary bars.

712,826. Combined Percussion and Electric Primer. William Mason, New Haven, Conn., assignor to the Winchester Repeating Arms Company, New Haven, Conn. Application filed June 9, 1902.

The electric primer is entered into the forward end of the receiving cup and located directly in front of the anvil block which is formed with a flash-hole connecting the two primers.

712,845. Electric Switch-actuator. Joseph Y. Porter, Detroit, Mich. Application filed August 14, 1901.

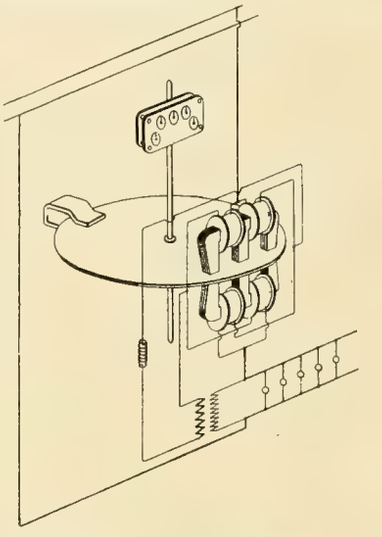
In the apparatus described are combined a line wire, an insulated section thereof, a connecting wire between the section and the line-wire, an electrically actuated mechanism for operating the track-switch, an electrical switch for making and breaking the circuit through the track-switch-actuating mechanism, and means for actuating the electrical switch lo ated in the connecting wire and adapted to be actuated by either the maximum or minimum current used by a car.

712,847. Driving Centrifugal or Other Machines by Means of Electric Motors. Gideon Pott and Robert Williamson, Motherwell, Scotland. Application filed January 15, 1902.

Combined with the stationary spindle are a sleeve loose thereon, to which the armature of the motor is fixed, a clutch carried by the sleeve, and a flanged disk secured to the driving shaft with which the clutch gradually engages by centrifugal action on starting the motor.

712,871. Grinding Machine. Oakley S. Walker, Worcester, Mass. Application filed August 12, 1901.

In the machine are a grinding wheel spindle, means for rotating the spindle, a reciprocating platen, means for reciprocating the platen comprising an electric motor, and means for automatically reversing the motor controlled by the movement of the platen.



NO. 712,742.—ALTERNATING CURRENT METER.

712,881. Marine Governor. Lida Wilson, Brooklyn, N. Y. Application filed February 8, 1902.

The means to prevent "racing" of marine engines comprises a damper in the steam or other motive-agent-supply pipe, an appliance to hold the damper normally open, an electric motor with friction driver to close the damper when the motor is energized, a float actuated by the variations of water level relative to the vessel, with means actuated by the float when falling below the desired determined level to close the electric circuit of the electric motor.

712,882. Electrical Controller Contact Arm. Edgar H. Wise, Westmont, Pa. Application filed May 20, 1902.

The arm has box-like contact sections mechanically connected together but insulated from each other, and contact members adapted to play in the box contact sections in direct contact therewith.

712,922. Negative Retoucher. Paul Frankois, Nanticoke, Pa. Application filed June 23, 1902.

The photographic retoucher described consists of a casing, a spring-retracted lead-holding tube adapted to be reciprocated within the casing, an electromagnet adapted to be carried by the casing, an armature adapted to be vibrated when the magnet is energized, a hammer fixed on the end of the vibrating armature, and a pivoted knocker adapted to transmit the strokes of the hammer to the inner end of the tube.

712,939. Printing Telegraph. Oscar L. Kleber, Pittsburg, Pa. Application filed September 10, 1900.

In the system described are a pair of type-wheel-setting mechanisms, each mechanism being held for independent operation, an impression surface, an electromechanical means for alternately moving the type-wheel mechanism to a printing position, the means including devices for bringing the alternately moved type-wheels onto the same printing point on the impression pad.

712,947. Electric Arc Lamp. Louis C. H. Mensing, London, England. Application filed June 30, 1902.

A pivoted lever connects an adjustable rod with the solenoid to allow the movement of the solenoid to communicate its motion to the brake wheel for actuating the carbons.

712,950. Telephone Lock. Gales P. Moore, St. Louis, Mo., assignor to the Controller Company of America, St. Louis, Mo. Application filed June 4, 1902.

A lock for a coin-controlled telephone is described.

712,961. Electric-railway System. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 5, 1900.

See page 344.

712,981. Supporting Device for Electric Motors. Benjamin R. Van Kirk, Philadelphia, Pa., assignor to Burnham, Williams & Co., Philadelphia, Pa. Application filed July 18, 1902.

The inventor describes the combination of two motors and a supporting shaft for each of the same, with a link connecting the frames of the motors and extending from a point on one motor above its shaft to a point on the other below its shaft, whereby the tendency of one motor to rotate as a whole around its shaft is made to oppose the similar tendency of the second motor.

712,989. Electric Cautery. William E. Washburn, Cedar Rapids, Iowa. Application filed September 8, 1902.

The cautery comprises a knife adapted to be heated by an electrical current, current-conducting rods supporting the knife and a movable knife block guided by the rods.

712,991. Regulating Rotary Converters. Ernst J. Berg, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed March 20, 1899. Divided and this application filed March 26, 1902.

In the system of electrical distribution described are combined alternating-current mains, a rotary converter connected thereto, an inductance device in series with the alternating-current mains, and means for automatically varying the inductance in the alternating-current mains with variation of load on the rotary converter.

712,994. Method of Operating Electric Brakes. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed June 30, 1897. Divided and this application filed April 24, 1902.

The method consists in supplying current to electrically actuated braking devices on a number of car axles, and automatically releasing any one of the braking devices whenever the speed of rotation of its axle is substantially less than that of another axle.

712,995. Process of Peroxidizing Storage-battery Plates. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York, N. Y. Application filed August 23, 1900. Renewed September 10, 1902.

The process of treating storage-battery plates consists in subjecting the plates as anodes to electrolysis in a bath consisting of a solution of sulphuric acid to which nitrate of lead is added.

712,999. Storage Battery. Bruce Ford, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed August 28, 1900.

A flat battery plate has its edge turned over to form a tubular bead constituting a support for the active material or material to become active.

713,010. Regulating Dynamo-electric Machines. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed January 7, 1900. Divided and this application filed March 31, 1902.

The system of distribution comprises a source of direct current, an inverted rotary converter receiving current therefrom and supplying alternating current to translating devices, a field winding on the converter connected to the source of direct current, and means dependent on the power factor of the alternating current, for varying the amount of current in the winding.

713,015. Surface-contact Structure. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed October 11, 1897. Divided and this application filed February 28, 1901.

In a removable surface contact, a metallic stud surrounded by insulating material is combined with a support, a terminal secured beneath the support, and a projection on the stud arranged to make electrical contact with the terminal.

713,016. Electric-railway System. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed March 5, 1900. Divided and this application filed March 21, 1901.

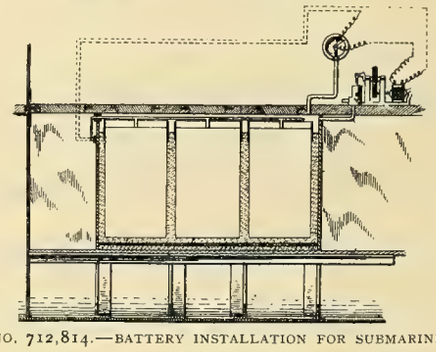
See page 344.

713,020. Process of Manufacturing Elements for Storage Batteries. Elmer A. Sperry, Cleveland, Ohio. Application filed February 20, 1902.

The improvement described in the process of manufacturing storage-battery plates consists in mixing together while dry and in a finely divided condition lead, lead oxide, and an alkali-metal salt and then moistening the mixture with an alkaline hydroxide.

713,022. Compounding Alternators. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed August 20, 1897. Divided and this application filed April 16, 1902.

See page 349.



NO. 712,814.—BATTERY INSTALLATION FOR SUBMARINE BOATS.

713,023. Electric Meter. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Original application filed July 27, 1898. Divided and this application filed April 12, 1902.

The method of measuring electrical energy described consists in generating an electric current proportional to the current to be measured by mechanically rotating a conductor in a magnetic field, transmitting the current so generated, controlling thereby the rate of rotation of the conductor in accordance with the current to be measured, and recording the revolutions of the conductor.

713,044. Method of Producing Asymmetrical Currents from Symmetrical Alternating Electromotive Forces. Michael I. Pupin, Yonkers, N. Y. Application filed January 4, 1898. Renewed October 4, 1902.

For this and succeeding patent see page 344.

713,045. Apparatus for Producing Asymmetrical Currents from Symmetrical Alternating Electromotive Forces. Michael I. Pupin, Yonkers, N. Y. Original application filed January 4, 1898. Divided and this application filed September 8, 1900.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, NOVEMBER 22, 1902. No. 21

Induction Motors in a Chicago Iron-working Establishment.

Electric drive for manufacturing plants has many interesting and instructive variations. In large iron-working establishments, for instance, the conditions to be met in planning the motor installation have a trying individuality all their own. Here the machines to be driven are mostly of a very heavy type and require the motor to operate continuously—unless liberal allowance is made—on full load at least. A plant of this character, using alternating-current motors, which has operated continuously without a halt for repairs since its installation is that of A. Bolter's Sons, Chicago, Ill., manufacturers of structural and architectural iron and steel work and machinery castings. The plant of this firm is located on the corner of Belden Avenue and Ward Street, and covers 27,875 square feet of ground. The old plant proper was contained in one building, a three-story brick affair, which faces Belden Avenue, with a 100-foot frontage and extends back to a depth of 50 feet. The first story of this building is given over to a blacksmith and machine shop, the second floor to offices and an architectural steel and iron shop, and the third to a pattern shop.

Back of this old building and on Ward Street is the foundry, which is also built of brick. Its ground dimensions are 75 by 140 feet. This building was erected some time after the Belden Avenue one, but is not a new one. Still further back, and adjoining the foundry, is the structural-iron and steel shop, 75 by 165 feet in dimensions and 50 feet high in the clear. This is also built of brick and was erected but recently. The foundry and structural workshops are constructed with their Ward Street sides almost entirely of glass to afford plenty of light to the workmen.

Distributed throughout the above-mentioned three divisions of the plant are a number of three-phase induction motors working on 60-cycle, 200-volt current supplied by the Commonwealth Electric Company.

The most interesting installation of the three buildings is that in the structural-steel and iron workshop. Here are to be found seven motors, ranging from five to 50-horsepower capacity, and each, excepting one small line-shaft motor, operating an individual machine. Fig. 1 shows a 50-horsepower motor belted to a 12 by 12-inch, double-cylinder, Rand compressor, of the "Imperial" type, the latter affording a working pneumatic pressure of 100 pounds. As is seen in the illustration, this motor is placed so close to the compressor that an idler pulley was necessarily brought into service, owing to the large difference in the diameters of the driving and driven pulleys. This motor operates at 850 revolutions per minute and drives the compressor at a speed of 175 revolutions per minute. The power afforded by this compressor is utilized to operate five pneumatic lifts, a riveter and numerous small hand tools, such as hammers, chisels, etc.

Fig. 2 shows a 20-horsepower, 1,120-revolution motor belted to a Johns patent beam shears, the first machine of the kind installed in the United States, being a German invention, and manufactured in Berlin. These machines are employed for cutting I-beams and channel irons and operate, as the name implies, on the principle of the shear. One stroke of the cutting or operating blade takes in eight inches of a beam or channel iron and cuts out a strip of metal one inch and a quarter in width, that being the thickness of the cutting edge. This machine cuts through a steel beam with the same ease that a tinner operates his shears when working in sheet iron.

An A. & C. sawing machine geared to a five-horsepower, 1,120-revolution motor is seen in Fig. 3. The diameter of this saw is 28 inches and its speed is governed by a pair of friction driving wheels set at right angles to each other, the driving wheel being capable of a movement such that it may be made to contact with the driven wheel at any distance from the latter's center. This machine is used for cutting up I-beams and channel irons, too small for the Johns machine. Back of this machine, as shown in the illustration, is a small wooden cabinet in which are installed the operating switches, the leads coming directly from the transformers installed outside to this cabinet. A similar small working board is set up in the main building, which controls the distribution for the foundry and the main building. Fig. 4 represents a coping punch, belt-driven by a 20-horsepower motor, operating at 1,120 revolutions per minute, like all the former ones, excepting the air-compressor motor, which, as was mentioned, has a speed of 850 revolutions per minute.

Besides the above, there are three other motors in this room, one driving by belt a line shaft which in turn operates an emery grinder, a drill press and a band saw and circle saw in a small improvised template shop, another belt-connected to a small punch similar to that shown in Fig. 4, and still another operating a shearing or punching machine of heavier type. The first of these three is of 10-horsepower capacity and the second and third are of five horse-

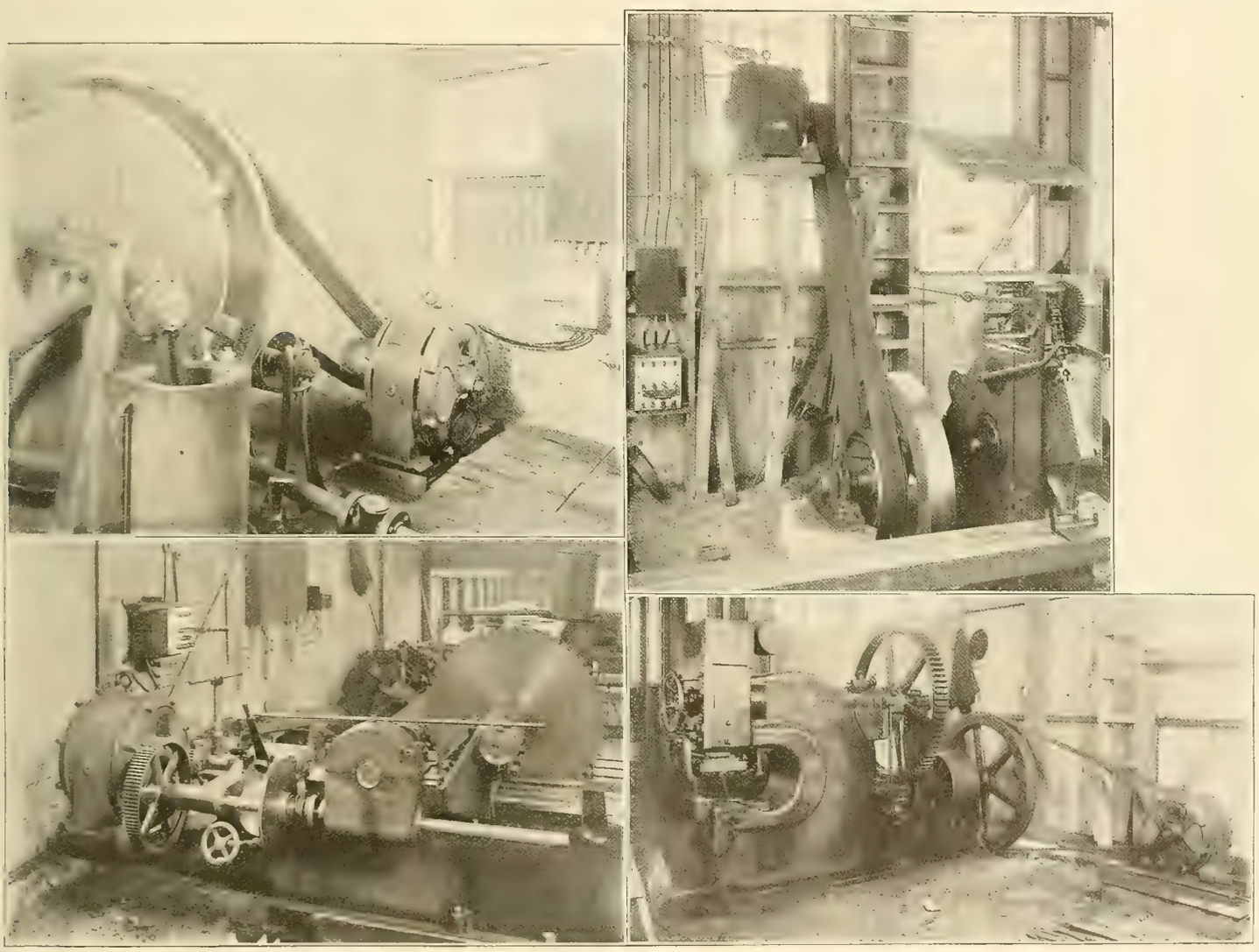


Fig. 1. Air Compressor.
Fig. 2. Beam Shears.
Fig. 3. Sawing Machine.
Fig. 4. Coping Punch.

INDUCTION MOTORS IN A CHICAGO IRON WORKING ESTABLISHMENT.—VARIOUS MOTOR-DRIVEN MACHINES.

power each. A 40-horsepower, 1,120-revolution motor is installed in the foundry to operate a No. 12 Buffalo Forge Company's fan. This is used for forced draft in the cupolas and for other similar purposes. The architecural room—second floor of old or main building—has two 40-horsepower and one 30-horsepower motors installed in it, which operate line shafting for driving all the machinery in the architectural, blacksmith, machine and pattern shops. These three shops, as has been said, occupy the three floors of the old building facing on Belden Avenue. The machinery, being driven from the line shafting, is that ordinarily found in pattern, machine, blacksmith, and structural shops—lathes, planers, bolt and nut machines, drills, saws and the like.

Installed in a cab or shed built close to the foundry in the yard and convenient to the railroad, is the hoisting and controlling apparatus for a five-ton derrick. Here, as may be seen in the cab-interior view in Fig. 5, is a hoisting motor with controller. This motor is capable of being operated at variable speeds through the medium of the controller and controlling gear shown in the illustration. The outfit is designed especially for intermittent work and is similar to the motor used for elevator service. The derrick is used for transferring pig iron, castings and such heavy stuff from the cars, and for assistance in loading finished trusses, machinery castings, etc. Like all the electrical equipment in the Bolters' plant, the derrick motor and controlling apparatus were made by the Westinghouse Electric and Manufacturing Company.

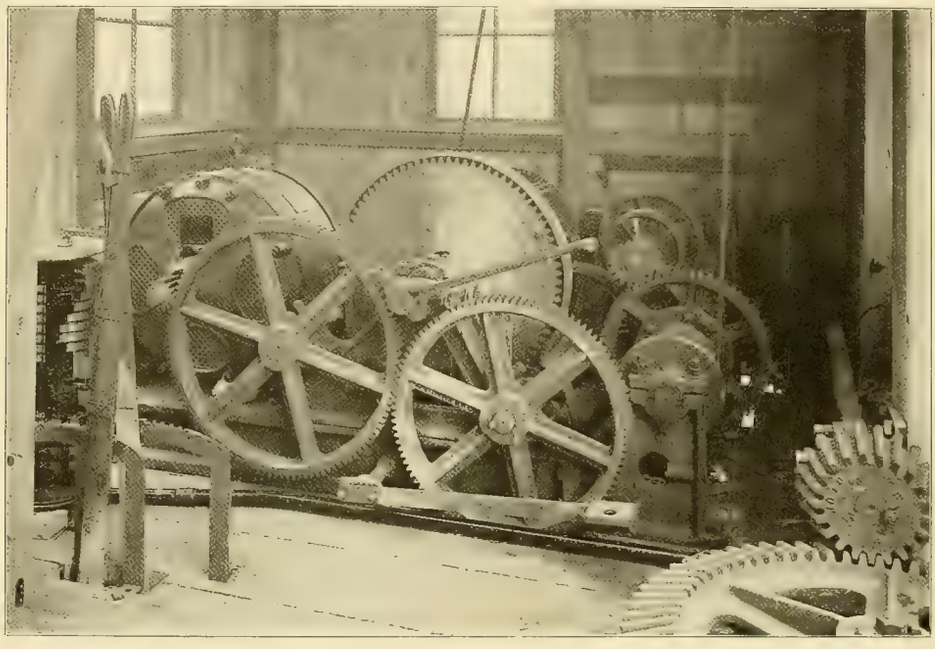


FIG. 5. INDUCTION MOTORS IN A CHICAGO IRON-WORKING ESTABLISHMENT.—MOTOR-DRIVEN HOISTING APPARATUS.

English Steam Roads to Be Electrically Operated.

The Northeastern Railway of England, as has already been mentioned in these columns, is about to change a part of its system from steam power to electricity, and H. A. Watson, its general superintendent, and V. Reaven, superintendent of motive power, are now in Canada for the purpose of gathering information with the object of making a success of the electric service. Mr. Reaven says the section on which they propose using electricity is around Newcastle, where 47 miles of road is much congested by the dense population, and where they carry 2,500,000 people a year. Tenders are already in for the work, and the amount involved in the change will be about $1,250,000. The company proposes that each car shall have its own motor, rather than use electric engines. The question of utilizing electricity as a motive power has been for some time occupying the attention of several of the British railway boards, and Mr. Reaven states that he had learned, since reaching Canada, that the Lancashire and Yorkshire road had determined to change its motive power to electricity at Manchester, Liverpool and other large centers of population. It is also announced that an American syndicate has offered to purchase the Great Western railroad, that the negotiations are still in progress and that if they are successful the road will be equipped throughout with electric power.

Conductors, motormen and shopmen on the Calumet Electric Street Railway, Chicago, have been granted an increase in wages by Judge Grosscup, whose court has had control of the road since it went into the hands of a receiver. The wages will be 18 cents for new men and 21 cents for old men. Day shopmen will be paid 21 cents an hour instead of 20.

Tesla Motor Patents in Litigation.

In the infringement suit which the Westinghouse Electric and Manufacturing Company brought against the Catskill Illuminating and Power Company some interesting facts appear concerning the Tesla motor. The case was decided in favor of the Westinghouse company by the United States Circuit Court of the Southern District of New York, but has been carried up to the United States Circuit Court of Appeals by the Catskill company. The appealed case was called for Monday, November 10th, but was postponed until last Monday, at which time it came up for a rehearing. In the brief for the appellant, prepared by Charles A. Brown of Chicago, many interesting historical facts are presented.

The patents on which it is claimed the Catskill company is infringing were applied for by Nikola Tesla on December 8, 1888. These patents were granted as improvements to prior patents granted to the same inventor, and relate to the rotating-field motor. The infringement proceedings involve the working principles of the Scheefer meter.

An idea of the slight knowledge of the action of the electric current in dynamo-electric machines some 14 years ago may be obtained from the following, which is an extract from a paper read before the American Institute of Electrical Engineers by Mr. Tesla in May, 1888: "In our dynamo machines, it is well known, we generate alternate currents which we direct by means of a commutator, a complicated device, and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilized in the motor, but they must—again by means of a similar unreliable device—be reconverted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate-current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor. In view simply of this fact, alternate currents would commend themselves as a mere direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by, such currents.

"But the operation of the commutator on a motor is twofold; first, it reverses the currents through the motor; and, secondly, it effects, automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the systems, that is to say, the directing of the alternate currents on the generator and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presented itself—How to perform this operation by the direct action of alternate currents?" From the above one easily understands what rapid strides have been made in the applications of electricity since that time. It seems scarcely possible to realize how short a time it has taken to develop a science which, 15 years ago, was just becoming known to the inventor.

Another instance of the work being done on the alternating current is shown in a paper written by G. Ferraris in April, 1888. He conceived the idea of the rotating-field principle or mode of operation of a motor obtained by the direct action of two out-of-phase alternating currents in fixed energizing coils of the motor, and he embodied it in illustrative apparatus and lectured at the Turin Institution on the subject, a full disclosure of his work having been published on April 22, 1888. The important thing in the mind of Ferraris was the motor and its rotating-field mode of operation, and that the method of producing the required out-of-phase alternating currents was of no consequence. Records show that for four or five years he had been working on inductive and other split-phase methods, measuring the difference of phase obtained under different conditions and generally determining the laws of transformers, the differences in phases of currents, the retardation of induction, etc.

Mr. Ferraris treated the obtaining of the necessary out-of-phase relationship of the currents as a manifest thing. Either two independent and originally out-of-phase currents of the same period or rapidity of alternation could be employed, or the two could be obtained from a single alternating current. And he describes three ways of obtaining them from a single alternating current, and describes it as manifest and well-known matter in the following: "The effects above described may be produced (the rotating magnetic field) by means of a single alternating current. It is, in fact, always possible in various ways to obtain the two currents necessary to produce the component magnetic forces from a single alternating current, and to vary the difference of phase between them within certain limits. One way of doing this is by letting the current pass through the primary coil of a transformer. Then the original current and the induced current are at our disposal. . . . .

"Another method of obtaining the same result consists in producing the two component fields from the two secondary currents produced in two transformers, or in two portions of the same transformer traversed by the primary current. Finally, to produce the forces, two derived currents can be used. If in one of the circuits resistances free from self-induction are introduced, and in the other circuit a coil of small resistance and high self-induction, it may be brought about that, while the mean intensities of the two curents are equal, or have a predetermined ratio, the phases of the currents themselves differ considerably." Ferraris, from his knowledge of the electrical laws governing split-phasing predicted the failure of such a source of out-of-phase currents for power-transmission purposes, but suggested the utility for meter purposes, a prediction which has been fulfilled by the present developments of the art.

Again, Shallenberger, in the spring of 1888, developed a meter having a rotating-field motive device run by out-of-phase currents, obtained by split-phase apparatus from a single source. The device was gotten up as a meter for single-phase alternating-current systems, just then coming into use.

Borel and Paccaud devised a motor apparatus operated by split-phase currents some time in 1887, the publication and patents occurring in the summer of 1888.

Meylan, in La Lumiere Electrique, July 14, 1888, describing the Borel meters for alternating currents, says, in the course of a description of the work of Ferraris, and after setting out the rotating idea: "How is it possible now to attain the two alternating currents which we need? Nothing is simpler, and there are many means offered us for that; in the first place by the use of a transformer; one of the coils is inserted in the primary circuit and the other in the secondary circuit. . . . Another arrangement that allows of obtaining currents with a difference of phase consists in putting the two circuits in multiple arc and in inserting in one of the branches a large self-induction." Thus the idea of using split-phase currents and split-phase apparatus for producing the necessary out-of-phase currents seems to have come naturally to all to whom the rotating-field motor idea became known, and the fact that such a motor required two or more out-of-phase alternating currents.

What all the technical men of that day seem to have been seeking for, was the modern economical multiphase system of transmitting power. The Tesla motor required double circuits, and these the inventors were trying to do away with by some means, which would still retain the full and undiminished power-carrying capacity of the currents.

The Tesla invention of the May 1, 1888, patents solved the problem of the utilization in a motor of double-phase alternating currents for power-transmission purposes, and did this by a peculiar construction of motor, to wit, with two or more independent energizing circuits and such a connection of those circuits with the source or sources of the double-phase currents (an alternating-current dynamo) that that out-of-step characteristic of the currents was preserved in the energizing coils of the motor, and a rotating or whirling magnetic field was thereby produced, which caused the armature to start up and rotate.

The invention of the patents in suit, granted December 8, 1888, is not addressed to the utilization of two-phase currents in a motor, but to a way of producing the necessary two out-of-phase currents. Whereas, in the patents of May 1, 1888, the two-phase currents were produced separately in fact and in point of time by the separate coils of the ordinary polyphase alternating-current generator, in the patents in suit the two out-of-phase currents employed are produced from a single-phase alternating current, one being delayed or made to lag more than the other by the inductive or the derivative method. The original unitary current is divided into two currents, and the two are then artificially thrown out of step

with relation to each other, and in that condition they enter and operate the motor.

For a better idea of the relation of the two sets of Tesla patents to each other, the three diagrams, shown in Fig. 1 are given. The first is typical of the earlier Tesla patents and the second and third of the patents now in suit. In these diagrams are shown in dotted lines those parts of the apparatus that make use of the out-of-phase alternating currents after they are produced, and in full lines those parts of the apparatus which are involved in the production of the out-of-phase alternating currents prior to their utilization. (G) is the generator; (L), the line wires; (M), the motor; (a) and (b), the two independent energizing circuits of the motor; (1), an induction coil or transformer; (S), a self-induction coil; (R), a resistance coil. The line (x) (x) separates the current-producing parts of the systems from the current-utilizing parts.

The Scheefer meter, which, as has been said, is involved in the infringement suit, is shown in Fig. 6. Figs. 2, 3, 4 and 5 are diagrams of development stages. Fig. 2 represents a disk which is operated by means of a single energizing circuit, wound upon a field core similar to that of the Scheefer meter. This is wound upon one leg of the core and causes a rotation by means of a difference in the strength of the magnetic poles. It makes no difference whether this winding upon one leg of the core be a series or a shunt winding. In either case the meter will rotate and will be in one case a meter which will measure volts (that is, when it has a pressure winding), and which will in the other case measure current or amperes (when it has a current winding). The trouble with a meter like this is that it will not measure watts unless both windings are superposed, but when both windings are superposed upon the same leg of the core, as in Fig. 3, a rotation is obtained, which is in proportion to the volts times the amperes, or the watts, because both the pressure and the series windings are delivering their magnetic fluxes into the circuit and causing rotation of the disk.

The trouble with this meter, however, is that, because it is under the influence of the shunt winding at all times, even when there is no load connected in circuit, a rotation will ensue and the meter will register when there are no lights in the circuit. To obviate this difficulty, Mr. Scheefer put upon both legs of the core a shunt winding, and thereby secured two opposing balanced tendencies to rotation (Fig. 4), which exactly balanced each other. There would be no rotation, therefore, in the disk with this arrangement under no load. Now if to the shunt windings which thus balance each other in their effect upon the disk are added two series windings which assist the shunt winding on one leg and oppose the effect of the shunt winding upon the other leg, a rotation will ensue which is in proportion to the watts, and a wattmeter will be the result. This arrangement is shown in Fig. 5.

This is a meter which will operate to secure the same result as the Scheefer meter. The Scheefer meter, however, takes the series winding, and for convenience in arrangement, places it between the two legs of the magnet, and causes it to operate by its magnetic flux to strengthen one pole and weaken the other. It is by this last step that infringement is claimed.

While considering either one of the two devices (Figs. 5 and 6) it will be readily understood that the magnetic flux produced by the shunt winding upon the two legs of the magnetic cores creates a north pole at one end and a south pole at the other end. The series winding, whether placed upon each leg of the core or placed in the center between the two legs, operates by its magnetic flux to strengthen one pole and weaken the other. There results from this condition of unbalanced poles the following action: Each pole sets up in the disk eddy currents, which produce magnetic effects opposed to that of the core There will be repulsion, therefore, between the magnetic poles created in the disk and the magnetic poles of the field. The stronger pole, however, having a predominating effect, will drive away the polar region created in proximity to it upon the disk, and will thus overcome the opposing tendency of the other pole. In addition to this repulsion effect, there will be likewise an attraction between the strong pole and the polar regions of the opposite sign in the disk, which will tend to assist the rotation of the disk. The meter may have a difference of phase in the circuits of its two windings, but this depends wholly upon the character of the translating devices connected in circuit therewith. It continues to operate whether there is a difference of phase or not, and it operates according to the same principle of operation, whether there is a difference of phase between the currents of its energizing circuits or not.

The essential feature of the patents in suit is the rotating or whirling field of force. This rotating or whirling field of force, as defined in the Tesla patents, is produced by the blending of the fluxes due to the independent energizing circuits of the motor. As expressed by Mr. Ferarris in his disclosure of the inventions of the patents, "the magnetic fields produced by two electric currents are superposed" in order to produce the rotating field. The Tesla rotating or whirling field of force requires the superposition of the magnetic fluxes in one and the same space. Otherwise they do not lose themselves in a resultant. This superposition of the magnetic fields does not occur, and the operation of thereby securing a resultant in accordance with the law of the parallelogram of forces does not proceed in the Scheefer apparatus.

On the contrary, the arrangement of the parts necessary to bring about that operation is practically reversed. The fluxes or lines of force or operating magnetic fields of the two out-of-phase currents do not traverse the same space or cross each other at an angle in that space. As a consequence, there is no parallelogram of forces brought into play. Again, the fluxes due to the separate currents are exerted in lines that are parallel to each other and independent of each other and far apart, and they maintain their independence throughout. There is no resultant in the sense of the Tesla patents. The individual fluxes do not lose themselves in a resultant. There is no motion of a resultant which is essential to the rotation of the armature. In the Scheefer meter the currents coact, not on the principle of the parallelogram of forces, nor through the action of a resultant magnetizing force, the whirling of which whirls the armature, but on a different principle.

It does not operate by a difference of phase, but by a principle of attraction and repulsion, distinct from that of the Tesla patents. The defendant asserts, moreover, that the patents in suit are completely anticipated and void on that account.

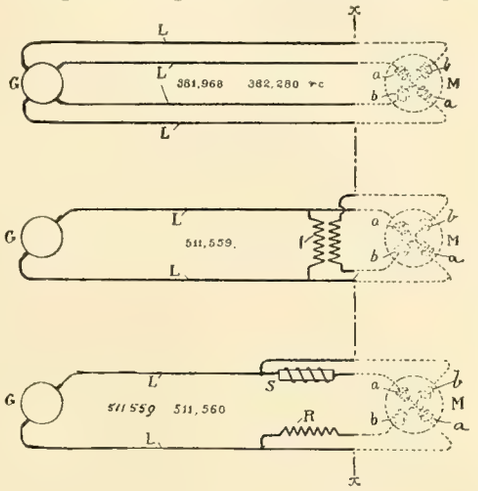


FIG. 1. TESLA MOTOR PATENTS IN LITIGATION. - DIAGRAMS OF TESLA PATENTS.

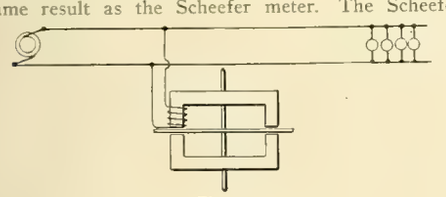


Fig. 2.

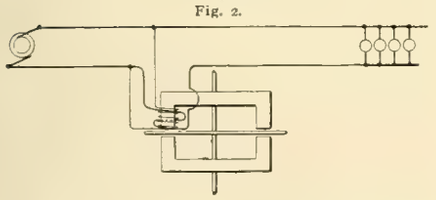


Fig. 3.

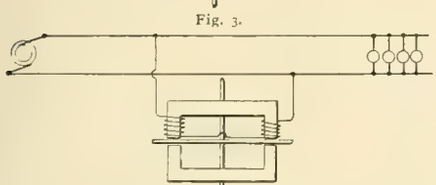


Fig. 4.

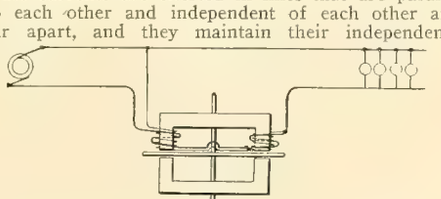


Fig. 5.

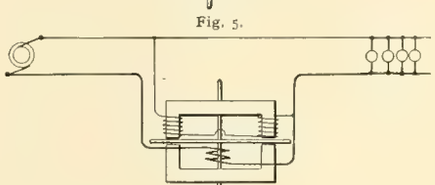


Fig. 6.

TESLA MOTOR PATENTS IN LITIGATION.—DIAGRAMS OF SCHEEFER METER.

The General Electric Company is reported to have obtained control of all the street-railway systems on Puget Sound.

New York State Electrical Laboratory.

On Thursday of last week the commission appointed by the Legislature of New York state to consider and investigate the advisability of that state establishing a state electrical laboratory and standardization bureau met at Niagara Falls. The commission is composed of State Engineer Bond, C. P. Steinmetz of the General Electric Company and H. W. Buck, electrical director of the Niagara Falls Power Company. While the commission has held several meetings since it was organized, its work is now approaching completion, for it is expected to make a very full and complete report to the next state Legislature.

It is understood that the commission will report in favor of a laboratory and standardization bureau, believing that it will be of very material benefit to all sections of the state, so rich in power development and power resources. It has been ascertained by the commission that the capitalization of companies in New York state involving the use of electricity is $1,462,615,595, and that the capitalization of the companies engaged in the manufacture of electrical apparatus is $217,974,695, or a total of $1,680,590,290, which would be directly interested in work the laboratory might do.

When established the electrical laboratory would be a state institution. It would act as arbitrator in disputes over electrical matters and as a standardization bureau of vast benefit. Among other things that would properly come under its official observation would be disputes arising from mutual induction, crossing of circuits and failures of insulation resulting in accidents to life, standardizing electric street lights and meters, electrolysis, questions of installation and insulation, disputes between manufacturers and buyers, etc.

One of the main features of the proposed laboratory would be an available supply of power for experimental purposes, so that phenomena could be observed as well as experiments made. This necessity establishes the hope that the laboratory will be located at Niagara Falls, a city rich in power development and in its power supply. In every part the equipment of the laboratory would be modern and up to date, so that very high standards would be attained.

There seems little doubt but what the New York state Legislature will be asked to establish the electrical laboratory, and when this is done, the results obtained may be expected to be of much benefit to the whole country's electrical development and advancement.

Extension Plans of South Side Elevated.

Plans now being made for extensions of the South Side elevated railway in Chicago have been presented to the City Council in the form of an ordinance. The plans embody extension of the elevated road eastward at Fortieth Street and westward to the Union Stockyards; formation of a loop around the stockyards; construction of a third track for express service between the Illinois Central terminal and the Union Loop; dedication to the city of the street underneath the elevated structure from Fortieth Street to the downtown district, and the pledge to pave and keep it in permanent repair. It is also proposed to elevated the tracks of the Chicago Junction (steam) railway between Halsted Street and the Illinois Central tracks near the lake front. The elevated road will have a new outlet westward at Emerald Avenue, using the steam-road tracks to a point east of Emerald Avenue, where the two lines will separate, the Alley "L" proceeding southward on its loop around the yards and the Chicago Junction railway coming to the street level at Emerald Avenue. East of the elevated road's present structure the two roads are to use the same tracks in Fortieth Street to the Illinois Central. Work on the extension will be begun as soon as possible after the ordinance is granted.

Metropolitan Elevated Terminal.

The proposition to build a downtown terminal for the Metropolitan West Side Elevated Railway Company of Chicago was ratified at a recent meeting of the stockholders. The plan is to construct a line of railway commencing at a point in Market Street, between Jackson Boulevard and Twelfth Street, and running easterly into Fifth Avenue, together with all the necessary stations, branches, curves, side tracks, etc. The spur to be built will be about one-fifth of a mile in length, and is designed to relieve the congestion on the "Loop" during certain hours of the day.

Ground for the new downtown terminal was purchased several months ago, and the work of construction will begin immediately after the first of the year. The cost of the improvement will be covered by the proceeds of the $2,500,000 of extension four per cent. bonds which were sold some time ago.

More Steinmetz Patents.

Charles P. Steinmetz' of Schenectady, N. Y., work in the development of electrical apparatus and systems, both for direct and alternating current is well shown by the patents granted to him for his inventions. In the last issue of the Patent Gazette patents are granted to him for two inventions. One of these (No. 713,356) relates to an alternating-current system of electrical distribution, and is more particularly of use in those systems in which the work circuits are operated at comparatively low potentials. It is one of the objects of the invention to do away with the necessity for the use of extensive and cumbersome feeder circuits in low-tension alternating systems of electrical distribution.

In accomplishing the object stated he makes use of the fact that the potential in an inductive circuit may be made to rise if a source of leading current or electromotive force be connected thereto. By suitable proportioning and adjustment this rise

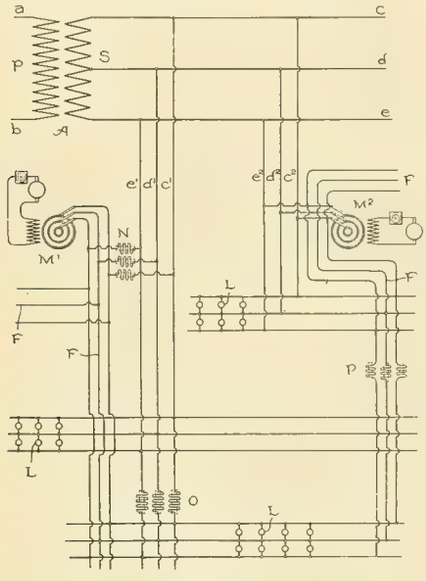


FIG. 1. STEINMETZ ALTERNATING CURRENT DISTRIBUTION SYSTEM.

of potential may be made to compensate exactly for the drop of potential, due to ohmic resistance or other causes. A constant potential may thus be maintained.

"In carrying out the invention in practice," says Mr. Steinmetz, "any suitable source of leading current may be employed, though for the present purpose I find it convenient to use synchronous motors with overexcited fields. These are preferably located in proximity to those points in the network which require to be raised in potential to compensate for the drop in the mains. These sources of leading currents or phase modifiers are connected by what I may term 'suction feeders' with points in the network in the immediate vicinity and act to draw up the potential at those points to the value desired. By the means described constant-potential regulation may be secured without the necessity of extending feeders back to the source of supply."

The system to be described is fed from any suitable source of alternating currents. In the drawing (Fig. 1) a step-down transformer (A) is shown as serving this purpose. The transformer (A) has the primary winding (P) fed from the mains (a) (b), while the secondary (S) is tapped at a point intermediate its ends and connected to a main (d). The outer terminals of the secondary are connected to mains (c) (e), thus forming, in conjunction with the main (d), a three-wire system which is intended to supply a network of conductors of considerable extent. The mains (e') (d') (c') and (e^2) (d^2) (c^2) are connected to the corresponding wires of the three-wire system and convey current to lamps (L) or other translating devices connected to the network in the ordinary manner. Overexcited synchronous motors are connected to the network at suitable points and are located at sub-stations more or less remote from the source of current supply. For purposes of illustration two synchronous motors (M') (M^2) are shown connected to the mains (e') (d') (c') and (e^2) (d^2) (c^2), respectively. Leading from the terminals of the motors are feeders (F), which connect with points in the network in proximity.

The employment of the means shown obviates the necessity for carrying feeders back to the main station. In accordance with the present invention feeders are led from points in the network back only to the nearest sub-station containing only a synchronous motor with overexcited fields.

The self-induction of the mains, acting in conjunction with the leading electromotive force derived from the overexcited synchronous motors, will frequently be sufficient to cause the desired rise of potential to compensate for drop. If the self-induction of the mains is insufficient for this purpose, it is necessary to introduce an artificial self-induction, and this may be done by coiling the mains or the feeders from distance to distance, as illustrated, for example, at (N), (O), and (P) in the drawings, or if desired, inductance coils with iron cores may be employed, as indicated at (N), (O), and (P) in dotted lines.

Two other patents (Nos. 713,523 and 713,574) issued to Mr. Steinmetz cover a method of adjusting compound-wound direct-current generators. The purpose of the invention is to compensate for the variation in voltage in such a machine due to the variation in permeability of the magnetic circuit, and he accomplishes the result by varying the field magnetomotive force or forces at a rate greater than the rate of variation of load.

Fig. 2 illustrates the invention as applied to a self-exciting direct-current dynamo-electric machine having series and shunt coils. In order to straighten the external characteristic of the machine, it is necessary to increase the ampere turns of the series winding at a rate greater than the increase of load on the machine. This result is accomplished in the present instance by shunting the series coil with a resistance having a temperature coefficient greater than that of the series coil—in other words, by a device the resistance of which increases with increase of current faster than the resistance of the series coil increases under similar conditions. If, as is usually the case, the series coil is formed of copper, one may employ iron as the material of which to form the shunt about the series coil.

In the drawing, (1) represents the armature of the direct-current dynamo-electric machine. Connected in series therewith in the usual manner is the series exciting coil (2). Shunted around the series coil is the variable-resistance coil (3) of the character described—that is to say, having a temperature coefficient higher than that of the series coil. This resistance is arranged to be varied simply for the purpose of initial adjustment, and it is not in general intended to be altered during the normal operation of the machine, although, if desired, such use is not prohibited. For this purpose a switch arm (9), with coöperative contacts, may be employed. In shunt with the brushes in the usual manner is the shunt-exciting coil (4), having in series therewith the usual variable regulating resistance (5).

In the operation of the invention it will be obvious that as the current supplied either to or from

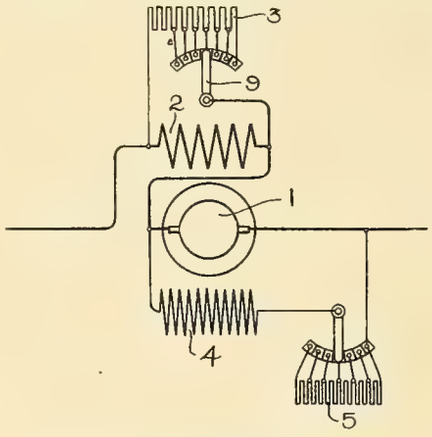


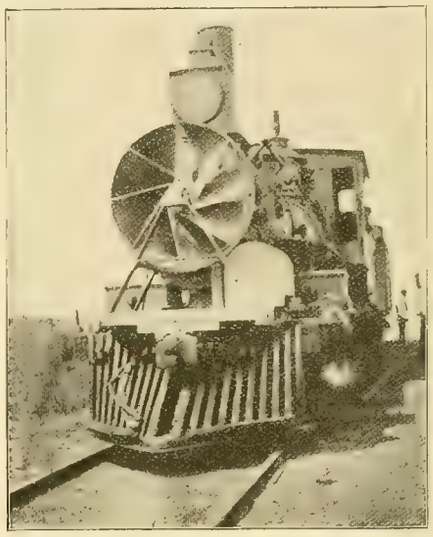
FIG. 2. STEINMETZ ADJUSTMENT OF COMPOUND-WOUND GENERATOR.

the machine increases the current through the series coil and the resistance in shunt thereto will divide in certain proportions. As the current through the machine increases the branch currents through the series coil (2) and its shunted resistance (3) increase. Owing to the fact, however, that the resistance of the shunt (3) increases with increase of current faster than the resistance of series coil (2), it follows that a greater proportion of current will pass through the series coil at higher values of load than at lower. By suitably adjusting the resistance of the shunt (3) a value may be found such that the current passing through the series coil (2) increases faster than the load by an amount just sufficient to compensate for the drop in voltage due to the decreasing permeability of the magnetic circuit. The load curve thus becomes a straight line. The invention is capable of a number of modifications and is equally applicable in connection with the speed regulation of motors.

Novel Train-lighting System.

A novel competitor to the now well-known axle-light system of generating electricity for illumination of steam-railroad trains is offered in the Gullott system, which has been experimented with successfully on a small scale on an important road, and is now to be applied to an express train. In the new system, as well as in the axle-light system, the motion of the train is used to generate the electricity. The manner of using this force instead of taking it from the car axle, consists in utilizing the power delivered from a rotary fan attached to the front end of the locomotive, as shown in the accompanying illustration.

The fan is located close to the boiler head and presents a moving and cutting surface to the air pressure, causing the air to travel to the outer end of the fan's blades until discharged. No air pressure is massed on the flat surface of the boiler head, but the curved surfaces of the fan blades utilize the traveling air and thereby generate power. The fan cutting through the air revolves swiftly and, it is said, does not add to the resistance of the air nor retard



NOVEL TRAIN-LIGHTING SYSTEM.

the speed of the train. No gale of wind is required to cause the fan to operate; the ordinary pressure of the train moves it sufficiently to generate the electrical energy required to light any train and leave a large surplus for ventilating fans and other purposes. The apparatus so located does not obstruct the view of the engineer nor offer any objectionable complications.

The dynamo is located either on or under the pilot and is connected to the fan by a special device. A storage battery is located on the tender or underneath each car, and so equipped automatically with cut-outs as properly to govern the flow of current from dynamo to battery. It is evident that the cost of illumination will be only the expense of installing and maintaining this apparatus.

Recent tests on a train running 45 miles per hour, says the Railway Review, resulted in the development of 4.5 kilowatts, which amount of energy is sufficient to charge the storage battery so that it will illuminate a train of five cars seven hours per night and leave the battery with nearly its maximum charge, due to the continuous operation of fan. On high-speed trains greater power and efficiency are obtainable.

The Lighting Situation in York, Pa.

The light committee of the York (Pa.) City Councils, by awarding the contract for city lighting to the Edison Electric Light Company and rejecting the bid of the recently established Merchants' Electric Light Company, has provoked a storm of public criticism. When the Merchants' company was organized and a plant established the citizens of York congratulated themselves, because they thought that they were now out of the power of a monopoly, which would mean cheaper lighting for the streets, but the light committee, on the pretext that the councils are about to consider a proposition for the establishing of a municipal lighting plant, awarded the contract to the old established company. The new company's bid was for a period of either three or five years, and would have meant a saving of $18,000 to the city treasury. So great is the disapproval of the citizens that the awarding of the contract may be reconsidered at the next meeting of the City Councils, as a number of its members are in accord with the popular sentiment, and before they will yield to the decision of the light committee a fierce fight will be precipitated.

General C. M. Spitzer of Toledo, Ohio, has been chosen president of the Jackson and Battle Creek Traction Company of Jackson, Mich. He has placed $1,000,000 of the bonds, $750,000 of the amount going to himself and his associates in Toledo and other Ohio cities, Cleveland investors being largely interested. The road will be 43 miles long.

Palmer Process of Reproducing Pictures at a Distance.

Herbert R. Palmer of Cleveland, Ohio, has been granted a patent (No. 713,140) for a process of making facsimile reproductions of pictures at a distance by means of an electric current. Mr. Palmer, in connection with Thomas Mills, has done considerable work in this line, and an account of an experimental test conducted between Chicago and New York by these gentlemen was mentioned in the Western Electrician of April 20, 1901. In that test zinc plates were used. Mr. Palmer's new invention is an improvement, inasmuch as he uses half-tone plates, while the art has been restricted to zinc plates heretofore. In practicing his invention photographs and any picture which is made up of variations of light and shade may be accurately and minutely reproduced at a distance.

Mr. Palmer says: "In my process I avail myself of the well-known half-tone process of producing a printing plate from a photograph or other picture having gradations of light and shade. In this half-tone process the photograph may be taken directly on a metallic plate having a positive coating and the plate thereafter etched by acid, which eats deeper where the lights are, wherefore the raised portions are adapted to carry the ink in printing and print black as desired. In practical use, however, it is found more satisfactory to photograph the picture through the screen onto a transferable negative film, which is then placed over a zinc plate covered with some coating normally soluble, but rendered insoluble by light, whereupon the light portions of the picture which became dark in the negative do not receive on the zinc plate sufficient light to render the coating insoluble, wherefore this coating washes off, and the etching acid eats this portion of the zinc plate deeply, as before. A half-tone plate for printing produced by such a process as above described consists of a series of lines or dots placed close enough together so that to the eye they give the appearance of being substantially continuous.

"Systems of producing pictures electrically at a distance are well known. They include, briefly, a platen for carrying the transmitting plate having a picture composed of conductive and non-conductive parts, whereby the current is made and broken between the plate and stylus, and electromagnetic or electrochemical means at the other end for producing corresponding changes on the received material. Such a transmittable picture has been heretofore produced by hand-sketching on the metallic plate with an insulating ink, as sealing wax dissolved in alcohol. In endeavoring to eliminate this inaccurate hand operation I have hit upon the use of a half-tone plate with the low portions filled in with an insulating substance, as plaster-of-paris. In such use, however, I have found that with the lines or dots of the half-tone plate close enough together to give the eye the desired impression, they will be too close for the instrument to respond, the necessary inertia of the parts, the reluctance of the receiving magnet, the capillarity of the ink at the receiving end, if ink be used, etc., preventing the receiving mechanism from responding to the breaks of the transmitter or preventing the transmitter from breaking at all by reason of an arc continuing the current from one metallic line to the next. On the other hand, if the transmitting plate has its dots or lines

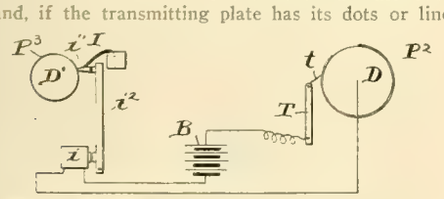


FIG. 1. PALMER PROCESS OF REPRODUCING PICTURES AT A DISTANCE—DIAGRAM OF APPARATUS.

far enough apart for the telegraphic apparatus to take the necessary cognizance thereof, they will be so far apart that no satisfactory picture will be presented to the eye, but there will appear simply a series of disconnected dots or lines, giving the general character of the picture, it is true, but on such a coarse scale as to be useless for ordinary purposes. I have found that I can harmonize these opposing requirements by first taking the half-tone picture through a very coarse screen (much coarser than is used in the practice of the ordinary half-tone process), transmitting from this half-tone picture, and reducing the received picture to bring its lines or dots close enough together to give the proper appearance to the eye.

"Fig. 1 is a diagrammatic view of the telegraphic apparatus. Fig. 2 shows the transmitting coarse half-tone plate which is made from the photograph or picture to be reproduced. Fig. 3 represents the picture produced directly in the receiving apparatus.

"The transmitting apparatus may consist of any of the well-known devices used in the art of facsimile telegraphy. What I have shown consists, substantially, of a rotatable drum (D), the surface of which has metallic connection with the main line. A metallic stylus (t), mounted upon a traveler (T), holds its point near the surface of the cylinder. As the drum (D) rotates, the traveler traverses its length. An electromagnetic inking device has its magnet (i) in electric circuit with a source of current (B), the traveler (T), and the drum (D), and its pen (i') is in close proximity to the surface of the receiving drum (D'). This receiving drum rotates in unison with the transmitting drum, the inking apparatus (I) traveling in unison also with the traveler (T) of the transmitting drum. Now when the half-tone plate, as (P²) (produced directly or indirectly by the camera), has been secured facing outwardly upon the rotating drum (D), the stylus being properly adjusted, it completes the electric circuit, and it is evident that this circuit will be established or broken, according to whether the point of the stylus is resting upon the metallic part of the plate (P²) or on the plaster of-paris filling. The pen (i') is normally held removed from the recording drum, upon which is wrapped a sheet of paper; but whenever the electric circuit is closed it is held in contact with it by means of the magnet (i) and the armature lever (i²). From this arrangement evidently the surface of the receiving sheet will be covered with a series of closely ruled lines reproducing the original photograph, as shown in Fig. 3. The drum (D') may be smaller than the drum (D) to reduce the size of the received picture, as shown, or it may be larger or of the same size, as desired, it being understood that the speed of travel of the pen is varied proportionately as the speed of surface movement of the drum is changed.

"By having the screen cross-hatched diagonally, as shown in the drawings, the plate will be placed on the drum, with its upper and lower edges parallel with the axis of the cylinder, and the stylus will

Fig. 2 Transmitting Plate.

Fig. 3. Receiving Plate.

PALMER PROCESS OF REPRODUCING PICTURES AT A DISTANCE.

then trace from one light area to the next across the exposed metallic portions of the plate, giving better results than if it traced parallel with the metallic portions caused by the lines of the screen.

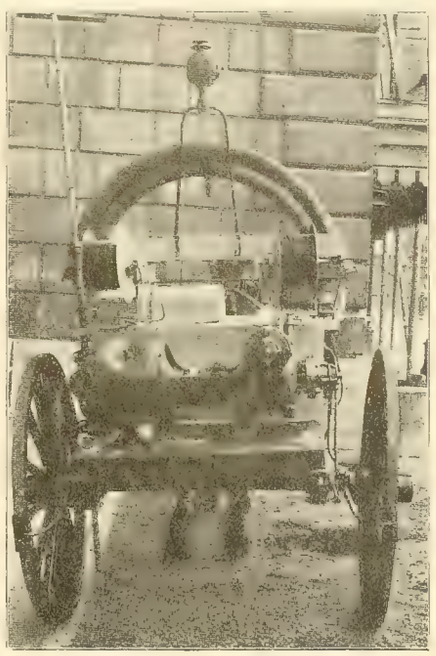
"For some purposes the picture as received, Fig. 3, if the telegraph apparatus is adjusted accordingly, may be artistic enough; but to produce a better effect I prefer to reduce it photographically. The ordinary camera is employed for this purpose. If the final picture is to be used in a printing-press for printing half-tone work, which is the object primarily contemplated, the plate will be either a metallic plate positively sensitized or a transferable film negatively sensitized which is used to produce the final picture. Thus the process after the picture is received may be substantially the same as that before it is transmitted, except that after transmission the screen is omitted, as when the picture is received it is already composed of absolute blacks and whites."

Fast Run on Lake Shore Electric Railway.

On the morning of November 13th a Lake Shore electric car made a run from Cleveland to Toledo, Ohio, 120 miles, in three hours and 10 minutes, the fastest long trip ever known to be made by an electric car. For 60 miles, it is claimed, the car ran at a rate of a mile a minute, and one straight stretch of eight miles was covered in seven minutes. The time as noted was as follows: Left Cleveland 3 a. m.; Rocky River, 3:22; Beach Park, 3:38; Lorain, 3:43; Ceylon, 4:18; Norwalk, 4:40; Monroeville, 4:53; Clyde, 5:15; Fremont, 5:25; Genoa, 5:55; arrived at Toledo, 6:10. The car carried a party of American Eagles who had been attending a celebration in Cleveland. The car used was of the 50-foot double-truck type. The regular running schedule between Cleveland and Toledo is about six hours.

Electric Fire Pump in Rouen.

The electric fire pump shown in the accompanying illustration and used by the Rouen Fire Company of Rouen, France, is described as follows by United States Consul Thornwell Haynes. The outfit is composed of a centrifugal pump (Thiron and Sou's system) and of an eight-horsepower motor, which gives normally 2,000 revolutions per minute. A continuous current of 525 volts can be applied. This motor is well covered, so as to prevent all penetration of water. Above are two reels. On one is wound the wire upon which the current is received, the extremity being exposed in such a manner as to allow connection with a hook suspended from the railway or electric-light wire; on the other reel



ELECTRIC FIRE PUMP IN ROUEN.

is wound the return wire, the free end being connected with a cast-iron block to be fastened to one of the tramway rails. There is beneath the covering a compartment containing two circuit-breakers, a circuit-closer, and a commutator.

To start the apparatus, it is only necessary, after connecting the two wires to the line giving the energy, to close the circuit and start it running slowly with the rheostat. The time necessary for starting is about a minute.

The reels on which are wound the conductors can receive 200 meters (656.167 feet) of insulated wire; if to this is added the 200 meters of hose on the reel and the 35 meters (114.83 feet) to which the water can be thrown, it is seen that a distance of 435 meters (1,427.16 feet) can be covered. The distance that the water can be thrown, nearly 115 feet, is accomplished with an orifice of 18 millimeters (0.7 inch) and a volume of 350 liters (92.46 gallons) a minute.

The whole machine can be placed on a handcart, or on a little two-wheeled wagon drawn by one horse. Its total weight, with accessories and two men on the seat, is about 1,040 kilograms (2,292.78 pounds). The motor and pump are not longer than a meter (39.37 inches), and about one-half a meter (19.685 inches) wide and one-half a meter high.

Behind the machine is a reel capable of holding 300 meters (984.25 feet) of hose, two lances, a ladder with hooks, an axe, a hydrant key, a nozzle, etc. The weight of this reel, equipped, is 330 kilograms (727.518 pounds).

The idea of this pump, which is the only one of its kind in France, if not in the world, was suggested to Robert Lefebvre, the captain of the Rouen Fire Company, by a conversation he had last year with a German engineer at the Berlin Fire Extinguishing Exposition. The latter had conceived the idea of an electric pump for cleaning the walls of the buildings, etc. If sand thrown by an electric pump could clean buildings, why could not water thrown in the same manner extinguish fire? In the solution of this question, the electric fire pump was born.

Space Telegraphy in the Navy.

In his annual report Rear-admiral Royal B. Bradford, chief of the Bureau of Equipment, recommends government control of all wireless-telegraph stations along the coasts of the United States. Admiral Bradford says it is proposed to establish wireless-telegraph stations for the purpose of instructing officers and men at Newport, New York, San Francisco and probably other naval stations. In order to ascertain the effect of heat, which is said to be injurious to the successful working of wireless apparatus, a station will be established at Key West, Fla.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Induction Motors in a Chicago Iron-working Establishment. Illustrated 359, 360
English Steam Roads to be Electrically Operated 360
Tesla Motor Patents in Litigation. Illustrated 360, 361
New York State Electrical Laboratory 361
Extension Plan of South Side Elevated 361
Metropolitan Elevated Terminal 361
More Steinmetz Patents. Illustrated 362
Novel Train-lighting System. Illustrated 362
The Lighting Situation in York, Pa 362
Palmer Process of Reproducing Pictures at a Distance. Illustrated 363
Fast Run on Lake Shore Electric Railway 363
Electric Fire Pump in Rouen. Illustrated 363
Space Telegraphy in the Navy 363
Editorial 364
Legal Contest Over Permanency of Electric-power Supply 365
Use of Incandescent Lamps as a Pyrometer 365
Spectacular Electric Lighting 365
Tests of Submarine Naval Vessels Successful 365
Large Hydro-electric Development at Atlanta 365
Improvements in San Antonio 365
The Work of the Signal Corps. Part II 366, 367
Gas-power Development for Electrical Plants 367
The Alternating Current for Heavy Railroad Work 367
Large Power Station in Galveston 367
Development of the Telephone Field 368
Telephone News from the Northwest 368
Ohio Telephone Notes 368
Indiana Telephone Items 368
Southern Telephone Developments 368
Telephone Men 368
General Telephone News 368
Manufacturers and Dealers 368
Signal Circuits. By J. C. Mock and W. E. Foster. (Railway Signaling Club.) 369, 370
Magnetic Separators in Flour Mills 370
Col. J. J. Astor Gives His Marine-turbine Patents to the World 370
Developments in Electrometallurgy of Iron and Steel. By Marcus Ruthenberg. (American Electrochemical Society) 370, 371
Book Table.—Oudin's "Standard Polyphase Apparatus and Systems" 371
The Sederholm Boiler. Illustrated 371
Institute Membership 371
Queer Quirks of the Quad. By Henry Burns Geer 372

DEPARTMENTS.

Correspondence 372, 373, 374
New York Notes 372
Southern Developments 372
New England News 372, 373
From the Buckeye State 373
Detroit, Mich 373
Information from Indiana 373
Northwestern Notations 373, 374
On the Pacific Slope 374
Personal 374
Electric Lighting 374
Electric Railways 374
Societies and Schools 374
Publications 374
Space Telegraphy 374, 375
Telegraph 375
Miscellaneous 375
Trade News 375
Business 375
Illustrated Electrical Patent Record 375, 376

DATES AHEAD.

Engine Builders' Association of the United States, Sherry's, New York city, December 1st and 2d.

Interstate Independent Telephone Association, Auditorium Hotel, Chicago, December 9th, 10th and 11th.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

IT IS rather curious that the completion of the British Pacific cable, whereby the earth is completely encircled by telegraph wires for the first time, has not attracted greater attention. Contrasted with the great commotion caused by the laying of the first Atlantic cable, the announcement of the successful placing of the last link of the world's girdle of submarine cable is received tamely enough. Cables have become commonplace; space telegraphy is the latest thing in the way of transmitting intelligence, and even that has lost the charm of its pristine novelty. And yet the achievement is a great one, only arrived at after years of discussion and effort. The greatest ocean is crossed by the longest span of submarine cable yet put into the service of man. An enterprising Yankee has telegraphed around the world in 40 hours—not quite equal to Puck's boasted performance of 40 minutes, but still a very creditable accomplishment. But nobody pays any particular attention to the feat. We have ceased to wonder at the things done with electricity over such a prosaic material as copper wire; we now look for marvels in the ether.

ONE possible invention of the future is a device to enable one to see objects at a great distance—a farseer that will do for the eye what the telephone does for the ear. Many persons believe that such an instrument may be combined with the telephone. A late writer says: "Light is only a little higher up the scale of vibrations, and, as the inventive genius is still ascending, it will only be a question of time until some bright mind lays before us the completed scale, from the lower vibrations of sound to the higher and more subtle ones of light, in one and the same instrument." Despite the fact that some widely heralded devices of this general nature have utterly failed to "materialize," like the "telectroscope" of the renowned Polish schoolmaster with the unpronounceable name, not a few bona-fide investigators are at work on the problem, many of them basing their work on the curious property of selenium of varying its electric resistance by the action of light. The most recent announcement on the subject is that an invention of this character has been submitted to the French Academy of Sciences. It is not possible, says the secretary of the Academy, to pronounce upon the real value of the discovery at this early stage, but it has been submitted to the examination of a technical committee. The information publicly given on the subject is that a fresh contribution on the solution of the problem of vision through obstacles has been submitted to the Academy by an inventor whose name would only be made known after the report of the committee on the practicability of the invention.

This is somewhat vague, but encouraging. It is stated that the latest device is on the selenium order, and it is to be hoped that a real advance has been made in the study of the problem, for a real farseeing device would be a most valuable addition to the world's comforts.

TECHNICAL EDUCATION, or, more specifically, the education of the electrical engineer, was given much attention at last summer's convention of the American Institute of Electrical Engineers. A fair idea of the trend of the papers and discussions was given in the technical press at the time, but necessarily much was omitted by reason of the limitations of time and space. But as the published Transactions of the Institute covering this interesting discussion are now at hand, with the subject-matter revised, no doubt, by the writers and speakers, we take occasion to refer, briefly, to the contribution of one member who surveyed the whole subject in a broad-minded and judicious manner.

Mr. C. O. Mailloux, for to him we allude, ably elucidated the apparently paradoxical thesis that engineering graduates are not practical enough because they are not theoretical enough. In other words, the groundwork of elemental, theoretical knowledge should be thorough and extensive if possible, but at any rate thorough; the superstructure of practice must not be built on a flimsy foundation. A broad general education is necessary. The higher the apex of the pyramid of knowledge, the broader and more substantial must be the base. "The objects sought are, briefly stated, to foster taste and develop capacity for study, to make the perceptive faculties more active and keen, to develop the powers of observation, thought, analysis and synthesis, to enlarge the scope of the reasoning faculties, and, in general, to broaden the intellectual horizon. Any process, method or means of training which attains these objects must be accounted good, for it equips the mind with the three graces—aptitude, application and judgment—which are the handmaids of success, that point out and prepare the easiest paths to distinction, making the process of acquiring skill and experience less tedious in any vocation."

Therefore, the schools should consistently persist in broadening and deepening the theoretical training at the expense of practical training, if necessary. The speaker continues: "One of the great qualities needed in any engineer is receptivity. If the young man were drilled thoroughly in fundamental principles instead of being given a smattering of them, together with a smattering of practice, he would not be deluded, as he so often is, with the idea that he has already learned all that is worth knowing, both theoretically and practically, and that knowledge and experience have no new fields for him to conquer. * * * * The success that has been achieved by those who have had neither theoretical nor practical training in technical lines, but who have had merely general intellectual training and discipline, is an indication of the great importance and benefits of a training in which the individual is taught to think and to study, that is to say, whose mind has been developed to the highest possible degree of receptivity and assimilative power."

Turning to studies and the manner of studying, Mr. Mailloux fully agrees with those who insist upon the necessity of a good training in the English language and who point out the drawbacks of an undeveloped and uncultivated faculty of oral or written expression. "The faculties of thought and of expression are so closely related, physiologically," he says, "that the dwarfing of one necessarily dwarfs the other. It is my opinion, and I believe observation confirms it, that the individual who neglects to learn the important art of clear expression has handicapped his intellectual faculties to a great extent, for he has not attained his full possibilities in the direction of clearness of thought." This is well expressed—that is, the manner of the sentences just quoted precisely illustrates their matter—and we are gratified that the importance of teaching engineers the elements of English composition and of inculcating a love for good English literature, frequently urged by the Western Electrician, is so clearly recognized by a man of Mr. Mailloux's standing and experience. Not only English, but the classical and modern foreign languages are strongly recommended by the speaker, who is in the happy position of being able to converse in five modern languages and read ten.

In the teaching of mathematics Mr. Mailloux advocates thoroughness, simplicity and patience. The steps of the reasoning should be of moderate length; the training should be gradual and sympathetic, so that the student may assimilate his studies and not suffer from mathematical dyspepsia. "While it is true that there is no royal road to mathematical knowledge, it is certainly a great mistake, in my opinion, to imagine that the best road is along the line of maximum effort. I believe, on the contrary, that the best road lies along the line of least effort. I am not in sympathy with the idea of some teachers that it is necessary to make a thing difficult in order to have it well learned and remembered. Mental growth is essentially a slow process, which should never be forced. The intellectual gymnastics should be such as involve the least mental effort and produce the most intellectual exercise." Mr. Mailloux admires the advanced mathematical-teaching methods of Dr. John Perry of the Royal Technical College of London. This authority lays great stress on the cultivation of the higher mental attributes of his pupils, especially the imagination. If, psychologically, the mathematical student needs stimulating, the perusal of a few stirring novels may be prescribed.

Good sense, moderation and well-balanced judgment characterize Mr. Mailloux's remarks on the subject of technical education, which are the more valuable, as they are, in a way, a summary of the discussion that had preceded them. A mere outline is given above; the reader will do well to read the contribution entire, for which space is not available here.

Legal Contest Over Permanency of Electric-power Supply.

A legal battle was begun in Salt Lake City, Utah, on November 12th in Judge Morse's court the outcome of which promises to be of considerable interest to the electrical world. It is the case of the Telluride Power Transmission Company against the De Lamar Gold Mining Company to recover payment for electrical power furnished by the complainant company. The defense claims that it did not get the amount of power contracted for, and enters a counter claim for damages in the sum of $51,432 as against claim of plaintiff company for $57,120.

Several well-known experts are present to give expert testimony in the case, and the outcome of the suit is being watched with special interest by three states, Utah, Nevada and Colorado. The experts will give scientific testimony tending to show whether electricity can be controlled by, and is fully responsive to the one in command; whether as a force it can be compelled to do the bidding of those in control.

The case was first brought in Tooele County, Utah, but for legal causes was transferred to Salt Lake City. The complainant alleges that it furnished power to defendant from March, 1898, to May, 1900, for the operation of the Golden Gate Mill at Mercur, for which it should receive $57,120. A contract was entered into between the parties in July, 1897, and defendant, in its answer and cross complaint, says it is not indebted to the power company. The defendant claims damages for lack of and stoppage of power. It is also alleged that the power company violated the terms of its contract in neglecting to supply a uniform amount of power, and judgment is asked for the sum named. The plaintiff is represented by Attorneys Brown and Henderson of Salt Lake, Storey of Ouray, Colo., E. A. Wedgwood, E. C. Lockner and Fred Slegmeyer; the defense by Dixon, Ellis & Ellis of Salt Lake.

Should a decision be obtained in favor of the defense, it may be the forerunner of a new line of litigation in the courts. Wherever electricity is furnished for power, the question is usually present with regard to whether the consumer gets the amount contracted for. The fact that electricity cannot be measured by the ordinary man, except by results obtained, makes this force or power a subject of frequent dispute. This is, probably, the first action of its kind ever brought up for legal adjudication. An effort is being made to establish the fact that the contract was not fulfilled and that the power contracted for was not supplied by plaintiff company. The experts will try to show how much control the electricians are able to maintain over the power. It is claimed that the loss of power was caused by defective apparatus which decreased the percentage of supply.

Among the experts in the case now in Salt Lake are R. H. Jones, superintendent of the Pike's Peak Power Company, one of the largest enterprises of its kind in that part of the country; Professor Corey of Stanford University; G. L. McGuinnis of San Francisco; Barton M. Jones, manager of the Pike's Peak Company; Duncan McVechie, mine superintendent of the Golden Gate Mill; Frank G. Janney of the De Lamar mines; L. N. and P. M. Nunn of the Telluride company; Mr. Woodhouse of Provo and his working staff, and General Irving Hale of Denver, general western manager of the General Electric Company.

Use of Incandescent Lamp as a Pyrometer.

One of the most interesting uses of the electric incandescent lamp so far reported is as a pyrometer for determining the temperatures of flue gases and furnaces. The principle is simply to regulate the flow of current through the lamp filament so as to bring it to the same point of incandescence, judged by color, as the firebrick lining of the furnace or flue, and determine by means of a table the temperature corresponding to the given flow of current. It has been observed that a filament through which there is no current flowing, appears as a black line when held against a background of incandescent firebrick in a furnace or stack. As current is turned on and its strength increased the filament becomes brighter and brighter. At the point where the filament has the same color as the heated firebrick it is invisible. Above this temperature, the current strength being still further increased, the filament appears as a white line.

The observations are taken by means of a telescope mounted on a tripod several feet away from the furnace, and pointed at an aperture in the furnace. Inside the telescope is a very small carbon-filament electric lamp, supplied with current by two dry-battery cells, through a resistance coil. The current strength is read on a suitable ammeter, and a comparison with a table gives the corresponding furnace temperature reading. Many experiments made with this apparatus, which has a limit of 3,600 degrees Fahrenheit, in which the readings have been compared with those of the highest type of existing pyrometers show the new apparatus to be extremely accurate. Its great merit is its simplicity, requiring only an ammeter for reading the current strength, two dry cells, a telescope, and a resistance coil.

Spectacular Electric Lighting.

In the modern spectacular production the most improved mechanisms used in electric lighting are put into service, irrespective of cost. Without the electric light the beautiful effects secured would be an impossibility. The recent production of the "Beauty and the Beast" at the Illinois Theater in Chicago affords probably as good an example of the modern spectacular production as one will see. During the progress of the three acts, the electric light in many forms is brought into use.

The four seasons are depicted beautifully. During the progress of the ballet representing spring, summer and autumn, the entire lighting plant is throwing an amber glow on the stage, producing a soft effect, pleasing to the eye and typifying content and happiness. Then comes winter, with its chill and cold. Here one is met by the hard, fierce, brilliant light thrown from the open arc, seldom if ever used in stage work, but particularly adapted to a winter scene, since its rays approach most nearly in whiteness to those of the sun, reflected by snow. During the transition of spring, summer and autumn, the soft amber light thrown on the various costumes produces just the effect desired. This particular color accentuates the green, heightens the yellow, warms up the red and takes the chill from the white. In the instant that one passes into the winter season he immediately notices that the colors which prevailed during the first three seasons have lost much of their distinction. The same costumes are on the stage as before, but they have lost their warmth of color.

An idea of how the desired effect is reached can be seen by an analysis of the tableaux, beginning with May. The scene opens in white and pale-green lights. Soon the depth of the green in increased and the white is displaced by yellow. By this means the two main colors of spring, yellow and green, are retained as the basis of the picture, and lead naturally into the gradual transformation into summer. The green in turn disappears in favor of dull red, the yellow deepening for the harvest dresses and poppy and golden green, while a few touches of mauve and pink are brought to illustrate the variety of the advancing season. All the yellow finally goes, being replaced by the warm, variegated shades of red, purple and brown common to autumn. Thus the eye has been led by almost unconscious steps from one color to another, each stronger in brilliance than the preceding.

All the above effects are produced without a clash of colors, and so naturally are the transitions made that one scarcely realizes that a change has taken place. The electric light is manipulated so skillfully that the change from spring to winter comes as naturally as if Dame Nature herself manipulated the controlling switches. Of course, all the lights used by the company are not its own property; in fact, most of them belong to the theater, which, in this case, is particularly well adapted in lighting facilities to such a production.

Another interesting feature of the seasons' ballet is the use of miniature incandescent lamps of one-half candlepower at four volts pressure. Ten of these small lights are rigged into a headgear, one of which is worn by each of a number of girls in the ballet. The current for these lamps is supplied by two battery cells in series, the two cells being fastened in some manner in the costume of each girl. These lamps burn continuously during the progress of the ballet.

Tests of Submarine Naval Vessels Successful.

Success marked the tests made last week with the Holland submarine boats, the Adder and Moccasin. The trials were made off Greenport, L. I. The Moccasin, submerged, made 7.28 knots, or a quarter of a knot in excess of the required speed. Captain C. J. Train of the inspection board of the navy was on board the Moccasin during the submerged test. He praised the boat, and said he would "just as soon be on board the Moccasin as any boat in the navy." The Adder, in a surface run over a 10-mile course awash, made 7.8 knots per hour, and the Moccasin over the same course, running light, made 8.5. The boats steered well and responded well and in other ways were perfectly manageable. Electric batteries and motors are used for the power when the boats are submerged. It is believed the results of the tests will show that the American submarine boats surpass those of England and France.

Large Hydro-electric Development at Atlanta.

An important southern hydro-electrical power-transmission enterprise has recently been projected by eastern capitalists, having for its object the creation of an industrial center near Atlanta, Ga., and the possible ultimate development of an electricity supply system in the nearby cities. The project involves the immediate construction of a concrete dam across the Chattahoochee River at the Bull Sluice Shoals, about 15 miles from Atlanta, and the erection of a generating station at the dam. For the present the entire output of the plant will be utilized by local manufactories. In the event of a sufficient demand for power at Atlanta a transmission to the city limits may be installed with a sub-station at this point, where the power will be transformed for local use in mills and factories located near by.

The plant will have an ultimate capacity of 14,000 horsepower at the generator terminals, of which 6,000 horsepower will be available at the present time. The remaining 8,000 horsepower will be installed as rapidly as is warranted by the local demands for power. Steam railroad facilities are at present undergoing improvement for the accommodation of the new industries which, as the result of the power enterprise, will undoubtedly be attracted to this vicinity.

The development of this undertaking involves an expenditure of over $1,500,000, all of which has already been subscribed by the promoting interests comprised in the Atlanta Water and Electric Power Company. The company is incorporated under the laws of Georgia and is officered by men prominent in hydraulic and electric-power enterprises, viz.: President, S. Morgan Smith of York, Pa.; vice-president, Forest Adair of Atlanta, Ga.; secretary and treasurer, J. J. Spaulding of Atlanta, Ga. The board of directors comprises the above gentlemen, together with C. Elmer Smith of York, Pa., and George C. Smith of the Westinghouse companies.

The entire hydraulic work, including the erection of dam and power house and the furnishing of the hydraulic machinery, will be carried out by the S. Morgan Smith Company of York, Pa. The electrical work will be designed and executed by Westinghouse, Church, Kerr & Co., engineers and auditors for the Atlanta Water and Electric Power Company. The electrical equipment will be furnished by the Westinghouse Electric and Manufacturing Company, and the entire power installation will represent the most advanced practice of these three concerns.

The dam will be constructed of Cyclopean masonry with concrete facings and will be approximately 1,100 feet in length, 50 feet high and 65 feet wide at the base. The geological formation of the river bed, which is hard gneiss rock, is peculiarly favorable to the hydraulic work.

At each end of the dam will be located a concrete bulkhead, each extending 10 feet above the crest of the dam proper into one of the turbine penstocks. The power house will be located immediately in the rear of the main bulkhead and built upon the river bed. Seven steel penstocks, each 12 feet in diameter, extend from their anchorage in the base of the bulkheads to the wheel casings, a distance of 50 feet.

The turbines are of the horizontal twin inward-flow type. There will ultimately be seven pairs of 2,500 horsepower each, in addition to two single exciter turbines of 250 horsepower each. The turbines are encased within a steel casing placed within the penstocks, with the steel draft tubes extending 20 feet below the power-house floor into the tail race. The shafts extend into the generator compartment, these being direct-coupled to 1,500-kilowatt Westnighouse revolving-field alternating-current generators. A similar arrangement is employed with the exciter units, each of which is of 150-kilowatt capacity and capable of carrying indefinitely the entire excitation load.

The generators furnish current at 2,200 volts and 60 cycles directly to the station switchboard. A considerable amount of power will be furnished to local concerns directly from the station bus, thus avoiding transformation losses, but provision has been made for a complete equipment of 1,500-kilowatt water-cooled transformers which will raise the pressure to 22,000 volts for transmission, should this be decided upon.

The present installation will consist of three 1,500-kilowatt units with the exciters and the necessary controlling apparatus, but the entire power house and equipment has been designed with a view to immediate extension when warranted by the demand for power.

Improvements in San Antonio.

The San Antonio (Texas) Gas and Electric Company is making considerable additions to its already extensive plant. The foundations are almost completed for placing in position an 800-kilowatt General Electric three-phase generator. A 200-kilowatt generator was started last October. A new General Electric switchboard, 26 feet long and seven feet high, has also been added. It is planned to move the street-railroad plant into the electric-light power house by removing the boilers, engine and dynamos, thereby combining the business into one plant. The work is under the direction of George H. Cushman, superintendent of the electric department.

The Work of the Signal Corps.

Part II.

Philippine Islands.

The Signal Corps' work in the Philippines has been constructed under the charge of Lieutenant-colonel James Allen, until March, 1902, when he was relieved by Major William A. Glassford. The fine system of telegraph lines and cables was very largely constructed and installed under Colonel Allen. This system increased during the fiscal year by 2,600 miles, consisted on June 30, 1902, of 31 submarine cables, 1,326 miles in length, and land lines 5,108 miles in length, making an aggregate of 6,434 miles.

It is almost needless to say that the work of construction in the archipelago under the disturbed and difficult conditions existing there, demanded talents of the highest order, and the system stands to-day a monument to the energy, skill and resourcefulness of the American soldier. Colonel Allen's work must always serve as a standard of attainment for Signal Corps' officers. Major Glassford comes to the work with qualities of work fully guaranteed by similar difficult work in Porto Rico and Alaska. His work in the Philippines has been marked by material improvements in modern equipments and consequently in telegraphic and telephonic facilities, which, initiated by his predecessor, have been brought under him to fuller fruition.

On entering the Philippines the American army found practically no existing telegraph lines. The few land lines connecting the Visayan cables of the Eastern Extension Telegraph Company had been promptly destroyed by the insurgents, as well as the lines in Luzon when they retreated before the advance of our army. The only lines of any importance that came into our possession were several hundred miles of dilapidated and antiquated lines in the Cagayan Valley and along the west coast of Luzon.

Applying itself to the problem of establishing a suitable system of telegraphic intercommunication, the Signal Corps has constructed and laid from August, 1898, to June 30, 1902, approximately, 9,000 miles of lines of telegraph, telephone and submarine cable. About one-third of this mileage consisted of extensive temporary field lines erected for the purpose of maintaining communication by means of permanent lines with division headquarters at Manila. On June 30, 1902, the permanent system maintained and operated by the Signal Corps aggregated 6,434 miles, of which 5,108 were land lines and 1,326 miles cable. All the important islands of the archipelago, except Romblon and Palawan, are connected, and even the former is to be reached by cable.

There has been constructed and laid during the fiscal year 1,044 miles of land line and 618 miles of submarine cable, aggregating 1,662 miles. There are 281 stations on these lines, over which official messages may be transmitted; many of them, however, are telephone lines, owing to the extreme difficulty of retaining in service skilled telegraph operators for the given pay. A recognized difficult feature of this work is the absence of trained Signal Corps' officers. There are now 11 Corps officers and two detailed officers of the line, serving in the Philippines and charged with the maintenance and repair of 6,500 miles of line located on 13 separate islands. The daily work of these officers exceeds 12 hours and frequently runs to 16, and it covers every day in the year, Sundays and holidays. The work and surroundings are such that one-quarter of the officers of the Signal Corps are to-day disabled from Philippine service, and it is almost impossible to replace these men. In speaking of this trouble, Major Glassford writes: "The demand for superintendents at the larger and business transfer offices is so great, and the retention of the experts now occupying these positions so essential, and in view of the fact that the expiration of the term of service will soon remove nearly all of these first-class sergeants, I have to suggest that the law approved February 2, 1901, authorizing the appointment of 10 lieutenants for Philippine service be applied as a reward of long and faithful service, and as an inducement for those remaining. The retention of these expert telegraphers is absolutely necessary for the continued efficient operation of these lines."

On June 30, 1902, there were 301 civilians in service, of whom 13 Caucasians and six Filipinos were paid from army appropriations, and seven Caucasians and 275 Filipinos from civil appropriations. All employes have served most faithfully, and the Filipinos, under supervision, work with fidelity and cheerfulness.

Speaking of the telegraph schools, which were opened August, 1901, and from which it was hoped many recruits would be drawn, Major Glassford reports: "They have generally failed to make good operators. The school at Calapan, Mindoro, has, however, been quite successful, and several men from it have transferred to the Signal Corps, but not in sufficient numbers to supply the needed operators. A school to instruct natives as operators was also established, but none has qualified, and the best have acquired only a rate of receiving seven words per minute. No encouragement whatever is therefore to be expected from this source within a reasonable time."

The telegraphic and telephonic facilities of the city of Manila have been extended and improved during the past year. There are 51 miles of wire, partly lead-covered cables, on which are installed six telegraph offices and 177 telephones. There has been an average of 470 telephone calls daily. The central telegraph office has been fitted up with modern appliances; otherwise the enormous business centering in Manila could not be properly transacted. The generating plant is a source of electric power for all telegraph lines radiating from Manila, and also furnishes the current for lighting all the barracks, offices and quarters at the Cuartel Infanteria.

The transport Burnside has been fitted up as a cable ship, and without impairing materially its use as a transport, it has performed extensive work of extreme value. The 14 new cables laid during the year aggregate 607 miles. The Burnside traveled 9,905 miles in its work of laying and repairing cables; it also repaired 13 cables.

The installation and continued maintenance of the extensive cable system of the Philippine Archipelago has been extraordinarily successful, far exceeding the most sanguine expectations of General Greely. It is well known that commercial cables are transferred from the establishment where manufactured direct to the cable ship and thence to the bottom of the sea. The Signal Corps has been seriously handicapped by the necessity for twice as many transfers, which more than doubles the chance of injury to, and necessarily shortens the life of, a cable. The cable now goes from the manufacturing establishment to a lighter or car, thence to a commercial transport, then to the cable ship, and finally to the ocean bed. The conditions of transfer to Manila have been such as, in the opinion of foreign cable experts, should totally destroy the usefulness of the cable. It is officially reported that one large lot of cable thus shipped from New York to Manila, not only was covered with heavy extraneous freight, and consequently without ventilation, but in passing through the tropics the entire mass was heated to such an extent that frequent tests showed the temperature to be 92° F.

The higher physical character of the American-made cable is illustrated, however, by the fact that such cables, after subjection to extreme vicissitudes of physical condition, have worked uninterruptedly for periods ranging from one to three years. Indeed, some of the cable used has been handled no less than seven times before it was laid. To insure the proper maintenance of these cables, they should be regularly inspected and tested; cable buoys should be repaired and replaced, and other usual work connected with cable repairs and testing be carried on.

The Department of the Luzon was in charge of Captain Carl F. Hartmann, up to May 26, 1902, when he was relieved by Captain C. McK. Saltzman. Among other installations made by Captain Hartmann, was a large quantity of 20-pair lead-covered cable, which to a considerable extent was of necessity aerial, instead of underground.

The Department of the South Philippines was in charge of Captain L. D. Wildman until March 15, 1902, when he was relieved by First-lieutenant Charles S. Wallace, who has distinguished himself, both with troops in the field and in technical work connected with the extensive telegraph lines and cables of the department. In this department the lines have been cut repeatedly by the insurgents; in fact, at the beginning of the last fiscal year the only towns with telegraph communication were Catbalogan and Calbayog, and while plans have been made for the construction of over 400 miles of line, nothing has been done of any material advancement, as the insurgents destroy the line as fast as it can be put up.

In Mindanao a telegraph line is under construction to connect Cottobato with Davao, for which an allotment of $5,000 has been made. The total distance will be about 350 miles. Lieutenant Wallace, speaking of the labor problem, says: "Natives are employed as laborers and drivers for native transportation on the construction of new lines and as messengers, linemen, janitors, etc., in the maintenance of existing lines. They are paid on construction duty 50 cents, Mexican, per day, and rations; as messengers and linemen from $15 to $25 per month and rations, and are scarcely worth even this low rate of wage. Every native aspires to live like a gentleman, and without manual labor; therefore, they are very anxious to learn telegraphy and to become proficient in clerical work."

The introduction of repeaters and duplexing of land lines and cables has steadily progressed, improving greatly the efficiency and rapidity of the service; indeed, without the most modern improved methods the Signal Corps would have been unable to have transacted the enormous volume of telegraph business that has been placed with it. The appliances are in all cases of the latest types. The primary cell has been discarded wherever possible, being replaced by storage batteries.

Reports in considerable detail have been made of the business transacted by telegraph and telephone in the Philippine Islands during the last fiscal year. If these telegrams had been all transmitted over the Eastern Extension Telegraph Company, at minimum commercial tariff in the archipelago, their cost to the government would have aggregated the large sum of $3,109,677.22. Augmenting this by $70,000 for telephone tariffs and $49,444.66 for commercial tariffs, the grand aggregate value of Signal Corps' work is $3,229,121.88.

Regular reports for 10 months show that there were sent in that period 799,250 messages on official business, or an approximate number for the fiscal year of 933,834 messages. The commercial business systematically increases, as is shown by comparison of the receipts of September, 1901, $3,677.73, with those of June, 1902, $4,969.17, an increase of more than one-third. It is safe to assume that hereafter the income from commercial business will be at least $60,000 a year.

In connection with the progress that has been made in the islands must be taken into consideration the expense of the work that has been done by the Signal Corps. There has been spent by the United States during the fiscal year $31,000 on telegraph lines in the Philippines, of which $26,360.11 was for service. In addition, it is estimated that property to the value of $151,000 has been shipped from the United States.

The entire permanent plant is estimated to be worth at present $1,060,110. This value is obtained by fixing a value of $405 for line, instruments and battery for each of the 5,108 miles of land telegraph line in operation. Similarly the 1,326 miles of submarine cable are estimated at $395 per mile laid and installed. The entire cost to the United States of maintaining the telegraph system of the Philippines for the fiscal year 1902 was $460,347.07. In addition to this, the Philippine civil government has expended $88,619.31, most of which was for payment of native employes.

As an offset telegraphic business has been transacted, which, at the current commercial rates in the Philippines, would have cost the United States and Philippine governments no less than $3,109,667.22, and telephone business, which would have cost $70,000; the sum of $49,444.66 was collected for commercial tariffs and turned into the Philippine treasury. This would give a value for services rendered by the Army Signal Corps of more than six times the cost of its total expenses.

The question of the reduction of cable rates is one that has been the subject of much thought, correspondence and personal interview during the past fiscal year. General Greely has taken the matter up personally with the Eastern Telegraph Company, Ltd.; one object has been to increase cable facilities to the Philippines by an extension of existing and the building of new cable lines, so as to make an alternate route; but the conditions existing did not made such a move practicable at the time.

Pacific Cable.

The chief signal officer of the army has previously expressed his official opinion that the military command by the United States of the Pacific in the future will depend very largely on cable communications under its complete control.

The importance of an alternate route between the Philippine Islands and the Asiatic coast has been strongly emphasized by the interruption to the Manila-Hongkong cable in June, 1901, although it fortunately lasted only 10 days. It is a matter of grave importance, that a second route should be obtained either by an all-American Pacific cable or by connection with Borneo or Japan. The route via Borneo could only be accomplished by co-operation with the Eastern Extension Telegraph Company, as it has exclusive landing rights in that island for many years to come.

An alternate route from Cape Aparri to Formosa, which would undoubtedly benefit Japan and the United States, is possible only through favorable action with the government of Japan, combined with the consent of the Great Northern Telegraph Company, a Danish corporation holding certain exclusive telegraph rights in Japan.

Scarcely second in importance is the Pacific cable installed by Great Britain and its colonies, which is now in operation between Australasia and British Columbia, via the Fiji group and Fanning Island.

The United States within the past four years has demonstrated in a manner never before seen by the world the importance of electrical communication in war, and it alone of all nations refrains from installing, operating and maintaining a submarine cable between this country and our Asiatic possessions. Such a cable in war times, while not costing half so much, would be worth half a dozen war ships, as stated by competent naval authorities. Such a cable, operating at greatly reduced tariff rates, would not only pay good interest on the invested capital, but would greatly facilitate the evolution of American trade in the East by affording speedy and economical facilities to citizens of the United States.

The official experiences of the chief signal officer of the army show unquestionably that telegraph operators and managers give their first allegiance to corporations and lastly to their country; this, whether they are American, English, French, Spanish, or of other nationality.

Should there be failure in present negotiations looking to a commercial transpacific cable under such restrictions as will place that cable thoroughly under American control, whether in peace or in war, the chief signal officer believes that action should then be taken for the construction and installation of an all-American cable, which, in the words of the president's message on that subject, "should remain in the power of the American government, whether in peace or in war."

United States.

The work in the United States in the Department of California has been progressing favorably during the year. Telegraphic and telephonic communications have been regularly maintained between the department headquarters, Forts Baker, Mason, Alcatraz Island and the General Hospital of Presidio.

The total number of telegraphic messages handled was 40,034, and the commercial tariff amounted to $1,465.91. The Signal Corps system of wireless telegraphy is operated successfully and continuously between Fort Mason and Alcatraz Island. The work of purchasing, inspecting and forwarding of electrical and other supplies to the Philippines has demanded careful personal attention on the part of the signal officer of this department.

In the Department of Colorado only 462 miles of military telegraph lines are operated, the more important being those that are connected with the Indian reservations and the Mexican frontier. The extension of railroads, and consequently of commercial-telegraph systems, in Arizona, will soon make it possible to abandon some of the systems connected with the Indian reservations. The number of messages handled during the year was 32,703, and the amount of money turned over to the commercial companies $2,123.47.

In the Department of the East much has been done in the way of perfecting intercommunication between the various artillery posts for fire-control purposes.

In the Department of Texas about 260 miles of military lines are operated, part of which forms the only telegraphic communication with the Lower Rio Grande Valley. This line is not only indispensable to military authorities, but is of great utility to the federal judiciary authorities and to the state and county officers policing the Mexican frontier. It is exceedingly difficult of repairs, owing to the total lack of modern facilities of transportation.

The Signal Corps post at Fort Myer has been under charge of Major Joseph E. Maxfield up to October 2, 1901, when he was ordered to Alaska. Captain E. B. Ives remained in charge until March 4, 1902, and on April 1, 1902, the work was taken up by Major R. E. Thompson. The primary work of this department is the instruction of recruits, who are worked from eight to 10 hours daily, among the work being practical and theoretical instruction in electricity, telegraphy, telephony, etc., and under date of September 15th, orders were given for a course of lectures to be delivered by officers of the Signal Corps and civilians.

[*To be concluded.*]

Gas-power Development for Electrical Plants.

The gas-engine station is assuming material form in several recent projects for the utilization of gas fuel for electric power and lighting purposes. Complete equipments of gas generators, gas engines and direct-connected generators are in process of installation for the Winchester Repeating Arms Company, New Haven, Conn.; the Atlantic Refining Company, Philadelphia, Pa.; the Consolidated Industries Company, Batavia, N. Y., and the Rockland Electric Company, Hillburn, N. Y. The first of these equipments to be put in operation will be that of the Winchester Repeating Arms Company at New Haven. The power house has been specially designed for the new gas apparatus, and the entire power for manufacturing and lighting purposes will be furnished from this plant. The engines are of the Westinghouse make, of the standard vertical, three-cylinder, single-acting type, aggregating 500 horsepower. They are each direct-connected to 250-volt Westinghouse direct-current generators, and are furnished with gas fuel from Loomis-Pettibone producer-gas generators located in the adioining producer room. Two additional engines of the vertical type are employed as auxiliaries. Suitable gas holders are provided for insurance of continuity and uniformity of fuel supply.

The power station of the Atlantic Refining Company will be equipped with a new type of Westinghouse gas engine and a type new to American practice, viz.: the horizontal, double-crank, double-acting engine. There will be two engines, each of 500 horsepower, and each engine will be direct-connected to a 350-kilowatt, 25-cycle, three-phase generator, arranged for parallel operation. The engines will operate upon a rich oil gas of approximately 1,200 British thermal units per cubic foot.

The equipment of the Consolidated Industries Company is of still greater interest by reason of the arrangements for the most efficient utilization of the fuel supply. The plant will supply three products, viz.: metallurgical coke, fuel gas and electricity. A special process will be used, yielding metallurgical coke and fuel gas as a by-product. The electricity for lighting and power purposes will be generated at a central power station, employing 250-horsepower Westinghouse gas engines of the new horizontal double-acting type, direct-connected to Westinghouse alternating-current generators, operating in parallel and supplying current at 1,100 volts to the distributing network. A smaller generating unit will also be used for light loads.

Another gas-power enterprise, and one capable of certain ultimate development, is that of the Rockland Electric Company, which, together with the Ramapo Iron Works and the Ramapo Foundry Company, is comprised in the Snow interests. The installation will consist of an independent gas-manufacturing plant, employing the Loomis-Pettibone process, and a power plant containing Westinghouse direct-connected gas-engine generator units. The producer plant will supply water gas to the iron plants mentioned for heating and metallurgical purposes, and electric power to all industrial plants in the vicinity, including the Mahwah branch of the Standard Brake Shoe Company, located about four miles distant from Hillburn. The plant will also supply current for lighting throughout the Ramapo Valley district of some 14 miles in extent, comprised between the towns of Ridgewood, N. J., on the south, and Hillburn, N. Y., on the north. The gas engines installed are also of the new Westinghouse horizontal, double-acting type of 350 horsepower, each equipment aggregating 1,200 brake horsepower, or 1,400 brake horsepower maximum. The engines are direct-connected to polyphase generators and constructed to operate in parallel. A 128-horsepower vertical gas-engine unit will also be employed for carrying light loads and assisting at peak loads. A small amount of direct-current power will be furnished for a short time from one of the main units.

These four installations, and especially that at Hillburn, should prove of considerable interest to gas engineers and manufacturers in general as representative of an advancement in the field of power development. The machinery will be furnished and erected by Westinghouse, Church, Kerr & Co.

The Alternating Current for Heavy Railroad Work.

[From the Railroad Gazette.]

We print on another page some description of the methods and equipment proposed for working the new electric-railroad line to be built between Washington and Baltimore (taking in Annapolis). This enterprise has been on foot some years, and has had several vicissitudes, but it seems now to be in a way to be completed. As a business enterprise we have never thought well of it, and still doubt its success—at least for many years. As a technical enterprise it is now taking on very great interest, for it is to be a step in the experimental demonstration of what may be the next great movement forward in the art of electric traction. In this light it is of unusual importance to railroad men. It suggests a way in which, perhaps, the field of heavy long-distance railroad work may be invaded by electricity; therefore, the engineering department officers, and the transportation officers who have engineering knowledge and taste will do well to read the paper with care, for it seems to point the way.

In the past few years we have repeatedly said in print, and in oral discussion that, *in the present state of the electric art*, heavy long-distance business, handled in large and infrequent units, can be done cheaper by steam than by electricity. We think that the really well-informed engineers agree in this opinion. But the words italicized must be read carefully. The state of the electric art will not be its present state five or ten years from now. Nothing in the whole field of engineering is more certain than this. The uses of electricity as a means of transmitting and applying energy will be multiplied in ways that the most daring imagination does not foresee.

The officer responsible for the security of investments in steam railroads is taking considerable risk if he does not keep a sharp eye on the sure and steady advance in the knowledge of the uses of electricity.

Mr. Lamme points out in the paper which is the text of these remarks that the single-phase alternating current, used from the generator to the motor, has advantages which seem to indicate that it will open up a new and broad field for electric traction. He says that the Washington, Baltimore and Annapolis railway will be the scene of the first commercial operation of this new system.

This is not a new thought, nor is it at all certain that this railroad will be the first to go into commercial operation. The reader will not have forgotten the determined and even brilliant fight made by Ganz & Co. of Budapest to get the job of electrifying the Metropolitan District Railway of London. It was proposed to use the system which has been some time in use on a short line in Budapest, and which has been installed on a line of 20 miles, or so, near Lake Como, which, we suppose, must have been something like a year in operation. This is an alternating-current system. It is a three-phase system, to be sure, and so far Mr. Lamme may be strictly correct in claiming priority for the Washington-Baltimore single-phase installation.

A couple of years ago, or thereabouts, Mr. Bion J. Arnold laid out a scheme for the Lansing, St. John and St. Louis Railway in Michigan. This road is now building, and a part of it is in operation with steam locomotives. It is probable, we suppose, that it will be working by electricity before the Washington-Baltimore line is in operation. This also is to be worked by alternating current. So much for the question of priority in actual working.

It would be hard to assign priority of idea. Electrical engineers have long studied and debated the advantages and disadvantages of the alternating current for traction, and have been aware of its possibilities and difficulties. Experimental apparatus was made and tried on a considerable scale at least eight years ago. There has been an impression that the manufacturing companies have rather discouraged the development of the use of the alternating system for business reasons; for, in recent years, they have had about all that they could do in installing apparatus already thoroughly tried out. It is denied, however, by officers of some of the big companies that this has been their policy.

However this may be, a few advocates of this system have been pretty resolute. Last summer at the Great Barrington meeting of the Institute of Electrical Engineers, President Steinmetz said "Mr. Arnold was the strongest advocate of the alternating-current railway last year at Buffalo," and Mr. Arnold said, "A study of the railway question from an engineering standpoint partially convinced me of the ultimate abandonment of the direct-current motor for heavy and long-distance service. . . . I have constructed 20 miles of road for this system, together with the necessary trucks and motor equipments. I firmly believe that the alternating-current motor will finally prevail for heavy railway work. . . . The principles underlying the system I advocate . . . are, first, a single-phase or multiphase motor. . . . . I am building my line for 15,000 volts. A static transformer will be carried upon each car, and the pressure reduced from the line voltage to the voltage of the motor, which, in the case under construction, is designed for 200 volts. Where it is unnecessary to utilize so high a line pressure the motor may be designed for the working voltage and the current fed directly from the working conductor into the motor, thus eliminating the static transformer" At Paris, in August, 1901, in the joint meeting of the American Institute and the Paris Institute, Mr. Arnold said: "I believe that the alternating current will ultimately predominate in railway work. I believe that we shall soon eliminate the sub-station, the rotary converter, and possibly the static transformer at the power station. We shall, at least, eliminate the sub-stations." A year later, at the Buffalo meeting of the Institute, he said: "I am now in favor of the alternating motor on railway trains, notwithstanding the fact that it does not seem to have many friends here to-day. . . . For slow-speed railway systems, such as we are operating in our cities to-day, I do not think that there is anything that can equal the direct-current . . . . but when we come into heavy railway work, where we want to start a heavy train from one terminus and run it through to another terminus at high speed, with few stops, it seems to me the alternating current is the ideal thing for it. I am looking for the manufacturing engineers of this country to solve that problem."

These sentences are quoted because they are convenient to hand and because they illustrate the point that the idea of railroad working by alternating current has had stout advocates for some years, and that even the machinery for such working has been devised by more than one electrical engineer. So much for priority.

But, after all, priority is not very important. The main thing is to keep our eyes and our minds open to the fact that the intelligent, courageous and enterprising gentlemen who are developing the art of electric traction are not sleeping, and to the further fact that in their young art they have possibilities of advances and of changes which cannot in the nature of things exist in steam railroading. Steam railroading is about five times as old as electric railroading. The probability of rapid and great changes is perhaps something five times as great in the younger art.

Large Power Station in Galveston.

The Southern Pacific Railroad Terminal Company is building a large power plant at Galveston, Texas, which will supply power to operate one of the largest grain elevators in the South for loading and unloading the company's steamships and for lighting its extensive wharves, sheds, etc. The building, which has already been erected, cost $46,000, and the machinery and electric plant will entail an additional expenditure of $139,600, making a total of $185,600. The building is of red brick and consists of a boiler room, 87 by 47 feet, an engine room, 103 by 43 feet and a pump room 14 by 70 feet in size. A Custodis stack, 150 feet high, has been built on piling foundation with a concrete base.

The power house is now ready to receive the machinery which will consist of the following: Three horizontal, cross-compound Buckeye engines, one horizontal tandem-compound McIntosh & Seymour engine, two duplex boiler-feed pumps, one Goubert auxiliary feed-water heater, one Wheeler Admiralty surface condenser of 25,000 pounds capacity, one Blake-Knowles air pump, one centrifugal pump with direct-connected engine, one 5,000-pound Wheeler Admiralty surface condenser, with combined air and circulating pump, and six Stratton separators. The General Electric Company will install three alternating-current, revolving-field three-phase 20-pole, 300-kilowatt, 150-revolution, 480-volt generators, two six-pole, 20-kilowatt, 360-revolution, 125-volt, direct-coupled generating sets, and a 100-horsepower, a 75-horsepower and a 40-horsepower motor. A black enamel slate switchboard, with panels 90 by 24 by 2 inches will be installed. The work is under the superintendence and direction of G. W. Boschke, superintendent of construction for the company.

A meeting of the stockholders of the Columbus, Seymour and Brownstown Traction Company of Columbus, Ind., was held recently and an organization was perfected under the head of the Indiana Central Electric Railway Company. The following-named officers were elected: President, John B. Burrell; vice-president, William H. Shields; secretary, W. P. Masters, and treasurer, Carl Wood.

DEVELOPMENT OF THE TELEPHONE FIELD.

Telephone News from the Northwest.

A local company has been formed at Valley Springs, S. D., and a local exchange will be constructed at once.

The Northwestern Telephone Exchange Company has completed a line to Kensal, N. D., from Jamestown.

A new telephone exchange is soon to be installed for Irene, S. D.

J. A. Steninger of Parker, S. D., has been granted a franchise for a local exchange at Marion Junction, S. D., by the council for a second time, and will proceed with the construction of a system.

V. B. Noble has been granted a franchise at Willow City, N. D., for a local telephone exchange.

Arrangements are about completed for the installation of an automatic-telephone exchange for Pembina, N. D.

T. J. Stephenson has bought materials to build a line from Cornucopia, Wis., seven miles, to connect with the line of the Bayfield Transfer Company, into Bayfield.

The Farmers and Merchants' City Telephone Exchange is about to begin operating a new exchange in Le Sueur, Minn.

The Fergus Telephone Company of Fergus Falls, Minn., has amended its articles of incorporation, increasing the capital stock to $100,000 from $10,000. Of this, $75,000 is six per cent. preferred stock.

The Northwestern Telephone Exchange Company has completed its long-distance line to St. Vincent, Minn., in the extreme northwestern corner of the state.

The Interurban Telephone Company of Holmes City, Minn., has amended its articles of incorporation, increasing its capital stock from $10,000 to $100,000. The company will issue $50,000 of preferred eight per cent. stock.

Those interested in the telephone system at Colton, S. D., propose to construct lines to Hartman, Baltic, Hartford and other towns.

The Northwestern Telephone Exchange Company has applied for a franchise for a local exchange at Dassel, Minn.

The new Valley Telephone and Telegraph Company of Green Bay, Wis., has secured 360 subscribers for the proposed exchange, and it is expected that there will be 800 by the time the exchange is completed. Application will be made at once for a franchise.

Workmen employed by the Union Electric Telephone Company in Moline and Rock Island, Ill., and Davenport, Iowa, struck because of the employment of non-union men, contrary, as they claim, to an agreement.

The Farmers' Telephone Company of Scribner, Neb., has reached an agreement with the Nebraska (Bell) Telephone Company for toll-line connection. The Fremont Telephone Company has been trying to reach an agreement for connection with the Farmers' company, and at once closed connections with the Hooper Telephone Company, which covers a considerable portion of the northeastern portion of the county.

The Corning Telephone Company of Corning, Iowa, has increased its capital stock from $15,000 to $25,000.

The Bell Telephone Company has completed long-distance connection from Winnipeg, Man., to Morden, Man.

The Iowa Telephone Company has completed connection for a copper circuit between Fort Dodge, Iowa, and the Twin Cities. The route is completed by the Western Electric Telephone Company's line from Livermore to Mason City, thence north over the lines of the Northwestern Telephone Exchange Company.

A local exchange is projected for Northville, S. D.

R.

Ohio Telephone Notes.

President F. S. Dickson, Secretary James B. Hoge, General Manager Maxime Reber and Auditor L. O. Fisher of the Federal Telephone Company returned Friday from another inspection trip over the Ohio field, but were unable to see all the plants owned by the company. With the general conditions, Mr. Dickson expressed himself as well pleased, but he is more than ever of the opinion that better rates will have to be obtained by all the plants before an increase in capacity can be made or the service improved in any way. The company now owns the plants at Bowling Green, Findlay, Columbiana, Fostoria, Detroit, Lancaster, Lima, Logan, Mansfield, Massillon, Toronto, Youngstown, Zanesville, Canton and Cleveland. The United States company is owned outright and large interests are held in the plants at Columbus, Akron, Dayton and Portsmouth. It is the intention to retain all these properties and improve them, if the proper advances in rates can be obtained to warrant the investment of additional money. Mr. Dickson will shortly remove his family to Cleveland and become a resident of that city, where the telephone interests of the section center.

The plant of the Home Telephone Company at Hamilton is nearing completion and, it is said, it will be one of the most complete in the country for a town of that size. Through purchase it has lines extending from the east to the west side of Butler County, and the terms have been so arranged that there will be no toll charges on these lines, all subscribers being connected directly with the exchange. Or in case there are any charges they will be 50 per cent. less than the usual fees. Frank Hughes is the president of the company and the directorate is made up of several of the strongest business men of Hamilton.

It is the expectation of the officers of the Columbiana County Telephone Company to get about $70,000 of the allotment that is to be made by the Federal Telephone Company for the extension and improvement of its plants. The management states that with the proposed improvements it will be little trouble to add 1,000 subscribers to the list.

The Beaver Township Telephone Company, near Columbiana, has connected its lines with the Columbiana County lines and is making arrangements to secure connections with Youngstown.

The Citizens' Telephone Company of Columbus is planning to erect a building for its exchange and business offices. For some time the present quarters have been inadequate to the needs, and when the new apparatus for additional service is installed, there will be little room for it. The management does not like the idea of sub-stations.

The Parkman Telephone Company of Parkman Township, Geauga County, has been incorporated with a capital stock of $1,000. It is the intention to build country lines.

The Weston Home Telephone Company of Weston, Wood County, has been incorporated with a capital stock of $10,000. Isaac F. Neifer, S. C. Murphy, John E. Clark and T. J. Pugh are the incorporators.

The Clarington Home Telephone Company of Clarington, Monroe County, has been incorporated by James Steiger, H. M. Smith, Albert Deitrich, W. T. Powell and J. A. Hyer. The capital stock is placed at $185,000.

O. M. C.

Indiana Telephone Items.

The Home Telephone Company of West College Corners has filed articles of incorporation with a capital of $4,000. The directors are W. H. Hawley, Charles Stout and J. C. Barkney.

The Wabash-Logansport Telephone Company of Indiana will construct a new line on the north side of the Wabash River, between Wabash and Peru, to be used exclusively for through business.

The New Long-distance Telephone Company of Indiana will, in a short time, make two important connections. The Home Telephone Company of Louisville is extending its line to Columbus, Ind., by way of Seymour and Jacksonville, the local plants of which the Louisville company recently acquired. The New Long-distance company will connect with the Home company at Columbus, and will thus secure connection with nearly all of Kentucky, at present untouched by the New company, and also with many important towns in Southern Indiana.

The Kinloch Long-distance company of St. Louis is building its line to Terre Haute, Ind., where a connection will be made with the New Long-distance company. The Kinloch company is now within six miles of Terre Haute, and President Sheerin of the New Long-distance company says that the Missouri connection will be made in a short time. The connection with the Louisville company will be made in about 40 days.

Telephone men from Fort Wayne, Decatur, Muncie, Winchester and Portland met at the latter place on the 13th inst. and effected an organization calling for a large capitalization for the construction of telephone plants. The meeting was well attended, but all interested were reticent, but it is known that the company will have a capital stock of several hundred thousand dollars and will give its attention to building plants in the West. It is stated that the Indiana and Ohio fields will not be invaded, but operations will be confined to states farther west.

There are 24 students enrolled in the course of telephone engineering at Purdue University, Lafayette. Sixty other students of the present sophomore and freshman classes are also taking work preparatory to telephony in their junior and senior years. The telephone manufacturers and supply houses are doing much to encourage the course, as are also the operating companies. Much valuable apparatus has been donated, which is used in practical explanation of the working of various systems of switchboards and appliances. The many facilities afforded at Purdue for studying conditions as they actually exist undoubtedly will qualify a large number of students to become competent telephone engineers.

F.

Southern Telephone Developments.

The Southern Bell Telephone Company continues very active in absorbing Independent lines in the South and building new long-distance connections. Besides the numerous exchanges purchased last week the company has just bought the Alabama and Georgia Long-distance Company for $12,000. The deal includes the lines between Gadsden, Ala., and Sylacauga, Ironaton and Oxford, Jacksonville and Cave Springs, Oxford and De Armandville, De Armandville and Choccolocco, Choccolocco and Helpin and other points, also the exchanges at Oxford and Piedmont. The Southern Bell has connected long-distance connections between Charlotte and Wilmington, N. C., by purchasing the Independent line from Charlotte to Monroe. It has completed a line from Raleigh to Wilmington and from Wilmington to Southport, N. C. A line from Atlanta to Clinton, S. C., has also been finished, while the connection will soon be completed to Columbia, S. C.

The Piedmont Telephone and Telegraph Company has been organized at Gastonia, N. C., with $30,000 capital, succeeding the Gastonia Telephone Company. W. T. Love is president and R. B. Babington superintendent of the new concern which has absorbed the exchanges at King's Mountain, N. C., Bessemer City, Shelby, Lincolnton and Cherryville. The company will use the Bell instruments and the Bell line and will be connected with the long-distance system of the Bell company and the American Telephone and Telegraph Company.

O. Morseman is securing subscriptions for the stock of the Paragould (Ark.) Telephone Company, whose capital stock will be $12,000. The company proposes to build a telephone line into Caldwell and Jonesboro. Thirty towns are already connected.

The Southern Bell company, which has recently purchased Independent exchanges at Union, S. C., and a number of adjacent towns, announces at Union that instead of increasing rates a decrease of $6 per year on business telephones has been inaugurated.

L.

TELEPHONE MEN.

Charles C. Kritzer will retire as manager of the Zenith City Telephone Company of Duluth, Minn., on December 1st. He is to be succeeded by A. E. Wickstrom of Chicago.

J. H. Quick has become manager of the Clark Automatic Telephone Company and the Nebraska Clark Automatic Telephone Company, with headquarters at Sioux City, Iowa.

F. L. Martin, the well-known advertising manager of the Kellogg Switchboard and Supply Company of Chicago, has resigned and taken a similar position with the Stromberg-Carlson Telephone Manufacturing Company.

Charles J. Glidden, ex-president of the Erie Telephone and Telegraph Company, has presented a framed copy of the map showing his recent European tour to the Massachusetts Automobile Club. Mr. Glidden traveled 5,000 miles in Europe in a Napier gasoline car, a picture of which is placed in a lower corner of the frame.

C. A. C. Crapo, for the last 12 years an employe in the switchboard department of the Chicago Telephone Company, has resigned to accept a position in the engineering department of the Colorado Telephone Company, Denver, Colo. At the time of his resignation Mr. Crapo was chief switchboard foreman at the Chicago Telephone Company's main office and was considered an efficient man. The Colorado Telephone Company has lately opened several common-battery offices.

GENERAL TELEPHONE NEWS.

The Western Maryland and Hyndman Telephone Company of Cumberland, Md., has been incorporated with a capital stock of $20,000. The incorporators are George W. Randall, U. G. Carl and B. F. Madore.

Dispatches from St. Petersburg, Russia, state that an American firm has been awarded a $1,000,000 contract to construct a system of telephone conduits in that city. The contract provides for 20 miles of underground tubes to be completed in 1903. The contract for the exchange equipment was secured by the Kellogg Switchboard and Supply Company, as intimated in the Western Electrician last week.

The Gray Telephone Pay Station Company recently held its annual meeting and elected the following-named directors: Amos Whitney, Franklin Clark, Charles Soby, William Gray, Frank C. Sumner, Hiram R. Mills and Francis C. Pratt, all of Hartford, Conn. The directors have chosen the following-named officers: President, Amos Whitney; secretary and treasurer, Charles Soby; superintendent, William Gray.

MANUFACTURERS AND DEALERS.

The Sumter Telephone Manufacturing Company of Sumter, S. C., has issued a new set of bulletins describing and illustrating its Bullseye express switchboard, long-distance and private-line battery-call telephones, small exchange equipment, transmitters, receivers, etc.

The International Telephone Manufacturing Company, Chicago, is having, it is said, a heavy demand for its improved, long-distance transmitter for central-energy instruments as well as for local battery telephones. It is reported that the International transmitter is one of the clearest, most distinct and far-reaching instrument of its kind now in use, and that it has never been known to become packed or deadened. This transmitter is said to be fully protected by patents allowed and to infringe no valid patent claim of others.

Signal Circuits.[1]

By J. C. Mock and W. E. Foster.

Before starting on the actual work it is obvious that a preliminary survey of the general subject in the form of an outline is necessary. We divide the subject "Signal Circuits" as follows:

First—Circuits for Automatic Block Signal Systems.

Installations.		Road.
(a) Early or obsolete	For	Steam Roads
(b) Present		Elevated Electric
(c) Prospective future		Surface Electric

Second—Circuits for Manual Block Signal Systems.

(a) Sykes lock and block.
(b) Coleman lock and block.
(c) Patenall lock and block.
(d) Leonard lock and block.
(e) Electric train staff.
(f) Telegraph block systems (automatic repeaters).

Third—Circuits for Interlocked Signals.

(a) Electric locking.
(b) Semi-automatic.
(c) Electric or electro-pneumatic interlockings.

Fourth—Special—including

(a) Draw bridges
(b) End of double track; junctions and crossings not interlocked.
(c) Annunciators and bells.

From the above outline we have selected for consideration circuits for automatic block signal systems (present installations for steam roads), and submit an outline in the form of a table showing four signal arrangements, with accompanying features effecting the arrangement of controlling circuits.

The idea is to place in each member's hands such an outline as will (with the least possible effort on his part) enable him to give the committee a brief outline of the system or systems in service on his road and his idea of the nearest practical approach to the ideal system and to facilitate discussion which will aid the committee to arrive at final conclusions and recommendations.

Referring to the outline the committee's circuit for the nearest practical approach to the ideal system in so far as it can be expressed by it is as follows:

(1) Three-position Signals (average length of block three-quarters of a mile).—This is the signal arrangement which we have chosen as the best of the four.

The three-position signal combines in its one-arm and one-lamp, all the functions of a two-arm and two-lamp (home and distant) two-position signal. Its day and night indications ("Danger," "Caution" and "Clear") are consistent and in harmony with interlocked signals. It reduces the number of lamps and arms and requires no more controlling appliances or complex mechanism; therefore we favor it as the simplest and most economical way of giving "two-block information."

We favor as nearly a uniform block of three-quarters of a mile as conditions permit, reducing the distance slightly for up grades and increasing it slightly for down grades, so as to preserve a practicable uniform time interval between trains, at the same time giving sufficient space for the swiftest and heaviest trains to be brought to a stop between the caution and danger indications, but under normal conditions keeping the distance between the caution and danger indication approximately three-quarters of a mile.

(2) Type of Signal—Semaphore Electric.—We favor the semaphore operated wholly by electricity, believing it to be just as efficient in operation and more economical than any other automatic signal of semaphore type. We prefer the semaphore type to the disk or banner.

(3) Normal Position of Signals—"Clear."—(a) The controlling circuits being simpler; (b) the signals are more readily inspected and consequently easier to maintain; (c) less liable to derangement from lighting (because less apparatus and less line wires are exposed). We believe these things outweigh the claims (a) that the normally danger is the consistent position (with relation to interlocked signals); (b) is (or should be) more economical in battery consumption; (c) is less liable to give false clear indications due to defects or inclement weather affecting the signals proper.

(4) Setting Point—At Signal.—We think it correct principle to allow a train to pull up to the signal, and wrong principle to pass danger signals, besides there is the objection that if the "setting point" is far enough in advance of a signal to enable an engineer on a train running 60 miles an hour to see the signal set—in foggy weather, he may not see the signal in the "clear" position.

(5) Type of Battery—Storage (using power line).—There are two examples of signals supplied with power from storage batteries charged from a power line—the installation from Allegheny to Homewood, given below in some detail, and the installation from Philadelphia westward on the main line of the Pennsylvania railroad. This last is an installation on four-track road. Here track circuits as well as the signals are supplied with current from storage batteries. For double track where the blocks are more than one mile long, we do not unqualifiedly advocate the use of storage battery charged with power line, because the interest and depreciation on the extra equipment is such a big factor that the economy over the primary battery method is doubtful. For example:

The Michigan Central railroad has a system of approximately two mile blocks (the average being somewhat less). Signals are (one-arm) "two-position," the distant signal located about 3,500 feet from its home. The yearly cost for maintenance and operation of each signal is about $67; $10 of this is charged to battery consumption for operating signal, primary battery being used costing about $5 per kilowatt-hour.

If electric power at five cents per kilowatt-hour could be had (a common rate for lighting and power) the operating power for each signal would cost 10 cents per year, reducing the total cost of maintenance and operation 16½ per cent.

Suppose we install a power line and station and transmit current for charging batteries over 40 miles (20 miles each way), this extra equipment, we will say, costs $6,000; interest at five per cent.—$300 depreciation; 10 per cent.—$600; total, $900. Cost to furnish 160 kilowatt-hours at five cents—$8. Total cost per year to furnish current for 80 signals—$908. Cost with primary battery at $5 per kilowatt-hour—$800. Difference in favor of primary-battery arrangement—$108.

It is obvious that we have a big man doing a small boy's work. But there is other work to do. There are track sections which cost about five dollars per year for battery and signal lamps that cost a couple of dollars a year for oil; which require daily or at best, semi-weekly attention, and even then are frequently extinguished by storms. These two items should be added to the work of the power-transmission outfit.

The best solution of the question seems to require the perfecting of alternating apparatus, namely, the signal motor, the switch indicator and the track relay. We can then dispense with all battery and oil lamps.

With such an arrangement we believe the cost of maintenance and operation for automatic signals can be reduced 50 per cent.

(6) Control of Distant Signal—Wireless—(generally).—We are disposed to favor the wireless method. It has been found reliable and it brings within easy reach all apparatus needing frequent inspection, reduces the amount of depreciable material and affords some immunity from lightning. On the other hand it requires a slightly less efficient and more complicated track relay and does not afford as good opportunities for rendering harmless disturbances due to foreign currents on the track.

(7) Lightning Guards—Choke Coil and Spark Gap.—This type of arrester, if scientifically designed and applied, affords protection. Fuse wires are annoying, causing many unnecessary delays and do not afford absolute protection against damage to relays and signals.

The recent improvement in track relays by use of carbon for contacts and high insulation between coils and core has reduced the lightning trouble so that in many sections we may safely omit lightning guards.

(8) Switch Indicator—Miniature Signal.—We favor switch indicators. There is scarcely any more excuse for omitting switch indicators in a system of automatic block signaling than there is for omitting dwarf signals in an interlocking plant where reverse and subordinate movements are made.

Every entrance to a block should be signaled. Switch indicators facilitate traffic by giving important and necessary information to a train about to enter a block from a switch.

We prefer the miniature signal to a bell, because its office is more important as a signal than as an annunciator. A bell not ringing (out of order) is equivalent to a clear indicator.

An indicator (out of order) stands at danger. Indicators can be worked in series or multiple by one battery, whereas, bells to work satisfactorily require local battery for each. The bell is a better annunciator and may be located farther from the switch or serve for a group of switches and is as good at night as in daytime.

(9) Switch Boxes—Shunt (only) Track Circuits.—This method is quite as effective, is much similar and less expensive than the other two. The switch indicator is present to show whether or not the switch box is properly performing its work. Breaking the track circuit is never used alone because it is not reliable and it is practically discontinued in connection with the shunt. It adds nothing toward efficiency and requires a normally closed contact in the switch box and an insulated joint in the main track, both objectionable from a maintenance standpoint. Opening the signal-controlling circuits also requires normally closed contacts in the switch boxes and necessitates bringing the signal-controlling wires from the line to the switch boxes, thereby introducing conditions where leaks due to defective insulation may maintain a closed circuit, independent of the switch-box contacts.

(10) Track Sections—Crossover Rails in Track Circuit.—Only one road, so far as we know, has included the rails of all crossover connections in the track circuits and only one that has issued instructions calling attention to the omission with an accompanying rule to trainmen. We think it is important and favor track-circuit equipment for all crossovers between main tracks and between a main track and side track.

We prefer stone ballast and a track section equal to the length of the block.

The club should adopt standard nomenclature, standard symbols, representing the various apparatus incorporated in a standard circuit plan with tracks drawn to longitudinal scale (not smaller than 1,000 feet to the inch), with two lines to represent each track, upon which shall be marked all switches (effecting the block system), crossing bells, stations, mile posts, road crossings, overhead bridges, insulated joints and all circuits complete including line, track (underground) and local wiring. It should be not merely a diagram of circuits but a complete wiring plan. The committee therefore requests that each member submit a sketch or plan of a signal circuit, including switch indicators, covering two or more blocks, showing what, in his opinion, a standard circuit plan should be.

During the past year the committee asked for standard circuit plans from various members and was favored with responses from two roads.

Both show peculiarities and are valuable contributions to the committee. One shows a home and distant signal arrangement with overlap, normal position of signals clear (although the signals are not shown in the clear position). The other is a home and distant arrangement of signals with normal position danger. On this there is no scale, no mile posts, no stations, and circuits are shown only for one direction. But both are very complete as regards information relating to the circuits. They are easily traced, and, on the whole, remarkably good plans. Next year the committee intends to present to the club its recommendations for standard circuit plans, and it needs a great number of good ones for reference. Each member is therefore invited to contribute, through the secretary, such information as will aid the committee.

1. Report of a committee of the Railway Signaling Club, presented at the meeting in Pittsburg of November 11 and 12, 1902.

Block Signaling on the Pittsburg, Fort Wayne and Chicago.

The block signal installation on the eastern division of the P., Ft. W. and C. has many new features in the way of maintenance and operation. Believing that the members would be interested in them, we submit a short description of the system.

The track situation is as follows: Four tracks from Allegheny to Rochester; two tracks from Rochester to Homewood. In this distance, 35 miles, there are 188 block signals and eight mechanical interlockings (none of the latter being at grade crossings).

The blocks are from one-half mile to three-quarters mile long, except through interlockings, in which case they merely extend between interlocking limits.

The block signals are three-position electric-motor semaphores. The three-position signal is the standard block signal for the Pennsylvania lines west of Pittsburg.

Distant signals for interlockings are automatic signals and are located a full block away from the home signals. They stand normally at caution, that is, 45 degrees from the horizontal and are cleared through a circuit-closer on the home signal, when the home signal comes to the clear position.

The home signals for all interlockings are two-arm, with the lower arm mechanically connected and the upper arm semi-automatic.

The upper arm is worked by a circuit controller operated by the latch of a regular mechanical lever in the machine. This lever does no mechanical work except to operate the mechanical locking. The circuit is so arranged (by the use of a stick relay) that after the lever has been reversed and the signal cleared, a train passing onto to the block section causes the track relay to open, which in turn causes the signal to go to danger. After a train has passed out of the block the signal will not clear again until the leverman puts his lever "home" and reverses it again.

The home-signal levers are also electrically locked in the reversed position, if either the home or distant signal fails to go to danger when it should. This prevents the leverman from changing the route until the trouble has been cleared up.

The signals are operated by storage batteries placed in five by seven-foot steel wells. Six cells of Chloride accumulator, type D-5, are used and their capacity is sufficient to operate four signals on a bridge simultaneously. Each well has two sets of storage cells, so that one set is charging while the other is discharging.

The charging is done as follows: Each signal repairman goes over his section, about seven bridges, the first thing each day, and throws a rotary knife switch in each battery well. This switch transfers the charged battery to the operating system and the discharged battery to the charging line. While the batteries are being charged they are cut entirely free from the operating system. The charging is done from a power station, located in the Conway roundhouse, by means of aerial charging line, into which the batteries are connected in series. The batteries are charged for eight hours each day. The voltage at the power station is 550 to 600, and over half of this is needed to overcome the drop due to line resistance.

The batteries are connected in three groups. The division is made so that each group can get from 1½ to 2½ amperes with all the batteries in circuit. Any well can be cut out of the line, so that in case of a break-down one or two sets of batteries can be charged at a high rate.

The power station is equipped with engines and generators in duplicate, so that either generator can be used to charge one or all three charging groups.

The expense of maintenance and operation during the past year for 188 signals has been $5.45 per sig-

nal per month. With the three-position system one signal is equivalent to two where home and distant signals are used, and the comparison of expense should be made accordingly.

Magnetic Separators in Flour Mills.

The magnetic separator is considered as necessary a piece of the equipment of a modern flour mill as the rolls or other vital part of apparatus. They were first used in England, and first adopted in this country in 1878. That was the year when farmers began binding with wire, 25,000 wire binders being sold the first season. The American Miller gives an interesting bit of history on the subject, as follows:

Here is where the matter affected millers: The wire rusted if it became damp, easily broke, and bits of wire inevitably got into the wheat through the thrasher. These little pieces of wire could not be taken out by the separating machinery, which did, however, take out the longer pieces, and went to the millstones. The action of the millstones flattened them out and made them more or less like diminutive saws.

Then the damage commenced. The chop went to the bolts, and these saws cut their way through the cloth, ruining it, and lodging themselves in the flour. Besides this, the bits of wire would be found lodged everywhere in the mill from separator to packer.

In some localities where the wire binders held full sway millers became desperate. Millers' conventions resolved against the binder, and some millers would not buy wheat that had been harvested with a wire binder—if they knew it. But this was practically impossible to determine, as the bits of wire could hardly be detected in the wheat. And so there was a state of things. The wire binder had evidently come to stay, for a while at least, and millers simply did not know what to do.

At this juncture, a gentleman connected with one of the binder companies, Mr. Ransom, came forward with a suggestion which arrested attention. Whether original or not, we do not know; but his suggestion was that magnets placed in any spout through which the wheat passed before reaching the stones would take the wire out. He showed a gang of magnets, bolted together, with blocks of wood between.

He became quite a missionary of the idea, and a small machine was constructed to show that the magnets would remove the wire. The suggestion took immediately. Millers placed magnets in the grain spouts in all imaginable ways. Several sets of magnets were employed for each spout, so that one could be removed for cleaning while the others were in use.

But what a surprise awaited the miller when the magnets were first put in. Of course, he knew that assorted bric-a-brac could be found in almost any load of wheat; but he was hardly prepared to find how much metal besides the wire binder bits had been going over his machinery, as the magnets demonstrated. It was a revelation and fixed the status of the magnet as a part of the mill's equipment.

Col. J. J. Astor Gives His Marine-turbine Patents to the World.

Through a letter to the editor of the Scientific American, published in a recent issue of that journal, Colonel John Jacob Astor dedicates all his patents on marine turbines to the public "in the hope that the development of the ideal turbine may be hastened thereby." As yet no engine has been built to utilize Colonel Astor's patents, but engineers and critics express themselves as sharing the belief that his theories will work out practicably. Colonel Astor's invention contemplates twin screws, set tandem instead of side by side, and revolving in opposite directions. In his letter he gives this description of his turbine:

"The turbine is shaped like a funnel, and comprises an outer shell or drum and an inner shaft running axially through it, these parts being relatively rotatable and each having oppositely set spiral blades. The steam is admitted into the outer shell at the small end and passes through the turbine, expanding into the large end of the shell and acting on the spiral blades to rotate the shell and shaft simultaneously and in opposite directions. By allowing both the inner turbine and the outer case to revolve, the speed necessary to insure efficiency, which in ordinary turbines is often inconveniently high, is cut in half. As a result of this construction the weight is reduced practically 50 per cent."

Colonel Astor says that such a turbine would seem to be particularly suitable in central-station work for generating electricity, in which case the field and armature may be driven in opposite directions. This would improve the efficiency of the dynamo and increase its output for a given weight. This principle is obviously also applicable to gas engines.

The Philadelphia Rapid Transit Company of Philadelphia, Pa., has announced that, beginning December 1st, the wages of the conductors and motormen in its employ would be increased from 19 to 20 cents an hour. The company controls all the street-railway lines of the city, and nearly 7,000 members are affected by the increase.

Developments in Electrometallurgy of Iron and Steel.[1]

By Marcus Ruthenberg.

Many iron ores are too low in tenure to permit smelting. If these ores be magnetic, or, rather, if the iron in the ores occurs as magnetite, that is, Fe_3O_4, it permits of a concentration that would not be possible if it occurred as either of the other two oxides. Concentration is essentially the separation of the valuable from the valueless portion, therefore, there must be some difference between the portions of ores, either in the shape, hardness, gravity, or, in th case of magnetite, of magnetic permeability, to permit of the separation of the particles, so differentiated. In ores in which the iron is carried as magnetite, it becomes one of the simplest and one of the most beautiful methods of separating the valuable from the valueless portions known to the art.

Magnetites occur but seldom of such purity that they are entirely free from sulphur and phosphorus, and it depends very largely upon what portion of the ore these two metals are associated with as to the fineness to which the ore must be ground and the particular method of treatment in the magnetic machine. As a usual thing, the sulphur will be carried in separate and distinct grains or laminæ of pyrite or phyrotite. The phosphorus may be carried disseminated throughout the mass as a phosphide of iron. It may be carried in apatite or phosphate of lime. If the sulphur be carried as pyrite, elimination is simple, for the reason that pyrite is non-magnetic, and the magnets, therefore, do not lift it. If it occurs as phyrotite, its elimination is not so simple. The difference in magnetic permeability between magnetite and phyrotite being so small, the magnet strength requires very delicate adjustment. Except in the case of iron phosphide, elimination of phosphorus is quite easy, as it is carried by the non-magnetic gangue. The magnets leave it in the tailings.

The essential feature is to determine what fineness of mesh is required to release each individual particle from its neighbor, as it is quite evident that if not ground fine enough the magnetic portion would drag a non-magnetic portion attached to it into the heads and therefore deteriorate the quality of the concentrates. It is found that when ores are ground finely and an attempt is made magnetically to concentrate them dry, there is a measure of adhesion between the particles of magnetic and non-magnetic portions that will not permit of cleanly work; this may be very prettily obviated by handling the ground ore in water, in which case the water seems to lubricate the particles so that the magnetic portions come away cleanly.

Having arrived at the point where the ore has been ground and concentrated magnetically in water, reasonably free from sulphur, phosphorus and deleterious gangue, we have a clean, fine, blue-black powder, which may go anywhere from 65 to 72 per cent. of magnetic iron, pure peroxide being 72.40. It now becomes a question as to how this iron ore may be handled in a furnace. If an attempt be made to charge it into a blast furnace, owing to its pulverent condition, it will filter on down through a bed of fuel and reach the tuyeres in an unreduced and unmolten condition. If an attempt be made to charge it into an open hearth or a reverberatory furnace, owing to its pulverent condition, it is an extremely poor conductor of heat, and an intense flame may be played upon it for any length of time, with the sole result of melting a plastic, pasty covering, leaving the inner portion of the mass unaltered.

Many attempts have been made to put these powdered ores into handleable form by briquetting, or making them into brick. To do this it is simply necessary to mix or agglomerate thoroughly the powdered ore with some viscous material which will act as a binder to hold the particles together. Many substances have been used for this purpose, many of them being the subject of patents. Milk of lime, clay, bituminous-coal dust, sugar-house waste, molasses, flour, starch, dextrine, tar, rosin, rosin soap, silicate of soda, linseed oil and linseed-oil substitutes have been used. It has also been proposed, and has been the subjects of patents both in this and foreign countries, to add the iron dust to the coking charge of a beehive oven. Any of these methods, under certain conditions, make a reasonably good brick. Possibly the best is that in which from five per cent. to 10 per cent. of clay is used. The brick being subsequently burnt in a kiln, is not too high a temperature, the elements of the clay flux the iron into a solid, coherent cinder-like mass. These clay brick stand the operation of the blast furnace well, if they have been well burnt. However, they are not porous, and a furnace may not work very fast on such a charge and make a clean cinder. The lime brick is one of the most inviting propositions of the lot, inasmuch as the lime is an addition to the value of the charge of the furnace, which the clay is not, but a lime brick disintegrates almost immediately in the furnace. The hydrocarbon binders have had many advocates, but while they make an elegant brick, they do not stand the action of the furnace, as the carbon binder burns out before reduction and melting can take place. In any event, given a 70 per cent. ore to start with, the addition of 10 per cent. of any binder reduces the iron contents of the resultant brick to 63 per cent. The experience of iron-furnace men upon these bricks for a charge has almost invariably been that as much flue dust is produced when running on bricks as when running on 40 per cent. of fine ore unbricked.

In strong contrast to the above methods of handling these fine ores or concentrates is the method that I have had in use for upward of a year. It consists in taking the concentrates cleaned up to the highest point of possible purity, and putting them through an electric furnace, the melting zone of which is a magnetic field. The ore, being magnetic, the magnetic field grabs and holds the grains of magnetite and the polar projection of this magnetic field being at the same time the electrodes of the smelting circuit, the magnetic bridge thus formed by the ore forms a high resistance in the smelting circuit. The heat of the smelting circuit, therefore, is engendered within this bridge of ore itself. The electrodes are water-cooled and play no part in the melting other than to conduct the current to the ore. The moment that the ore melts it loses its magnetism, and, gathering weight from new molten material being added to it, falls out of the magnetic field, its place being taken by fresh portions of ore from above. The results of this operation are glomerated, coherent masses, ranging in size from a bean to a walnut, that are hard, strong, tough and porous, differing in analysis in no way from the ore prior to its agglomeration, except for the absence of moisture and the last traces of sulphur. The product is an ideal condition for use in the blast furnace.

If reducing material, such as powdered-coke dust or charcoal dust, be added to the charge prior to its introduction to the electric furnace, a partial reduction takes place, and the frittered mass of carbonaceous dust and iron ore, partially reduced, is dropped into a soaking pit. If allowed to remain in this soaking pit a proper length of time, cementation takes place, through the action of the heat left in the ore by the electric furnace and the action of the carbon fritted into the mass, which results in producing reduced metal, which may be properly termed steel. Any slag-forming material remaining in the ore through imperfect cleansing or magnetic concentration remains with the metal. These materials in any event are comparatively small in quantity, and are just what is wanted to protect the bath of molten metal in the open hearth from the scorifying effect of the furnace. This material from the soaking pit is ideal for melting in the open-hearth furnace. It thus becomes possible to produce first-class steel direct from the ore through the intermediation of the electric furnace and the soaking pits, producing spongy iron or steel ready for immediate melting in the open hearth, without the intervention of the blast furnace in any part.

The blast furnace, while well recognized as an economical apparatus, is essentially a concentrator, eliminating the gangue of the ore, the limestone and the ash of the coke as a cinder or slag. It costs far more, in fuel consumption, to melt a ton of cinder than it does to melt an equal quantity of iron, and, inasmuch as all statements of economy are comparative, and it costs far less to grind and magnetically concentrate for the removal of the gangue, in that respect the blast furnace ceases to be an economical machine. The process also has the disadvantage of driving whatever phosphorus there may be in the ore into the resultant pig iron. The removal from the ore of this metal by magnetic concentration is a decided advantage over the blast furnace. It may be as well also, to remember the fact that the limestone and fuel charge are never entirely free from sulphur and phosphorus, which in the action of the furnace are driven into the resultant pig iron, the phosphorus entirely and the sulphur partially. In fact, the sulphur and the phosphorus of the pig iron owe nativity not alone to the ore, but to the various components of ore, flux and fuel.

In this electric reduction limestone is practically absent, fuel in contact with the charge is lacking, and reducing material necessary for the elimination of the oxygen of the ore is small in quantity, and may therefore be selected of exceptional purity, without regard to its enhanced cost. Anything that will burn may be used for fuel to generate the electric current, which is the source of heat to be utilized in the reducing and melting of your ore. Poor coal, high in sulphur, high in phosphorus—even lignites—may be used for fuel, as not even their gases come in contact with the ore, and therefore play no part in establishing the quality of the reduced metal. If waterpowers of magnitude be available, they are sources of energy convertible into heat units not to be ignored.

In connection with this subject it may not be amiss to speak of one class of ore which has attracted attention for many years, but no advantageous method has been put forward of handling it. I refer to ferruginous beach sands. These occur in many parts of the world, the most notable being those of the St. Lawrence River and the Pacific coast of the United States. They also occur of greater or less richness in the West India Islands and Australia. An almost universal accompaniment of the magnetite in these beaches is titanium. The

1. Paper read before the American Electrochemical Society at Niagara Falls, N. Y., September 16, 1902.

titanium generally occurs in separate grains of ilmanite. While the ilmanite is magnetic, it is less magnetic than the magnetite, and by gauging the strength of the magnets, they may be made to take magnetite and leave the ilmanite. These beach sands may readily be concentrated up to 71 per cent. of magnetic iron out of the possible 72.40. The sulphur and phosphorus are almost invariably low, and these sands make one of the most inviting fields for this kind of work. Titanium frequently occurs not only in these beaches, but also in the massive ore whose disintegration has formed the beaches. In the grinding of the massive ores fine grinding and magnetic concentration in water will practically reduce the titanium to a negligible point.

Theoretically, it has been stated, by various authorities that it takes from 3,000 to 3,500 kilowatt-hours to melt a ton of iron ore electrically. In my experience, I have succeeded in performing this fritting operation, either with or without reducing agents, with an expenditure of something less than 500 kilowatt-hours. Every ore, of course, is a distinct proposition in itself, but there are few ores that will not stand the cost of this method of treatment. When we consider the vast quantity of low-grade ores which cannot be economically treated in the blast furnace, the field becomes a wide one. Any ore that will stand the cost of grinding, concentration, and the various parts of the process of briquetting, will stand the cost of this fritting much more readily. The cost of the binder, whatever it may be, mixing, pressing, drying and burning, cannot be met without an expensive plant and quite a considerable expenditure in the operation, saying nothing of the reduced value of the ore bricks, due to the addition of the binder. It must also be remembered that in the case of the beach sands, nature has already ground the ore, and as these iron sands usually occur in or near the water, their environment is ideal for wet magnetic concentration.

BOOK TABLE.

STANDARD POLYPHASE APPARATUS AND SYSTEMS. By Maurice A. Oudin, M. S. Third edition, revised. 1902. New York: D. Van Nostrand Company. London: Sampson Low, Marston & Co. Pp. (5¼ by 7⅞ inches), 298, with 166 diagrams and illustrations, and several tables. Price, $3.

The first edition of Mr. Oudin's book was published only about three years ago, but it has merited the second and this, the third, editions. In republishing the book the author has taken the occasion to bring the text up to date and in his preface makes note of the wide application of the three-phase system, the increased size of generators and of power-consuming machinery, the creation of new devices for their control and the progressiveness of switchboard design. Some 40 pages of matter have been added, and several corrections made over the first edition. The introductory chapter gives a few of the more important definitions of alternating-current terms, no attempt being made at mathematical demonstrations. The explanations are short and to the point, and in some instances are almost too brief.

The main text of the book is begun with two chapters on generators. The revolving-armature, revolving-field and inductor types of machines are described without any attempt at matters of design, more attention being paid to the problems arising in the selection, installation, operation and cost of the generators. Mention is made of several typical installations, such as those at Niagara Falls, in the California and western plants and the Manhattan Railway Company's plant in New York city.

One of the best chapters in the book is devoted to induction motors, and the present practice in this line of machinery is clearly set forth, diagrams of wiring connections, curves and illustrations of motors being used to aid in an explanation of the text. Next follow chapters on synchronous motors and rotary converters, treated in a similar manner, and also one on static transformers, descriptive of the self-cooled oil, the water-cooled oil, the air-blast and the natural-blast transformers.

The chapter on station equipment and general apparatus is especially good and contains a practical explanation of the necessity for and uses of high-tension switches and circuit-breakers, lightning protectors, synchronizing devices, insulators, pressure and automatic regulators, compensators, rectifiers, frequency-changers, etc., besides a general account of switchboard arrangements for power transmission. Separate chapters follow on the two-phase, three-phase and monocyclic systems, the explanation of transformer connections and combinations of the three-phase system being noted as especially valuable to the practical engineer. Other chapters discuss the choice of frequency, the relative weights of copper for various systems and the calculation of transmission lines. In an appendix the author reprints in full the report of the committee on standardization of the American Institute of Electrical Engineers.

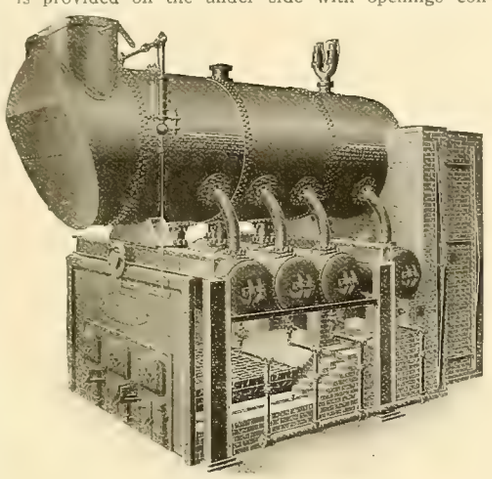
This book will be found helpful by the practical electrician or engineer who desires a general knowledge of polyphase equipment without delving into the theoretical side of the problems. The subject matter is presented in clear and concise language, and a liberal use of diagrams and half-tone engravings aids considerably in its comprehension. For convenient and easy reference the book would have been improved if it had been printed on a paper lighter than the very heavy stock that is used.

The Sederholm Boiler.

The Sederholm boiler has been designed to meet the growing demand for a high-class steam generator, capable of working up to the highest pressure, while still retaining the well-known advantages of the standard horizontal tubular boiler. It is said to combine the advantages of the horizontal tubular, the French or elephant and the water-tube boilers without possessing their defects. It is recommended to the steam-using public by the manufacturer, the Allis-Chalmers Company of Chicago, as the best steam generator wherever economy, durability and concentration of power is a consideration. The construction and setting of the boiler is illustrated herewith.

This boiler consists mainly of a tubular boiler of large diameter connected to a series of cylindrical drums placed underneath, as shown in the illustration. The object of this construction is to provide a roof, constructed of thin material, over the whole furnace, and to shield the thick shell of the large boiler from the action of the flame. It is herein that the main difference lies between this boiler and the ordinary horizontal tubular boiler. In the Sederholm boiler the main shell is protected by the furnace drums beneath it, and can therefore be made of any required thickness. For this reason this boiler can be built of any desired size and for high pressures, without the slightest danger of damage.

The main shell is built up of several courses, and is practically a large tubular boiler, so arranged that the fire will sweep through its tubes after having passed beneath the furnace drums. This main shell is provided on the under side with openings connecting it with the furnace drums, and these openings are carefully reinforced so as not to weaken the shell in the least.



THE SEDERHOLM BOILER.

The tubes are arranged in two nests, with a wide space for circulation between them, and they are furthermore placed so far away from the shell that all danger from leakage in consequence of too much stiffness is avoided. They are carefully expanded into drilled holes in the tube sheets, after which they are neatly beaded over.

The furnace drums are of comparatively small diameter. They are placed across the furnace, close together, so as to form a continuous roof over the fire, except that between the two last drums sufficient space is left for a bridge wall and arch. Being of small diameter, they need not be thick, and are therefore especially well adapted to withstand the action of the fire.

Each drum is connected with the main shell by means of three pipes, of which the central one is continued inside the drum and reaches to within a few inches of its bottom. Those at the ends, consisting of bent tubes, start from the tops of the drums and lead to the under side of the main shell, well below the water line. By this means a very efficient circulation is secured.

The drums are of sufficient size to admit a man easily to clean them when necessary, for which purpose each one is provided with a suitable manhole. They are further so constructed that no seam is in the fire, the longitudinal seams being on top and the circular seams at the ends, well out of range of the flames. The heads are dished, so as to require no stays, and there is, therefore, nothing but a plain, thin, cylindrical sheet exposed to the fire.

The central circulating pipe of each drum reaches almost down to the bottom part of the drum, while the side pipes stop at the top of the drum. In this manner a very effective circulation is secured, the solid water coming down through the center tube and flowing toward the ends of each drum, from which it rises through the side pipes, together with all the steam made in the drum. The side pipes are curved, so as to be perfectly elastic, and not to oppose the free expansion of the furnace drums and the main shell.

Just inside the main shell, at the places where the side pipes enter, curved deflectors are provided to guide the current of water and steam upward in the wide space between the boiler tubes and the shell.

The boiler is supported on a structure built of iron and steel, entirely independent of the brickwork. There are four cast-iron columns, on which rest two girders of heavy I-beams. The boiler shell itself rests in chairs made of boiler plate; the rear chair rests solidly on its girder, while between the front chair and its girder a set of rollers is interposed, so as to leave the boiler perfectly free to expand and contract.

The boiler front is made of such size as entirely to cover the brickwork. It is of plain yet substantial design, and is provided with special air registers in addition to and above the usual fire and ash doors. Above these is a bracket for carrying the steam gauge, which is thus placed low enough to be seen without any difficulty whatever by the fireman.

The furnace is made with an unusually high firebox, no part of the furnace drums being nearer than three feet to the grate bars. At the rear there is a bridge wall provided with arched openings, through which the flames are made to pass. Behind the last furnace drum there is a second bridge wall, forming the front end of the return chamber, which is built of brick, at the rear end of the boiler.

The grate area is, in each case, carefully proportioned to the work the boiler has to perform, as well as to the height of the chimney and the kind of fuel which it is intended to use. Plain grates are furnished, unless otherwise specified, but any kind of a special grate or furnace may, if desired, be fitted to this boiler.

The top of the brick return chamber is roofed over by a curved, cast-iron skeleton-back arch of such a length as to cover the whole width of the return chamber. This arch is loosely attached to the end of the boiler. At the front end of the boiler there is a sheet-steel smoke box, provided with a large door for cleaning the boiler tubes. The flat heads of the main shell are braced, above the tubes, by means of strong stay-rods, running the full length of the boiler, as is usual in marine practice. Inside the boiler, in its highest portion, is a dry pipe so connected that the steam is taken only from the highest part of the boiler.

There is one manhole on the top of the main shell, and one below the boiler tubes, at the front end of the boiler. In addition, there is one manhole placed in the head of each of the furnace drums. With each boiler are furnished the usual boiler trimmings and the boiler is arranged to be covered three inches thick with first-class non-conducting covering.

As the result of tests of Sederholm boilers made at the Fraser & Chalmers works by Albert C. Wood, mechanical engineer of Philadelphia, an evaporation of 8.99 pounds of water from and at 212 degrees F. per pound of dry (Illinois) coal was obtained, the combined efficiency of boiler and furnace being 67.46 per cent. With "New River" coal, an evaporation of 10.88 pounds of water, from and at 212 degrees F. was obtained, and an efficiency of 70.37 per cent. was realized.

Mr. Wood said: "The performance of the boilers, on the whole, was very satisfactory. The evaporative results obtained with the Illinois coal are exceptionally good. The steam produced by the boilers was uniform in quality and practically dry. The products of combustion contained little, if any, unconsumed gases. Comparatively little smoke was made when burning 'New River' coal. It was found that the smoke could be almost entirely eliminated, when burning either 'New River' or Illinois coals by coking the fires in front. Comparatively smokeless, though probably less efficient combustion could be obtained with the Illinois coal, by carrying a thin fire (three to four inches in thickness)."

Institute Membership.

At a recent meeting of the American Institute of Electrical Engineers the following-named associate members were elected: Victor S. Beam, New York city; Mark Brewer Beattie, Minneapolis, Minn.; John Richard Bainton, Sydney, New South Wales; Curtis C. Collins, San Juan, Porto Rico; Frank Toulmen Copp, Jr., Schenectady, N. Y.; William Griffith Davis, Schenectady, N. Y.; Eugene Elmer Dudley, Worcester, Mass.; Walter Lowe Fairchild, New York city; Murray Charles Godbe, Salt Lake City, Utah; Coral Payne Goody, Logan, Utah; Guthrie Gray, St. Louis, Mo.; Frank Wells Hall, Chicago, Ill.; James Henry Hamilton, Cape Town, South Africa; Harry Ariel Haselden, Whitinsville, Mass.; John Samuel Henderson, Brewton, Ala.; Edward Herbert, Chicago, Ill.; Hall Farrington Hoxie, New York city; Julius R. Jacobson, Schenectady, N. Y.; Richard Harry Johnston, New York city; John McCallum Jolly, Sydney, N. S. W.; Benjamin Needham Jones, Harrison, N. J.; Robert Clay Jones, Dunedin, New Zealand; Arba Vanderburg Joslin, San Francisco, Cal.; Adolph Somers Kappella, Schenectady, N. Y.; John Leo Livers, Martinsburg, W. Va.; Alexander Lodyguine, Buffalo, N. Y.; Rupert Thomas MacKeen, Toronto, Ont.; S. C. Medbury, Jr., Richmond, Va.; William Nesbit, Syracuse, N. Y.; James Gillespie Blaine Replogle, South Fork, Pa.; Robert Julian Scott, Christchurch, New Zealand; Charles Leroy Stone, Schenectady, N. Y.; William Lawrence Waters, Milwaukee, Wis.; Robert Baird Williamson, Scranton, Pa.; William Allen Woolford, Schenectady, N. Y.

George Walter Greenwood of Jalapa, Mexico, was transferred to full membership.

Queer Quirks of the Quad.

By Henry Burns Geer.

The theorist theorizes, the inventor invents, but it rests with the workman to apply the practical test. That's where the whole thing simmers at last.

It's the quadruplex I have in mind now, and the way it works through sunshine and shower—through summer's heat and winter's cold—the blustering days of spring, and the calm, clear delight of the autumn that gradually merges into the frosty season that draws the tension, snaps the wire, leaving the quad or what-not that may be at the end of it strung up, as it were, in midair, with no connection to mother earth—a lifeless, useless thing.

It's a see-saw is the quad—a regular "teeter" game. It's a thing with a middle and two sides, or, if you prefer it, two ends—the long end and the short end. And then again, it's a sort of Doctor Jekyl and Mr. Hyde, because it's dual in its character, being both positive and negative—it and the battery that feeds it. The long end is the negative or common end, while the short end is the positive part of its character, or the polar end of it.

When it is in good trim it will carry double on both the common and the negative side (operators generally say "polar side" and "common side"). By "carrying double" is meant that two operators may work on either side, a sender and a receiver, respectively, thus enabling the one wire to which the quadruplex apparatus is attached to carry four messages at the same instant. That's where the value of the thing comes in; it makes, practically, four wires out of one.

But, alas! It is a thing of vexation and a worry forever. It falls wofully short of perfection, but it can be worked, provided you know how to work it, or some other fellow does, who will keep it in "balance" for you. Now, in balancing, the "see-saw" qualities of the combination crop out and its mulish characteristics are revealed, for it has a way of "breaking over" and "kicking" equal to any other quadruped on four legs. It develops "resistance," too, that none but a skilled hand can overcome or equalize. The amount of resistance depends very largely on the condition of the wire to which it is attached and the state of the weather along the route the wire traverses.

In overcoming the "resistance" rheostats, static coils and spark-arresters are brought into play. In playing this part of the game, the quadruplex apparatus is first detached from the main-line circuit and balanced locally; that's what we call it—"balancing the quad." Then the rheostat is brought into play, and the resistance coils boxed up in it are used to offset the resistance in the wire until that, too, balances. Then, to further clear the situation, a "static balance" is taken through the condensers attached for that purpose, and then the grind of messages is resumed.

As to how long a "balance" will last depends entirely on conditions out on the line and the amount of foreign "resistance" playing hide-and-seek out there, in the way of bad connections, poor insulation, induction from other circuits caused by rain, melting snow, fogs, or any form of dampness that is likely to develop "leaks" of different nature. Sometimes the trickling raindrops conduct a part of the current to the earth, causing the circuit to "work heavy," in common parlance. Oftentimes the "road is so rocky," so to speak, that it is impossible for the most expert electricians to make a wire "quad;" it will only "duplex." Then the next best thing is done; the common side is closed, and the polar side, otherwise the "short end" of the battery, is utilized in working the wire as a duplex only—utilizing only two men at each end—the wire then having a capacity of but two messages at a time in transmission.

Some wires, on bad, rainy days, are so heavy with leaks and escapes of current from poor insulation, that they will neither work as a quadruplex or a duplex, and even work poorly as single circuits, with the ordinary sounders and instruments attached. On long lines that are "quaded," the circuit frequently changes so greatly and so often as to require a dozen or more balances a day.

The transmission of two or more messages over the same wire simultaneously is possible only by careful adjustment, for the sounds going and coming, as it were, frequently break over into confused sounds; hence the great necessity of properly balancing the "see-saw" qualities of the quadruplex or the duplex. On a circuit that is working nicely as a quad, a slight movement of the relay spring up or down, as the need may be, will devlop the same sounds on both sides. Success depends on each fellow holding his end level—just like we used to when we "see-sawed" on a "teeter-board."

This is the way it looks to the man at the key, who is putting to practical test and bringing to the great active world of utility the creation of our master inventors.

CORRESPONDENCE.

New York Notes.

New York, November 15.—Engineers have been much interested in the partial destruction by fire of the East River Bridge in course of construction. The fire started at about four o'clock in the afternoon of the 13th inst. on the north side of the Manhattan tower and spread so rapidly that before the evening was over the New York firemen were given about as much as they were able to handle. Numerous small cables were so burned that they parted, but the main cables withstood the test, although whether they are critically injured cannot now be learned. The tower on which the fire occurred was so high as to make it almost an impossibility to use hose, and the heat became so excessive that what lines of hose were carried up were soon burned in two. The damage, according to one of the Roeblings, will amount to $75,000 at the least, and may be much more. The fire lasted from four in the afternoon until 11 at night, at which time all inflammable material on the tower had been consumed.

The aldermen have the Pennsylvania tunnel franchise and are taking it under consideration.

The quarterly report of the Manhattan Railway Company up to September 30th shows gross earnings of $2,495,112, with operating expenses of $1,338,941, thus giving a net of $1,156,171, an increase over the same period last year of $375,025. The general balance sheet showed cash on hand amounting to $270,743 and a profit and loss surplus of $6,372,418. Speaking of the affairs of the company, the report of President Gould says: "The statement of operations for the past year, showing an increase of over 29,000,000 in the number of passengers carried, and a decrease in the operating ratio, is an encouraging indication that the results which were predicted when the stockholders decided to equip the system with electricity will be more than realized, particularly as only one-half the lines have been under full electric operation since September 15th last, and that the high cost of fuel has materially increased the expenses."

It has been announced that the Brooklyn Rapid Transit Construction Company, successful bidder for the Brooklyn extension of that city's subway system, had awarded sub-contracts for two sections of the extension. Just within the time limit set by the Rapid Transit Commission a formal start on the Brooklyn tunnel was made last Saturday afternoon. At that time no awards of sub-contracts had been made, but the Belmont company invited an engineer of the Degnon-McLean company to attend the breaking of ground. It was assumed then that this engineer's concern would have a hand in the building of the extension. Ground was broken by Calvin W. Hendrick, division engineer of sewers for the commission. He wielded a pick about a minute and uprooted a cobblestone, after which a squad of a dozen men were put to work. The start was made at State and Pearl Streets, just below Bowling Green.

The Brooklyn Rapid Transit Company is preparing to erect a clubhouse, costing $45,000, at Fulton Street and Broadway, Brooklyn, for the use of its employes. The building will have a gymnasium, bowling alleys and billiard tables, etc., and in the basement will be a school for motormen. The company also is arranging a series of entertainments for the men this winter.

Those who burn soft coal on and after November 15th and thereby create a smoke nuisance in the city will do so at the risk of prosecution. Mayor Low recently issued a formal notice as follows: "Inasmuch as hard coal is now coming to market with considerable freedom, notice is hereby given that on and after November 15th the Board of Health will resume the enforcement of the anti-smoke ordinance, as heretofore." The anti-smoke ordinance was suspended during the recent strike and as a result New York's atmosphere was not of the clearest.

Two interesting places on the Fourth Avenue work of the rapid-transit subway are the Fourteenth and Twenty-third Street stations. The arduous part of the work is finished in each case, excavations having been completed and most of the steel erected. At Fourteenth Street the heavy building of the German Savings Bank had to be upheld while the drills buzzed away directly under the cash windows. While the line of the tunnel did not trespass on the bank's property, the space required for the station stretched far underneath. The entire foundations on the Fourth Avenue side, and part of those toward Fourteenth Street, had to be torn away. Gradually the rock and brick foundations were slid out of place and a wooden support substituted. As the excavation went deeper down, the wooden supports gradually became small towers. On these temporary foundations the bank stood until the excavation for the station and surrounding stretches of tunnel were finished. Up at Twenty-third Street the conditions were much the same, with the exception that the "skyscraper" instead of being built, is now in the course of erection. O.

Southern Developments.

Charlotte, N. C., November 14.—The survey has been completed for the proposed electric line between Lexington, S. C., and Columbia, a stock company having been recently organized. Colonel Graham of Lexington is interested.

The employes of the Electrical Construction Company of Richmond, Va., have returned to work after a lock-out.

The Virginia Passenger and Power Company of Richmond, Va., on November 14th took formal possession of the Petersburg and Richmond electric railway. The Virginia company has also practically decided to unite the two power houses in Richmond with the new power house being erected at Petersburg. When the plant is completed the company will probably abandon coal, using waterpower altogether. The Virginia company's plant in Dinwiddie County will develop 3,000 horsepower. The company will also occupy new quarters in Richmond on January 1st.

There is talk of extending the Augusta-Aiken S. C., electric line on to Columbia.

F. P. Porter of New York has been in Key West, Fla., examining the Key West Electric Company's properties, with a view to purchasing them for himself and associates. The deal will likely be consummated and would mean extensive improvements in the electric-railway and lighting services.

The City Council of Columbia, Tenn., has passed the Interurban Railway ordinance with the provision that the work shall be completed within two years' time. L.

New England News.

Boston, November 14.—As the lower portion of the old State House is to be taken for an East Boston Tunnel station, the Boston Transit Commission has notified the Western Union Telegraph Company, the Mutual District Messenger Company and the Direct Cable Company that they must vacate their quarters in the basement of that building, by January 1st. The Western Union company has an important branch office, and the other companies have their principal offices there. There has been a telegraph office in this building for some 25 years or more. The commission has awarded the contract for the steel to be used in strengthening the foundations of the building, and workmen are now installing three air locks in the Boston end of the tunnel. About 150 feet of the Boston end of the tunnel has been finished, and the East Boston end has reached well under the harbor.

The railroad commissioners are investigating municipal methods of dealing with suburban services and the use of electricity as a motive power on railroads and street railways. Mr. Bishop is visiting St. Louis, Chicago, Detroit and Cleveland, and Mr. White is visiting Washington, Philadelphia and New York. Mr. Jackson will join Mr. Bishop at Chicago, where they will inspect the electric railways.

George I. Rockwood, a mechanical engineer of Worcester, Mass., has just returned from a trip to England and he has given the Worcester Telegram an interesting interview on the machinery conditions in that country. He says that large motor trucks are successfully competing with steam railroads in hauling freight across country. A manufacturer told him that the motor trucks run a year without overhauling and some of them carry 10 tons at a load and travel from Liverpool to London. Much of this success is due to the excellent roads in England.

The Boston Building Trades Council has adopted resolutions condemning the Washington Street subway bill in its present form and calling upon wage-earners to vote against it at the coming municipal election.

The D. J. Mahler Company, to deal in electrical appliances, has been organized at South Berwick, Maine. It has a capital of $100,000; $50 paid in. Howard F. Butler of Boston is president and treasurer.

The Fair Haven and Westville company's annual report gives the following figures: Gross earnings, $980,171; operating expenses, $627,786; net earnings, $352,385; dividends, $137,500; construction and equipment, $143,015; cars run, 5,137,157 miles; passengers carried, 25,016,259. During the year the company absorbed the Winchester Avenue Railroad Company, for which 31,616 shares of new stock were issued, having a par value of $790,400.

Next Monday evening President Pritchett of the Massachusetts Institute of Technology will deliver a lecture on "The Place of Industrial Training in the Education of a Modern Nation," before the Association of College Alumni at Buffalo, N. Y. On Tuesday he will address the scholars of the Buffalo Central High School, and that evening he will be the guest of the Buffalo Tech. men at their annual dinner.

New York and London capitalists have inspected the Maritime Copper and Reduction Company's copper-mining properties at Goose Creek, N. B., 48 miles from Calais, Maine. The property was once worked by the Vernon company, and it is believed that it contains a large body of copper ore. There are seven veins of copper about 20 feet above high-water level. A smelter will be built and mining operations will then be begun.

The Massachusetts railroad commissioners have granted the Boston and Worcester Street Railway Company's request for authority to issue capital stock amounting to $750,000. This will be the corporation's first issue of stock, and comprises the whole amount of its capital. The company has received subscriptions for the whole of it and has obtained rights-of-way over the entire distance between Boston and Worcester, although there is a controversy over whether it shall go over or under highways in Southboro, a matter which the railroad commissioners are now considering.

The Weston Electric Light Company and the Na-

tick Gas and Electric Company have had considerable litigation over the question of which should provide lights for the village of Wayland Center, Mass., and the controversy was finally taken to the Massachusetts gas and electric-light commissioners, who have decided that the Natick company forfeited its right to the territory because it never exploited it and because it had rendered poor service elsewhere, while the Weston company has given good service in Weston and has the approval of the selectmen and people of that town, and it is more convenient to Wayland Center, consequently it should have the territory.

Hartford (Conn.) electrical contractors and dealers in electrical supplies have formed the Hartford Electrical Contractors' Association, with the following officers: President, Edward M. Baldwin; vice-president, H. E. Page; secretary, T. Edward Oakes. Practically all Hartford firms in those lines of business are members.

Judge Case of the Hartford County (Conn.) Superior Court, has decided that public necessity and convenience require the extension of the Bristol and Terryville Tramway Company's lines from Bristol to Plymouth, via Terryville, a distance of four miles. The extension will be built at once. It will put Plymouth and Terryville in direct electric-railway connection with New Britain, Meriden and Hartford.

B.

From the Buckeye State.

Cleveland, Ohio, November 15.—Chairman Newcomb of the banking committee in charge of the Everett-Moore affairs, says that the business is in a most satisfactory condition. The members of the syndicate have carried on negotiations within the last four months that have resulted in clearing up over a million dollars of the debts. The plan of refinancing the Northern Ohio Traction Company is well under way, and all the other properties are in a very satisfactory condition, either for refinancing or under negotiations for sale. Mr. Newcomb thinks that it will be but a very short time until matters will all be cleared up, and that very satisfactorily.

The Cleveland, Akron and Southern Fast Line Railway Company of Akron has been organized as follows: President, Judge C. R. Grans, Akron; vice-president, Charles A. Gates, Massillon; secretary and treasurer, C. H. Wheeler, Akron; general manager, Thomas L. Childs, Akron. The company proposes to build a line from Akron to Cleveland, over which cars will make the trip in an hour.

The Medina Electric Lighting, Power and Heating Company of Medina has been incorporated with a capital stock of $50,000 by O. P. Van Sweringen, M. J. Van Sweringen, J. G. Boyd, S. C. Stewart and A. J. Watt.

Electric-railway men are planning to extend the line of the Portsmouth street railway on up the river from Sciotoville to Ironton, with the intention of making connection there with the Scioto Valley, should it be extended south through the state from Columbus.

W. Kelsey Shoepf, president of the Cincinnati Traction Company, was last Monday elected to the directorate of the Cincinnati, Dayton and Toledo Traction Company and made chairman of the executive committee. Arrangements will be made as soon as possible for the Cincinnati, Dayton and Toledo cars to run into the heart of Cincinnati.

The Wellsburg, Steubenville and New Cumberland Railroad Company has filed an application with the clerk of Brooke County, W. Va., for a franchise for an electric road from Wellsburg to the Hancock County line, passing a point opposite Steubenville, Ohio. Henry M. Camp is at the head of the enterprise.

The stockholders of the Sandusky Southwestern Railway Company of Wapakoneta have elected a board of directors and the following-named officers have been chosen by them: President, George A. Hurd, Boston; vice-president and general manager, Frederick O. Olson, Wapakoneta; general superintendent, W. H. Wyke, Toledo; secretary, S. P. Doughlass, Toledo; treasurer, S. W. McFarland, Wapakoneta. All the right-of-way has been secured by purchase or otherwise and a portion of the road-bed has already been completed.

The Lake Erie, Bowling Green and Napoleon line has been completed into Pemberville, and cars are now in operation.

The Lake Shore has opened traffic between Lorain and Sandusky direct, with a transfer of passengers at Ceylon, where there is an unfinished bridge.

The Columbiana Railway Company of Columbus has been incorporated with a capital stock of $10,000 to build an electric line from East Liverpool to Salem, by way of Lisbon. D. J. Ryan and E. J. Miller, prominent men of Columbus, and E. C. Hicox and H. R. Young of Cleveland, are interested.

The Central Market Street Railway Company of Columbus has purchased land and will erect car barns and a sub-station to cost $40,000.

It is reported that the Cincinnati, Milford and Loveland Traction Company of Cincinnati has purchased the rights and franchises of the Cincinnati, Milford and Goshen, thus passing to the Kroger-Wilson syndicate.

Robert Sheldon and other members of the Columbus Railway Company have made arrangements to equip the Fairfield Traction Company's line from Lancaster to the Boys' Industrial Home with electric power. In the past it has been operated with steam. When the Scioto Valley traction line is completed this will give a through line from Columbus to the home.

The Frost Cross Arm and Lumber Company, incorporated in Delaware, has been authorized to do business in Ohio. The capital stock is $15,000 and the office will be in the Century Building, Cleveland.

The Cincinnati and Eastern, from Cincinnati to New Richmond, was opened up for passenger traffic Wednesday, with a celebration at the latter place such as has not been seen in a long time. The road is 18 miles long and well ballasted the entire distance. The power house is equipped with the compound condensing system, and the machinery is in triplicate throughout, so that there is no danger of delay on account of a breakdown. This is the first of the Scrugham roads to be put in operation.

The Appleyard syndicate has purchased a strip of land 400 feet long on Park Street, between Broad and Gay Streets, in Columbus, on which will be erected a modern freight depot, with capacity and sidetracks sufficient to accommodate all the electric roads running into the city, with the exception of the Johnstown line, and that has not been altogether settled. The building will have umbrella sheds, so that all freight may be handled in any kind of weather without danger of damage. The purchase price on the land is in the neighborhood of $50,000.

W. G. Wagenhals of Cincinnati, through his attorney, Charles L. Hopping, has filed a protest with the State Board of Public Works against the contract made by that board with Thomas N. Fordyce for the use of the banks of the Miami and Erie Canal for the purpose of building an electric line for the propulsion of boats on the canal It is the intention of Mr. Wagenhals to file a quo warranto suit to oust the Miami and Erie Transportation Company from the use of the canal banks, and it is hinted that the steam roads are behind it all, believing that it is the primary intention of the company to build an electric freight road from Cincinnati to Toledo. The whole matter will be based upon allegations of fraud in obtaining the contract, and the men say they will have plenty of proof to support them when the time comes.

O. M. C.

Detroit, Mich.

Detroit, Mich., November 17.—Foote and Boland, promoters of the Battle Creek and Marshall, Jackson and Calhoun County electric lines, have at last secured funds from the Spitzers, bankers of New York and Toledo, to finance their indebtedness of about $600,000, and the roads will be turned over to them.

H. M. Lau of Detroit has asked for a franchise at Wabash, Ind., to build an interurban road 22 miles long, from Wabash to Marion, Ind. One or two Detroiters and some eastern capitalists are associated with Mr. Lau in the enterprise.

The new power plant of the Edison Illuminating Company has obtained options on a number of pieces of property in the vicinity of the River Rouge, ranging in extent from 40 to 80 acres. It is expected that the plant will attract to itself and its vicinity a number of big industries.

It is understood that the interurban roads running out of Detroit will make a special bid for freight business in the spring, especially for Toledo and Cleveland, between which points it will be handled at night.

The contractor who is building the electric road between Niles, Mich., and South Bend, Ind., expects to complete the line in two months if he can secure enough teams. This line is a part of the Indiana electric railway now in operation between Goshen and South Bend, and will connect with the proposed line from Niles to St. Joseph, Mich.

Mr. Beardsley of Detroit and Judge Taylor of Flint, who are promoting an electric road to connect Saginaw with Pontiac, via Flint, are getting an extension of franchise from property owners between Saginaw and Flint, and evidently have hopes of the project. Their plan contemplates taking in the Bay City Consolidated, the Saginaw Valley Traction Company and the Interurban connecting Saginaw with Bay City.

The Lansing, St. Johns and St. Louis railway, now operated as a steam road between Lansing and St. Johns, will build a new train shed at North Lansing, and has ordered electrical equipment for the three new cars which will be installed by B. J. Arnold. The single-phase system of electric traction—the invention of Mr. Arnold—will be used.

The Detroit United Railway has placed in commission a new double-truck funeral car, to be run on the city and suburban lines. The car was designed and built at the company's own shops, and is about 50 feet in length over all. It is planned especially for funeral purposes. The front portion of the car is divided off as a private apartment for the reception of the casket. There is a door on each side of the car leading to this section. These doors drop down on a level with the sides of the car, and steel rollers are sunk in the floor, which furnishes convenient and easy facilities for placing the casket in the car and removing it. The other portion of the car is fitted up with seats, an aisle running through the center. The seats are upholstered in green plush and will accommodate comfortably 34 persons. The interior is handsomely finished. The car is heated with electric heaters and well lighted with three clusters of electric lamps. The windows are plate glass, and push buttons are provided at each seat and at all other parts of the car where necessary. The exterior of the car is painted a lustrous black, ornamented with gold stripes. It is a very easy-riding car and is equipped with four 50-horse-power Steel motors.

C. G. W.

Information from Indiana.

Indianapolis, November 17.—At a special meeting of the Paoli City Council, the New Albany, Paoli and French Lick Valley Traction Company received a franchise over the streets of the city. The promoters of the line agreed to begin operations early next season and complete the line by September. All other towns and cities, excepting New Albany, have granted the company similar rights. Elections were held in French Lick and Orangeville Townships, and a subsidy tax voted by a good majority in each case. Three townships in Dubois Township voted the tax also in aid of the above road.

E. J. Binford of the Indianapolis and Eastern Traction Company (Greenfield line) was granted a franchise at a special meeting of the Newcastle council on the 14th inst. C. S. Hernley and Gus Hodges of the Richmond and Northwestern company, who hold separate franchises, to forestall the Binford company, placed a large number of men at work in the main street the next day. This was done to save their limits, and they will have to push the work to the corporate limits in a few days to do so.

The electric line from Richmond to Cambridge City has been opened for traffic to Dublin on a regular schedule. The Indianapolis line will make connection at Dublin in two or three days, and through service will be established.

L. D. Fleming, representing Lagrange and Ligonier capitalists, has applied to the Warsaw City Council for a franchise for an interurban electric line to connect Lagrange and Warsaw and the intervening towns of Ligonier, Syracuse, Wawasee, Milford and Leesburg. It is claimed that the enterprise has been amply financed and that much of the right-of-way outside of the towns mentioned has been secured.

Two years ago the township in which Wabash is situated voted $20,000 tax in aid of the Wabash River Traction Company to construct its interurban line between Wabash and Peru. The Big Four Railroad Company refuses to pay the tax and insists that the township cannot vote aid to a traction line under the general railroad act of Indiana. The county treasurer has decided to attach two locomotives and other equipments in order to get the matter into court. The question is regarded important, and if the present law will not permit what has been done, the Legislature will be asked to amend it.

The Merchants Traction Company of Anderson, which sold its franchises and rights-of-way for an electric line between Anderson and Middletown to G. M. Hodges, who promised to build the line within 90 days, has settled up all its affairs and divided the consideration. Mr. Hodges, however, has done nothing, and from the preparation made by the Union Traction Company to build this particular line, it now dawns on the Merchants' company that Mr. Hodges merely represented the Union Traction Company in buying out opposition.

The Indianapolis Northern Traction Company, through George F. McCulloch, has applied for an electric-lighting franchise in Kokomo. This is regarded as a continuation of the battle between the Marrott and McCulloch interests.

F.

Northwestern Notations.

Minneapolis, November 15.—The purchase of the electric-light plant by the city is being discussed by the City Council of Hastings, Minn.

Interurban electric service has been instituted between Des Moines and Mitchellville, Iowa, over the new line. There will be a car over the line every 90 minutes.

The Electric Machinery Company of Minneapolis has been incorporated with a capital stock of $25,000. The incorporators are Charles H. Chalmers, T. Boustead and William Lau. The company has been doing business for some time and has lately taken the contract to construct a dynamo for the Glass Block department store in Minneapolis. The dynamo will be of 6,000 horsepower and will be the largest for any private plant in the Northwest.

The John U. May Company, which proposes an interurban line between Davenport and Clinton, Iowa, has secured an option of the State Electric Company's system in Clinton. The May company has just been granted a local franchise by LeClaire, Iowa.

The sheriff has levied on the plant of the Electric Light and Power Company of Colfax, Iowa, and if the amount of the judgment is not forthcoming, will sell it. The judgment was secured by a guest at a local hotel, who received a severe shock in a bathroom, the steam having caused the insulation to drop from the company's wire.

Langstadt & Meyer of Appleton, Wis., have completed a $10,000 electric-light plant at Ladysmith, Wis., and have put it in operation. The contractors now have the job of putting in a new plant for the mill of the Menasha (Wis.) Paper Company.

The Northern Electrical Construction Company of La Crosse, Wis., has been incorporated with a capital of $10,000. The officers are as follows: President, C. A. Sterling; secretary and treasurer, Marcy

Berger; assistant secretary, W. C. Heinroth; superintendent, John Stone.

The Wheaton (Minn.) Electric Light Company has been formed and succeeds to the ownership of the local plant installed by W. I. Gray.

The Waterloo and Cedar Falls Rapid Transit Company has completed an arrangement with the Chicago, Great Western Railroad Company for the use of a section of track for an extension. The electric road has completed a line from Waterloo to Denver, Iowa, this season. Next season the line will be continued to Waverly, Tripoli and Sumner, Iowa. The road has contracts for carrying the mail to Denver.

The Jordan Electric Light Company of Jordan, Minn., has been incorporated to install a local lighting system. The village voted bonds for the same purpose, but has been unable to find a purchaser, and private citizens decided to form this company.

James L. Humphrey has made a proposition to establish an electric-light plant to furnish street lighting for Humeston, Iowa.

E. G. DeCelle has sold his interests in the Owatonna Electric Light Company of Owatonna, Minn. C. L. Powell of Chicago will become manager of the plant.

The Burlington Railway Company has completed its trolley system between Deadwood and Lead, S. D., and is now running cars into Lead by electricity.

St. Louis County, Minn., has granted a right-of-way through the county to the Missabe General Electric Company for the construction and operation of street-railway lines. The first line will be built between Virginia and Eveleth, Minn.

The Railway, Light, Heat and Power Company of Creston, Iowa, has filed a trust deed in favor of the Farmers' Loan and Trust Company of New York, to secure $600,000 bonds for the construction of an interurban line from Creston to Winterset, Iowa. The cost is not to exceed $15,000 a mile.

R.

On the Pacific Slope.

San Francisco, November 13.—The Sacramento Electric, Gas and Railway Company is preparing to increase the carrying capacity of its electric road in Sacramento, Cal. Two more double-truck extension cars will be put on at once, and orders have been issued for four more, to be delivered in the spring. All the old cars will be rebuilt into double-truck vehicles. The matter of rebuilding the road from Twenty-eighth and R. Streets to Oak Park as a double-track system is being considered. Sixty-pound steel rails will be used.

Mr. Fleishacker of the Truckee River General Electric Company states that the company is extending its system both up and down the Truckee River and will soon have a large market for its power, independent of the mines on the Comstock lode. About 12 miles of new pole line are being built to connect the power station with Carson City, where transformers will be installed in a sub-station. A two-mile line of No. 6 copper wire has already been built to connect with the Floriston Paper Mills, which will be supplied with 375 horsepower. The Reno electric-lighting system has been rebuilt and enlarged at great expense.

President H. Mellmann of the Washington and Oregon Electric Railway, Light and Power Company of Portland states that contracts have been signed for the construction of the proposed electric-railway line between Pendleton, Ore., and Dayton, Wash., and that construction work will commence before November 20th. The road will be 85 miles long and will traverse a territory containing 40,000 people. Mr. Mellmann places the entire cost of the road, power houses, etc., at a million and a half dollars. Power will be developed at Two Canyons, near Pomeroy, where it is estimated that waterpower can be had sufficient to develop 5,000 horsepower.

Grading on the Redondo line of the Los Angeles-Pacific Electric Railway Company was finished November 1st, and the laying of rails is now under way. The total length of the line is 22 miles, and it is believed that cars will be running along the entire length of the route by December 1st.

Dr. Charles Van Norden, Alta, Cal., of the Central California Electric Company's plant at that place, states that the plant is now ready for operation. A transmission line connecting with Nevada City, Cal., has been constructed, and the stone power house of the company at Alta has been finished. The power house has a capacity for the installation of five 1,000-kilowatt units and one larger unit. Of these, two 1,000-kilowatt, three-phase Westinghouse generators, direct-connected to waterwheels, are now in place. The company already has plants in operation at Newcastle and Auburn, which transmit power to Sacramento.

C. T. Ruddock, San Francisco, and C. H. Boardman are now making surveys on the south fork of Trinity River, Cal., for an electric power station. A ditch seven or eight miles long with a carrying capacity of 10,000 inches of water will be constructed to bring water from the river to the power plant. A transmission line 30 miles long is to be built.

E. V. D. Johnson, superintendent, and W. S. Hancock, foreman of the Northern California Power Company, with headquarters at Redding, Cal., are selecting a site for a sub-station at Bully Hill, Cal. A branch transmission line is now being built from the company's main line to Bully Hill.

A.

PERSONAL.

Richard Emory has been made vice-president and member of the board of directors of the Central Market Street Railway Company of Columbus, Ohio, to fill the vacancy caused by the resignation of John G. Webb.

J. G. Lay has been appointed manager of the Western Union Telegraph Company's office at Denver, Colo., succeeding W. H. Butler, resigned. Mr. Lay was formerly chief clerk in the office of Superintendent Dickey, Omaha, Neb.

The remains of John W. Mackay reached New York from London, England, on November 12th on board the White Star liner Oceanic from Liverpool. Mrs. Mackay and her daughter, the Princess Colonna, were passengers on the same steamer.

Professor Joseph J. Thomson, professor of experimental physics at Cambridge University, England, has been given the initial appointment as Silliman lecturer at Yale University. The lectureship was founded by an $85,000 endowment by the late Benjamin Silliman of New York city.

The funeral of the late Professor Sidney H. Short was held in New York city on November 11th, the service being conducted by the Rev. Minot J. Savage of the Church of the Messiah. The pallbearers were Judge W. B. Sanders and Howard H. Burgess of Cleveland, Benjamin Graham of Rochester and H. McL. Harding, James H. McGraw, T. C. Martin and R. W. Pope of New York city. The remains were placed in a receiving vault in Woodlawn Cemetery.

Charles Mohlman, foreman of the iron foundry of the General Electric Company, Schenectady, N. Y., and one of the best in his business, died suddenly at his home in Schenectady, on Friday, October 31st. Mr. Mohlman was born in Nittlestadt, Westphalia, in 1856, and learned the foundry business there. In 1882 he came to America and worked in several foundries until January, 1886, when he secured employment as molder with the Edison General Electric Company and continued in its employ until his death. He was appointed foreman of the iron foundry in 1895. A widow and six children survive him.

The many friends throughout the West and Northwest of George J. Cadwell will be interested to know that he has severed his connection with the Milwaukee firm of Pawling & Harnischfeger, to accept a position with Manning, Maxwell & Moore of New York. Mr. Cadwell, it will be remembered, was with the western office of the General Electric Company for quite a while, more recently with the Christensen Engineering Company of Milwaukee, and until his change to Manning, Maxwell & Moore, handled the eastern business of Pawling & Harnischfeger, with headquarters at Philadelphia. For the time being Mr. Cadwell's headquarters will be partly in New York, 87 Liberty Street, and partly at Plainfield, N. J.

Professor Ogden Nicholas Rood, who was the head of the department of physics in Columbia University for 38 years, died of pneumonia on November 12th at his home in New York city. He was the oldest member of the Columbia faculty, being born in Danbury, Conn., in 1831. He was graduated from Princeton University and from the Sheffield Scientific School of Yale and also studied abroad. Before going to Columbia he was professor of chemistry and physics in the Troy (N. Y.) University. Through his research and experimental work he came to be known as the "Father of American Experimental Physics," and he was regarded generally as one of the ablest men in this country in his specialty. He was the first to apply stereoscopic photography to the microscope, the first to make quantitative analysis in color contrast, the first to measure the duration of flashes of lightning, and the first to make a photometer that is independent of color. Professor Rood was associated with many scientific societies. In 1867 he was vice-president of the American Association for the Advancement of Science, he was a member of the National Academy of Sciences, the American Physical Society, the American Philosophical Society of Philadelphia, the American Academy of Arts and Sciences of Boston, and many others.

ELECTRIC LIGHTING.

The Lighting and Heating Company of Kewanee, Ill., has been incorporated with a capital of $50,000. The incorporators are Xenophon Caverno, B. C. Parkinson and James Nokes.

The Citizens' Light and Water Company of Mount Carmel, Ill., has been incorporated to operate light, power and water plants, with a capital stock of $70,000. The incorporators are A. R. Manley, P. G. Manley and J. H. Mitchell.

The Houston (Texas) Lighting and Power Company is now completing a 68 by 84-foot addition to its power house, to make room for additional machinery. The company will install a Rice-Sargent cross-compound engine 18 by 36 by 42 inches of 120 revolutions direct-connected to a General Electric 600-kilowatt revolving-field three-phase generator. An additional boiler is in place. Oil burners are used. A large 3,000-horsepower condenser has also been placed. The work is under the direction of W. H. Chapman, general manager of the company.

The purchase of the $2,000,000 of common stock of the United Electric Light and Power Company from the United Railways and Electric Company by a syndicate acting through the Continental Trust Company, has been completed at Baltimore, Md. For the stock, which constitutes the entire issue, $900,000 is to be paid on or before January 15, 1903. The purchase of the control of the light and power company practically assures the launching of the great Susquehanna River electric power-development project by the syndicate.

ELECTRIC RAILWAYS.

The Walker Contracting Company of Clarksburg, W. Va., has been incorporated, with a capital stock of $25,000. The company will buy, sell, lease and operate street railways.

The Cleveland (Ky.) and Ducktown Electric Railway Company has been incorporated with a capital of $5,000. The incorporators are W. B. Eckhardt, M. C. King, A. A. Campbell and others.

The Western Reserve Traction Company of Cleveland, Ohio, has been incorporated with a capital of $10,000 to build an electric railway from Warren, Ohio, to Cleveland. The incorporators are T. C. Williard, E. Jay Pinney and others.

The Seattle (Wash.) Electric Company has ordered 18 new cars for the local Seattle service, the increased business of which has outgrown the present rolling stock. The Seattle-Tacoma interurban line has also been compelled to increase its rolling stock owing to the rush of business.

Considerable interest in Texas is centered in a rate war in progress between the Texas and Pacific steam railroad and the Interurban electric railway between Dallas and Fort Worth. Before the trolley line was built the fare between these two points was 95 cents. The electric road reduced it to 70 cents and the Texas and Pacific has followed with a rate of 30 cents, or one cent a mile, selling 500-mile books for five dollars each.

At the Chicago City Council meeting on November 17th an ordinance was introduced which, if passed, would prohibit the granting of any extension franchises for street railways, gas, electric-light and power companies until a municipal-ownership enabling act is passed by the state Legislature of Illinois. An effort was made to suspend the rules and put the ordinance on its passage, but it was finally referred to the local transportation committee.

SOCIETIES AND SCHOOLS.

The Engine Builders' Association of the United States will hold its next annual meeting at Sherry's, Forty-fourth Street and Fifth Avenue, New York city, on December 1st and 2d. On the afternoon of the first day an open meeting will be held for the reading of papers. On the second day there will be an executive meeting in the morning and the annual dinner in the evening. D. N. McBrier of Erie, Pa., is secretary of the association.

The two hundred and twenty-eighth meeting of the New York Electrical Society will be held in the large lecture room of the American Institute of Electrical Engineers, at the Berkeley Lyceum Building, 19 West Forty-fourth Street, New York city, on Tuesday evening, November 25th, at 8 p. m. A. Frederick Collins will lecture on "Operative Systems of Wireless Telegraphy." His treatment of the subject will be illustrated by diagrams and by apparatus in operation.

PUBLICATIONS.

The Joseph Dixon Crucible Company of Jersey City, N. J., calls attention to its silica-graphite paint for protection of heated surfaces, in an illustrated folder distributed to the trade.

The Whitehead Machinery Company of Davenport, Iowa, is distributing to the trade a catalogue descriptive of second-hand steam-power equipment, including engines, boilers, pumps, heaters, etc., that it has ready for immediate delivery.

The Jeffrey Manufacturing Company of Columbus, Ohio, has issued a very complete and carefully prepared catalogue on its chain belting, steel cable, elevating and conveying and power-transmission machinery. The publication contains 376 pages and is profusely illustrated. Among the electric apparatus shown are coal cutters, locomotives, drills, larries, generators, etc.

SPACE TELEGRAPHY.

The Grand Trunk Railway System, it is said, will conduct a series of experiments with a view of determining the possibility of operating wireless telegraphy on its trains. Stations will be placed along the road at intervals of from eight to 20 miles.

The Marconi Wireless Telegraph Company of Canada has been incorporated. J. N. Greenshields of Montreal announces that the company is about to establish a system of wireless telegraphy across the Dominion, connecting Victoria, B. C., with Cape Breton, N. S. Stations will be erected at many points across Canada, and all the principal cities and

towns of the Dominion will be included in the system.

Daniel Kelly, representing the United States Marconi Company, has been at Pensacola, Fla., negotiating for the establishment of a wireless-telegraph station on Santa Rosa Island, nine miles from the city, by which vessels fitted with Marconi instruments can be reported when within 200 miles from that port. The Marconi company is said to be working on a plan to establish a chain of these stations all along the coast from New York to Galveston.

It is stated that some of the ships of the British Navy are not fitted with the Marconi wireless-telegraph system, but have instruments of another type. It is learned that these instruments have not given the best of satisfaction, and steps are being taken to have the Marconi instruments installed. With this object in view, Admiral Douglas, commanding the British North American squadron, recently visited Sydney, N. S., and talked the matter over with Mr. Marconi and his directors, and the result of the admiral's visit, it is said, will be that British warships of the North Atlantic squadron, at least, will shortly have the Marconi wireless-telegraph system.

TELEGRAPH.

The Western Union Telegraph Company has bought out the Alabama Midland Telegraph Company. The latter company's lines extended from Montgomery, Ala., to Thomasville, Ga., along the old Plant System railroad.

A decision recently handed down by Judge Thayer of the United States Circuit Court of Appeals worsts the Great Northern railway in a suit to oust the Western Union Telegraph Company from the railroad company's right-of-way. The decision is the culmination of 10 years of litigation. It is to the effect that the contention of the Great Northern meant little less than confiscation; that the contract which the telegraph company has with the railroad is for perpetual right-of-way, and not to be disrupted. It is allowed, however, that the railroad company is entitled to the cost of transporting all materials which the telegraph company uses in the construction of its lines. The litigation involved 825 miles of lines built prior to 1892 and now valued at $2,500,000. The lines are on the old St. Paul, Minneapolis and Manitoba road, built prior to 1882, and decided by the court to be held jointly by the telegraph and railway companies.

MISCELLANEOUS.

The Venetian professor Favodo, who is said to be one of the best-read men in Europe in everything concerning Galileo, in the course of a lecture before the Historical Society of Rome, gave the results of his researches into the correspondence of Galileo with his intimate friend, the Venetian patrician, Sanuto. The letters seem to establish beyond question that it was Galileo who first invented the thermometer.

The Trades Assembly of Schenectady, N. Y. declared a boycott on the Schenectady Railway Company, owned and controlled by the General Electric Company, because one of the contractors on the new car barns employed non-union carpenters. The assembly represents 12,000 trades unionists and their families, and many of those who will make the boycott effective are employed by the General Electric Company. The assertion has been made, unofficially, of course, by an officer of the General Electric Company that if the boycott is persisted in the company will shut down its works in Schenectady on January 1st, throwing all its men out of employment.

TRADE NEWS.

The Haschke Storage Battery Company of Chicago, Ill., has been incorporated with a capital of $30,000. The incorporators are Nathan S. Smyser, E. J. Wilber, Jr., and A. H. Kay.

The Electric Specialty Company of 19 and 21 South Jefferson Street, Chicago, has increased its capital stock from $6,000 to $500,000 and intends to equip a large new plant to manufacture staple electrical goods, together with several patented specialties the company has acquired. The directors of the company are H. G. Willard, A. Montgomery Ward, Charles E. Felt, D. Avery Kimbark and John G. Elliott.

The Standard Pole and Tie Company, 44 Broad Street, New York city, announces that within the next week it will move its North Carolina office from Maxton to Wilmington. The company has had its office in Maxton for the last two years, but it now appears that it will be more to its advantage to have this office located at Wilmington. J. W. Davis, who is the manager of that office, has personal charge of the shipment of the octagonal and juniper poles from that section, and he also has supervision over the inspectors who inspect personally every carload of material before it is shipped. The company requests that all communications relative to the purchasing of material be addressed to the New York office of the company in the future, as in the past.

No better evidence can be had of the remarkable success of an electrical manufacturing company than was presented in the recent increase of capital stock of the Cutler-Hammer Manufacturing Company, Milwaukee. This institution, while actually capitalized at $200,000, has been operated for over a year with a capital approximating one-half a million. In view of this large cash investment in the business the Cutler-Hammer company, a few weeks ago, decided officially to increase, therefore, its capital stock from $200,000 to $500,000. This increase was mainly advisable from the fact that the company was desirous of continuing to carry the immense stock of standard apparatus of its manufacture necessary for making immediate deliveries from stock. In addition to the above, the company acquired a large property adjoining its present factory. This additional land is being utilized for a still further extension of the factory, and on it also there has been erected a handsome and commodious office building. This latter structure will be devoted exclusively to the private offices of the company and the clerical and engineering departments. Work on this building has been rushed to such an extent that the company now expects to occupy these new offices within the next few weeks. Incidental to the above, it may also be stated that the Cutler-Hammer company, in the designing and construction of this office building, has exercised most extraordinary care to insure in every possible manner its drawings and special fine tools from the dangers of fire and water. The importance of thus taking every precaution to preserve what is in reality the basis of the company's business will without doubt be fully appreciated by electrical manufacturers employing Cutler-Hammer apparatus in connection with their machinery. The total destruction of the Cutler-Hammer factory, under such circumstances, would, therefore, as far as the purchaser is concerned, only result in a comparatively slight loss of time, for with drawings and tools preserved, apparatus can be easily duplicated.

BUSINESS.

The Electric Appliance Company, Chicago, is directing attention to the Packard incandescent lamps as "quality lamps." It claims that there is an extra quality in the Packard lamps, and that the fact is being discovered by users generally. The increasing output is pointed to as evidence of this.

Norman Marshall, president of the Marshall-Sanders Company of 301 Congress Street, Boston, has just returned to the East from a flying trip to Chicago, where he was engaged in looking after the company's large and increasing business in this locality. The company is pushing vigorously the sale of its rosette plug receptacles, knife switches, sockets, cut-outs and other electrical specialties.

A. E. Whitmore, Minneapolis, Minn., the wholesale dealer in cedar poles of all lengths and sizes, reports a very satisfactory business during the past month. Mr. Whitmore is well and favorably known among users of cedar poles, especially in the Northwest, where many thousands of his poles are in use. He states that he is in a position to make special prices and will be glad to hear from those in the market for poles.

Manager Grosh of the General Electric Company at Salt Lake City, Utah, has closed a third contract with the Bamberger-Delamar Company, amounting to $10,000 for motors of from one to 75 horsepower for the mill at Delamar, Utah, and for a five-ton electric locomotive, to operate in the tunnel. Manager Grosh has also closed a contract with the Sheba Mining Company of Ibapah for a 50-kilowatt, three-phase generator and a 40-horsepower motor. The generator will be driven by a waterwheel, the power being transmitted to the mines to drive the compressor. A three-ton electric locomotive, generator and motor have been sold to the Silver Shield Mining Company of Bingham, Utah.

Charles H. Besly & Co., 10-12 North Canal Street, Chicago, call particular attention to their large and varied assortment of seamless brass and copper tubing. They carry 300 sizes of tubing in stock, varying in size from one sixty-fourth-inch outside diameter to 8½-inch outside diameter. Brass rods, sheet, wire and brazed tubing, braziers, sheet copper, soft and cold-rolled copper anodes, brush copper for electrical purposes, german-silver sheet, rod and wire are also carried in stock. A common expression among their customers is "When you want to get it, go to Besly's." Their new store building on Clinton Street is progressing rapidly and will give them over double the space of their present five-story building on Canal Street.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 11, 1902.

713,050. Automatic Fire Alarm. Frank Bernardin, Antwerp, Ohio, assignor of three-fourths to F. J. Macklin, Garrett Fox and W. H. Murphy, Columbus, Ohio. Application filed April 25, 1902.

The mechanism consists of a ball receptacle, a drop hinged therein a fixed fusible body supporting the drop in a raised position, a ball on the drop, a tube leading from the receptacle to a lower point, and an electric alarm.

713,122. Method of Making Electric Conduits. Amanda M. Lougee, Boston, Mass., assignor to the Clifton Manufacturing Company, Boston, Mass. Application filed December 2, 1901.

The method consists in applying to the interior of the armor a cementitious coating, containing vulcanizing ingredients, forming a lining provided on its outer surface with vulcanizing material inserting the lining within the armor and apolying vulcanizing material, inserting the lining within the armor and applying vulcanizing heat to the whole, thereby incorporating the vulcanizing material in the conduit.

713,123. Electric Conduit. Amanda M. Lougee, Boston, Mass., assignor to the Clifton Manufacturing Company, Boston, Mass. Application filed December 2, 1901.

The conduit comprises an armor having an insulating lining provided on its inner surface with a layer composed of comminuted fire-resisting material vulcanized to hardness at its exposed side.

713,133. Electric Switch. Tage Muller, New York, N. Y., assignor to the Auto-Electric Air Pump Company. Application filed March 13, 1902.

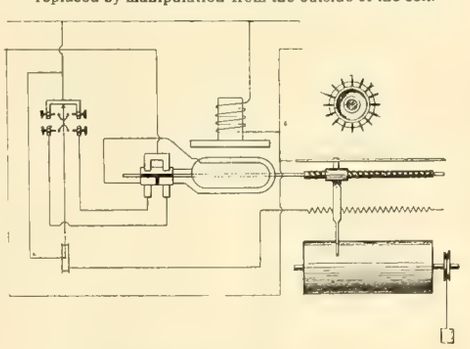
In the switch are combined a stationary electrode, a fluid-actuated member, a pin, a movable electrode and a tilting weight secured on the pin so as to move with the same, and a second tilting weight operated by the fluid-actuated member, mounted loosely on the same pin and adapted to operate the first-mentioned tilting weight and movable electrode on a quick action.

713,140. Process of Distantly Reproducing Pictures. Herbert R. Palmer, Cleveland, Ohio, assignor to the Electrograph Company of America, Cleveland, Ohio. Application filed January 21, 1901.

See page 376.

713,174. Voltaic Cell. Herbert B. Taylor, Newark, N. J. Application filed April 2, 1902.

In the cell are combined a jar or vessel with suitable cover and a container for holding one of the elements, and attached to the cover and having a releasable bottom, the bottom arranged and adapted to be released and replaced by manipulation from the outside of the cell.



NO. 713,257.—RECORDING MEASURING INSTRUMENT.

713,186. Secondary Battery. Robert Welford, Sunderland, England. Application filed November 21, 1899.

A battery electrode comprises the combination of a support formed with corrugations or ribs, a set of rods or prisms of active material placed within the recesses of the corrugations and each provided with a coiled conducting wire extending longitudinally through the same.

713,211. Mounting for Electric Heaters. Edward E. Gold, New York, N. Y. Application filed October 16, 1901.

Combined with an oscillating car seat are a fixed support therefor, the seat extending laterally beyond the fixed support so that there is a free open space beneath the seat, and an electric heater supported by the fixed support and extending laterally beyond the same and beneath the seat whereby the hot air therefrom rises directly about the seat.

713,222. Motor Control. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed January 3, 1902.

A motor is combined with devices for controlling the starting of the motor and means for energizing the devices until the motor has come up to speed and for then maintaining the same de-energized during the operation of the motor.

713,257. Recording Electrical Measuring Instrument. Edward Weston, Newark, and Adelbert O. Benecke, Vailsburg, N. J. Application filed February 10, 1902.

The instrument has a movable part, an electromotive device having its armature connected to the stylus of a time-controlled recording instrument, together with a dampening device capable of instantly stopping the armature of the electromotive device when the circuit is interrupted thereto, in combination with a source of electrical energy and circuits and circuit connections whereby any substantial movement of the movable part of the measuring instrument will cause an accurate permanent record of the nature and duration thereof. (See cut.)

713,258. Recording Electrical Measuring Instrument. Edward Weston, Newark, and Adelbert O. Benecke, Vailsburg, N. J. Application filed February 10, 1902.

An instrument for recording the nature and duration of physical changes is described. It consists of a movable agent or part controlled in its movements by such changes, a power-impelled recording instrument and a motive device mechanically connected to the movable stylus of the instrument, in combination with mechanical and electrical connections between the motive device and the movable agent in such manner that any physical change of the movable agent is accurately recorded as to its nature and duration.

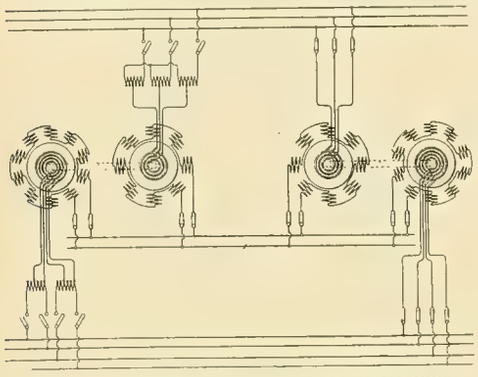
713,259. Recording Electrical Measuring Instrument. Edward Weston, Newark, and Adelbert O. Be-

necke, Vailsburg, N. J. Application filed February 10, 1902.

An instrument for recording the nature of physical changes consists of a movable agent or part controlled in its movement by the combined influence of such changes and one or more permanently acting variable forces as a spring or springs, a recording instrument and a motive device mechanically connected to the movable stylus of the instrument and to the spring or springs, together with a source of electrical energy and circuits and circuit connections between the motive device and the movable agent, whereby any variation of movement imparted to the movable agent is accurately recorded as to its nature and the variable force or forces correspondingly increased or decreased.

713,274. Electric Railway. Frank M. Ashley, Brooklyn, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 26, 1898.

Combined with a main overhead insulated conductor having exposed portions and inclosed in a suitably supported pipe-line having openings opposite the exposed portions are a sectional exposed overhead conductor, the sections of which are movable and normally disconnected from the main conductor, and a trolley carried by the car and adapted to engage with the sections to move them into engagement with the exposed portions of the overhead main.



NO. 713,307.—OPERATING DYNAMO-ELECTRIC MACHINES.

713,277. Electrolytic Refining of Lead and Lead Alloys. Anson G. Betts, Lansingburg, N. Y. Application filed January 9, 1902.

The process of electrodepositing lead consists in subjecting to electrolysis an electrolyte containing in solution a lead compound and a reducing agent capable of restraining the crystallization of the lead deposit.

713,278. Electrodeposited Lead. Anson G. Betts, Lansingburg, N. Y. Application filed October 9, 1902.

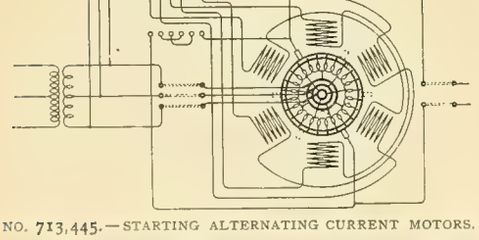
The lead is characterized by substantial purity, coherency, uniformity of structure throughout, and has substantially the density and homogeneity of cast lead.

713,284. Rectifier. Harold W. Buck, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 17, 1898.

The method consists in alternately connecting two sources of alternating electromotive force of the same phase to a work circuit and disconnecting one of the sources from the work circuit after the other is connected thereto.

713,305. Electrical Igniting Device. Clarence A. Holdridge, Chicago Heights, Ill., assignor of one-half to John A. Smith, Chicago Heights, Ill. Application filed September 16, 1901.

The igniter comprises a match and a metallic surface electrically connected, respectively with an electrical generator, the match comprising a tubular metal rod and an absorbent packing contained within the bore thereof.



NO. 713,445.—STARTING ALTERNATING CURRENT MOTORS.

713,307. Operating Dynamo-electric Machines. Frank H. Jeannin, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 28, 1901.

The method of synchronizing sets of direct-connected alternating-current dynamo-electric machines having different numbers of poles consists in connecting together the corresponding members of each set through tension-reducing devices, whereby the resulting flow of current operates to bring the machines into synchronism. (See cut.)

713,326. Maintaining Synchronous Rotation of Dynamo-electric Machines. Edgar W. Mix, Paris, France, assignor to the General Electric Company, Schenectady, N. Y. Application filed October 25, 1899.

The method of checking variations in speed of alternating-current dynamo-electric machines consists in maintaining a local induced circuit in conductors on the armature of the machine.

713,327. Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 27, 1902.

In a multiphase transformer are combined a number of sets of coils, magnetic material surrounding the active portions of the windings of each set of coils, and barriers of incombustible material interposed between the exposed ends of adjacent sets of coils.

713,340. Electromagnetic Brake. William T. Pember, Toronto, Canada. Application filed March 4, 1902.

In the magnetic car-brake described are a bar extending between the wheels on the same side of the car, shoes formed or attached to the ends of the bar, a coil encircling the bar and designed to magnetize and demagnetize the bar and means for hanging the bar so as normally to retain the shoe from contact with the wheels.

713,346. Ground-detector. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 19, 1900.

The ground detector comprises a number of segments related severally to the different wires of a distributing system, a common ground electrostatically related to all of the segments, and a number of index needles, each jointly controlled by a pair of distributing wires.

713,354. Means for Storing and Distributing Gas. George G. Smith, Florence, Italy. Application filed December 12, 1901.

The apparatus has an electric signalling device actuated by the float upon a predetermined change of the volume of gas within the gas reservoir.

713,356. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 6, 1899.

See page 362.

713,365. Electromagnetic Medical Appliance. Francis H. Vollery, Allegheny, Pa. Application filed May 7, 1902.

In the appliance are a source of electric current, a transformer a vibratory diaphragm conducting strings over the diaphragm, and connections arranged to complete the circuit through the parts and the body of the patient.

713,380. Controlling Motors from Distant Points. Norman C. Bassett, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 24, 1902.

Combined with an electric motor are a controller therefor at a distant point a pulley rotated by the motor, a pulley-carrying means for returning the controller to the "off" position, and a rope connecting the pulleys.

713,386. Interior-conduit Outlet Box. Hobart D. Betts, Englewood and Robert M. Thomas, Elizabeth, N. J. Application filed June 25, 1902.

Combined with an outlet box or similar electrical conduit member having an apertured bottom are a threaded stud or receptacle to lie in the bottom aperture, the stud having a flange, head or the like upon the portion outside the box, and means intermediate the box bottom and the head to effect angular axial adjustment of the stud with respect to the box.

713,445. Starting Alternating-current Motors. Thomas J. Johnston, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 8, 1899.

The method consists in starting the machine as an induction machine by closing the armature circuits and opening the connection between the armature and the alternating-current mains, feeding the fields with alternating currents until synchronism is reached or approximately reached, then opening the armature circuits, and feeding the armature with alternating current and the fields with continuous current, thus operating it as a synchronous machine and reversing the relation of induced and inducing members. (See cut.)

713,463. Governor. James A. Lighthipe, San Francisco, Cal., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 26, 1898.

A regulator for prime movers driving dynamo-electric machines is described. It comprises a motor for operating the valve, a source of power for the motor, contacts and connections by which the power is applied to drive the motor in one direction or the other, a coil in the main circuit and a centrifugal governor both operating the contact-maker controlling the motor, whereby the motor is caused to run in one direction by an increase of load or a drop of speed in the prime mover, and in the other direction by a decrease of load or a rise in speed. (See cut.)

713,464. Electric Locomotive. Ellwood C. Lindsay, Philadelphia, Pa., assignor to Burnham Williams & Co., Philadelphia, Pa. Application filed May 28, 1902.

One claim reads: The combination of a frame having bearings, an axle mounted in the bearings having traction wheels and a gear wheel, an intermediate shaft also mounted in the bearings in the frame and having a gear-wheel meshing with the gear on the axle, a motor hung to the intermediate shaft and provided with a gear-wheel meshing with the gear wheel on the intermediate shaft.

713,479. Recording Electric Wave Forms. Edwin J. Murphy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 23, 1901.

The device comprises two resistances mounted to create proportional potential drops in opposite directions of the potential to be recorded, a movable record strip, and means for indicating the shifting point of potential equality in the two resistances.

713,486. Electromagnetic Tool. Robert R. Nicely, Denver, Colo. Application filed March 8, 1901.

The instrument described consists of a shell composed of magnetic metal, a spool of non-magnetic metal located in the shell, a solenoid wound on the spool, a piece of magnetic metal inserted in the shell at one end of the spool and provided with an opening, a tool-holder having a stem passing through the opening and protruding into the spool opening, a vibratory hammer composed of magnetic metal, located at the opposite extremity of the spool, a retracting spring located in the shell and connected with the hammer at one extremity, a plug inserted in the shell forward of the spring, and a screw threaded in the plug and connected with the spring for regulating the strength of the hammer stroke. (See cut.)

713,497. Telegraphy. Henry A. Rowland, Baltimore, Md.; Henrietta H. Rowland, administratrix of Henry A. Rowland, deceased. Application filed June 4, 1900.

In the telegraphic circuit are a main-line conductor and electric generators delivering to the conductors periodically varying electric currents, means for modifying for each signal a predetermined number of the impulses delivered to the line by any generator and means for preserving the electrical properties of the main line intact.

713,500. Electric Time Switch. Madison Rush, Memphis, Tenn. Application filed April 17, 1902.

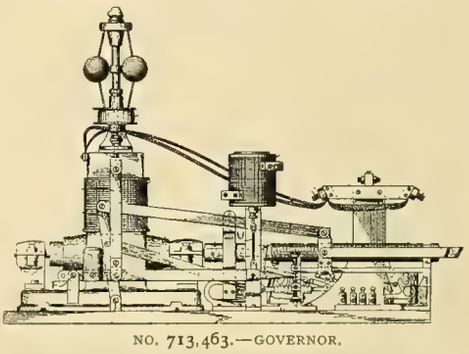
Combined with an electric switch of a clock are a mechanical device having means for automatically opening the switch, a pivoted lever having one arm in engagement with the device for retaining it in a set position and a bar operated by the clock and in engagement with the second arm of the lever, whereby the mechanical device is normally prevented from acting upon the switch.

713,503. Fuse Carrier. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 5, 1901.

The fuse carrier comprises two clamping members of insulating material provided with grooves for the reception of the fuses, and means for clamping the members about the fuses in the grooves.

713,523. Adjusting Compound-wound Generator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 24, 1898.

See page 362.



NO. 713,463.—GOVERNOR.

713,555. Rectifier. Harold W. Buck, Niagara Falls, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed October 17, 1898. Divided and this application filed April 12, 1902.

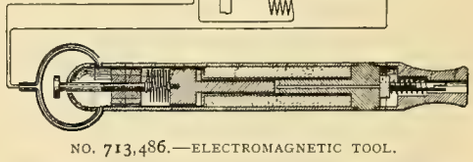
The inventor describes the combination of two sources of alternating electromotive force adapted to be alternately connected to a work circuit and means for connecting one source to the work circuit before the other is disconnected therefrom.

713,564. Electric Meter. Jesse Harris, Rensselaer, N. Y. Application filed January 23, 1902.

One claim reads: In an electric motor having a magnetic field, a conducting movable member within that field, conductors for an electric current, a fluid-conducting body in the circuit, portions of the movable member arranged to make successive electrical contacts with the fluid-conducting body in the circuit the contacts being arranged to produce a continuous unbroken flow of the current, and a counting device operatively connected with the movable member arranged to register its movements.

713,567. Starting Alternating-current Motors. Thomas J. Johnston, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed April 8, 1899. Divided and this application filed April 16, 1902.

Combined with an alternating-current motor of the synchronous type are means for operating the motor at starting as an induction machine, and switching means for converting it into a synchronous motor when the armature has acquired the desired speed, and at the same time reversing the relation of inducing and induced members.



NO. 713,486.—ELECTROMAGNETIC TOOL.

713,568. Non-active Metal for Use in Storage Batteries. Henry H. Lloyd, Germantown, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed June 29, 1900.

A non-active metal for use in and in connection with storage batteries has the qualities of toughness, smoothness, resiliency, and great mechanical strength in proportion to its weight, the metal comprising lead cast with substantially 12 per cent. by weight of antimony and rolled in a cold state.

713,574. Adjusting Compound-wound Generator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed August 24, 1898. Divided and this application filed March 24, 1902.

See page 362.

713,583. Connection for Measuring Instruments. Jonathan E. Woodbridge, Albany, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 26, 1902.

Combined with the mains of a three-phase alternating-current system are a system of Y-connected leads, two transformers for conveying three-phase currents inductively from the mains to the leads, and measuring instruments for one or more of the leads.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, NOVEMBER 29, 1902. No. 22

Randolph Street Rotary Sub-station in Chicago.

The constantly increasing demand for electric power and light in the territory covered by the Chicago Edison Company of this city has kept the company busy for some time past in laying out new generating capacity, designing new sub-stations and properly distributing the load on its system. Within the last few months four new 600-horsepower boilers have been added to the steam plant of the Harrison Street station, bringing the boiler plant of that power house up to its present ultimate capacity of 28 boilers. Contracts have also been let and the foundations are now in for a new 2,500-horsepower generating unit for this station. The unit will consist of a vertical-compound Allis-Corliss engine, direct-connected to a General Electric 25-cycle, 9,000-volt, three-phase alternator. In addition to this new work of a generating nature, and the new 100,000-horsepower Commonwealth station now building at Fisk Street, which has been previously mentioned in these columns, the company's distribution system is being greatly extended and enlarged. In the Western Electrician of January 4th a comprehensive account was given of the work then in hand by the Edison company. Since that time the company has placed in complete or partial operation in various parts of the city five new rotary sub-stations and four new storage batteries of approximately 3,000 kilowatts' capacity at a 1¼-hour rate of discharge. In addition to these new installations, the capacities of two existing storage batteries have been increased to the full capacities of the tanks.

The most important and by far the largest of the new rotary sub-stations now installed or in the process of installation is that located in the basement of the Masonic Temple at the corner of State and Randolph Streets and known as the Randolph Street sub-station. Considerable interest attaches to this station for many reasons. In size, it will be the largest sub-station in the city, having an ultimate capacity of 6,000 kilowatts, making it, in all probability, larger than 95 per cent. of the central stations in the country. The fact that the station is located in the Masonic Temple, one of the largest and best-known office buildings in the West, also attracts attention to the plant. The next largest rotary station in Chicago is that known as the Dearborn Street sub-station, which was described in the Western Electrician of January 4th. This latter station has a capacity of only one-half that of the Randolph station, and the fact that the stations are only a little over three blocks apart and that the equipment is in the chief particulars identical cannot help but impress one with the extent to which the Edison company's business has expanded in this locality of the city.

The Randolph station is located in a room at the southwest corner of the basement that was formerly used for restaurant purposes. The room has about 6,000 square feet of floor space and is completely isolated from the rest of the building. The room, as well as the whole building, is entirely fireproof and every precaution has been taken to provide against fire or accident. The station will have an ultimate capacity of 6,000 kilowatts, divided into 12 rotary-converter units of 500 kilowatts each. At present there are five of these rotaries installed, as may be seen in Fig. 1. The general layout of the station is indicated in the floor plan, Fig. 2, on the next page. Eight of the rotaries are to be set side by side, in the center of the room, and feed into two Randolph Street switchboards, and the remaining four will be placed at the west or State Street end of the room, with a separate switchboard for their control. The 12 units will be divided into three groups of four rotaries each. Each group will be controlled by a separate switchboard and operated from a separate high-tension line that will run directly from the Harrison Street station, and ultimately from the new Fisk Street station of the Commonwealth Electric Company. This arrangement is made so that in case anything happens to one transmission line or one group of rotaries, the others may be continued in operation independently. This arrangement also renders it possible for each transmission line to be fed by a separate generator, thus making the service still more reliable, reliability of service being absolutely necessary, and therefore a most important end to be attained in central-station service. The three groups of rotaries are also arranged so that they can be run in parallel.

The three transmission lines enter the station at the southeast, southwest and northwest corners of the room, as indicated in Fig. 2. Each line consists of a No. 0000 cable, and carries a three-phase, 9,000-volt, 25-cycle current. The line passes through a brick-compartment oil switch soon after it enters the room and is then carried to four oil switches of the triple-pole, single-throw, G. I. type A, each of the switches controlling a single rotary through a bank of three transformers. Between the sets of four switches are placed three tie switches of the same type. By means of these tie switches and a long bus cable on the south side of the room the three groups of rotaries can be all thrown together, or any group can be run from either one of two lines. These 15 rotary and tie switches are mounted along the walls of the room on skeleton angle-iron framework, so arranged that the switches are readily accessible for cleaning, inspection or repair. A portion of one of these structures is shown at the right in Fig. 3.

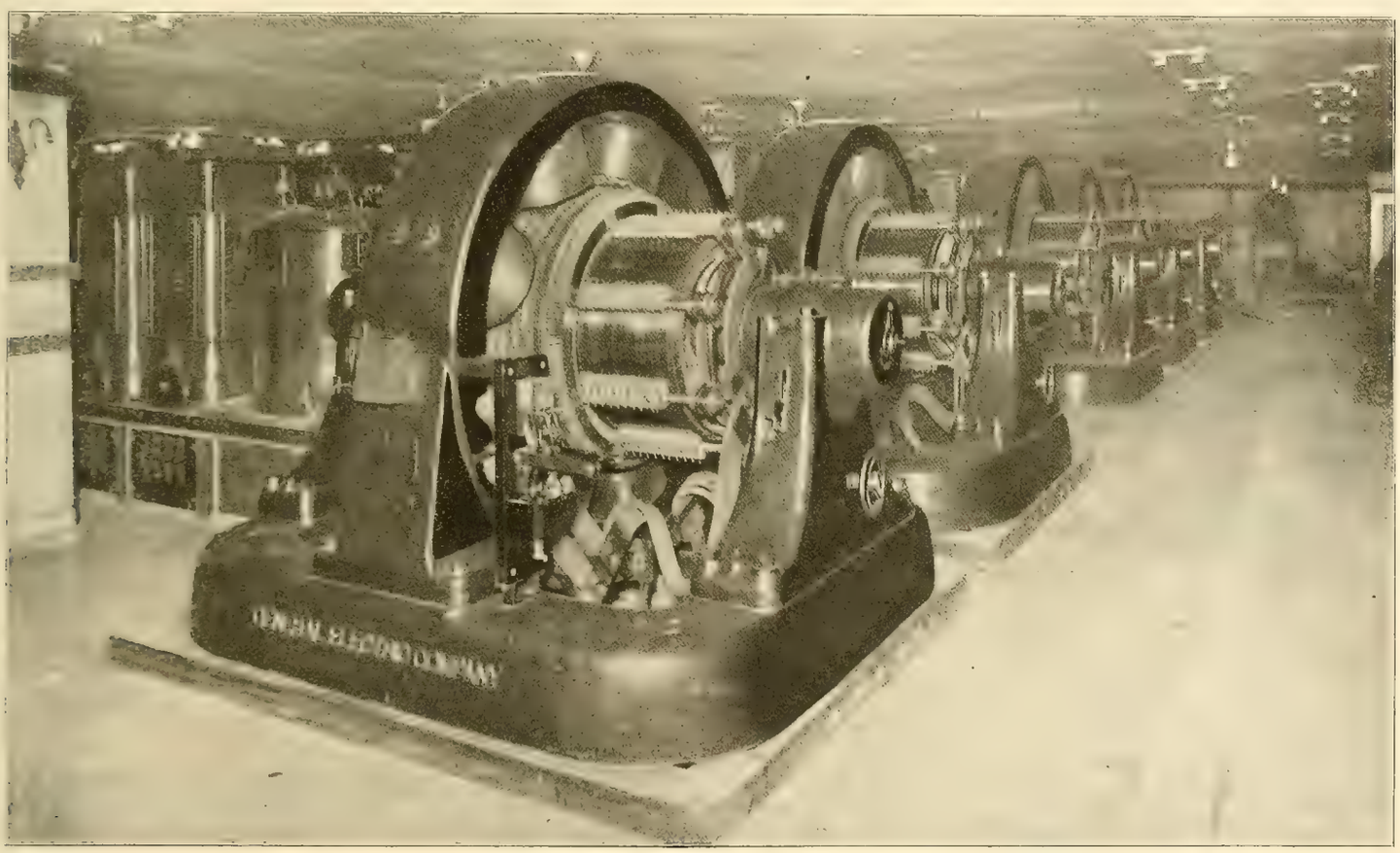


FIG. 1. RANDOLPH STREET ROTARY SUB STATION IN CHICAGO. GENERAL VIEW OF STATION.

From each oil switch the line is carried to a set of three 185-kilowatt air-blast transformers, connected in double delta and delivering a six-phase current to the rotary at 170 volts. Each rotary is a 500-kilowatt, eight-pole machine and delivers a normal direct current on the commutator end of 240 volts. Each rotary has a 65-kilowatt, air-blast, motor-operated potential regulator, by means of which the normal voltage can be raised or lowered approximately 15 per cent. The transformers and regulators are raised on a platform so as to provide an air chamber, the blast for each two banks of transformers and the two regulators being supplied by a 70-inch American blower, belt-driven by a 10-horsepower, 220-volt, direct-current motor. One of these blower sets is shown in Fig. 3, which also illustrates a regulator and set of transformers. Eventually the blowers are to be directly connected to the motors, as indicated in Fig. 2. The ultimate completion of the station will also call for a balancing set, consisting of a 100-kilowatt rotary converter, with its oil-cooled transformers and potential regulator. This rotary will be equipped with a two-

pole, double-throw switch, so it can feed into the positive or the negative side of the three-wire Edison distribution. By this means any unbalancing of the load on the system may be easily and quickly provided for.

As mentioned above, each group of rotaries feeds into a separate switchboard. The two switchboards on the Randolph Street side are shown by front and rear views in Figs. 4 and 5. The wiring arrangements of all the boards are the same, so that of one only will be described. In this connection the wiring diagram, Fig. 6, will help greatly to explain the connections. Each rotary has a separate panel, and the cables are run to the board in trenches divided by brick partitions, so that the wires from only two rotaries are laid together. For this reason only two rotaries can be put out of service at a time by defects in the cables. The complement of switches and instruments on each rotary panel is as follows: One indicating wattmeter, one power-factor indicator, a direct-current ammeter with reverse-current attachment, oil-switch control, green and red pilot lamps to indicate whether this switch is open or closed, a synchronizing switch and synchronizing lamps, regulator switch, two positive 1,250-ampere main switches connected in parallel, two negative 1,250-ampere main switches connected in parallel, one 250-ampere fused switch in series with the starting switch to protect the unit at starting, and a field switch.

On the frame of the rotary is mounted a 2,500-ampere automatic machine circuit-breaker. The direct-current ammeter, with reverse-current attachment spoken of, which reads current flowing in either direction, indicating current, therefore, at starting as well as under normal operation, is connected through a 220-volt lamp and a relay operating on 0.06 ampere of current, both mounted on the machine. Should a heavy short-circuit occur on the alternating side of the machine the direct-current side of the Edison system, including especially the storage batteries, would reverse and drive the rotary, thus feeding into the short. To prevent this contingency, this device has been arranged. When the current reverses a pointer with platinum contacts in the direct-current ammeter closes a circuit through the lamp, which serves as a resistance, and operates the relay, which in turn releases the tripping device of the machine circuit-breaker, thus opening the circuit and cutting out the machine. As a precaution against excessive speed there is arranged on the shaft of each rotary a mechanical speed-limit device, which is also designed to close the circuit through the tripping device of the circuit-breaker when the speed, in case of an accident, has reached a dangerously high limit.

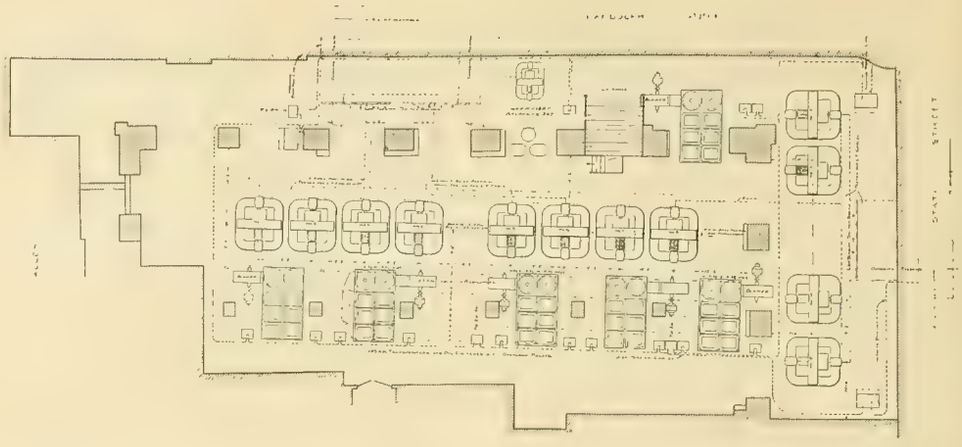


FIG. 2. RANDOLPH STREET ROTARY SUB STATION IN CHICAGO.—FLOOR PLAN.

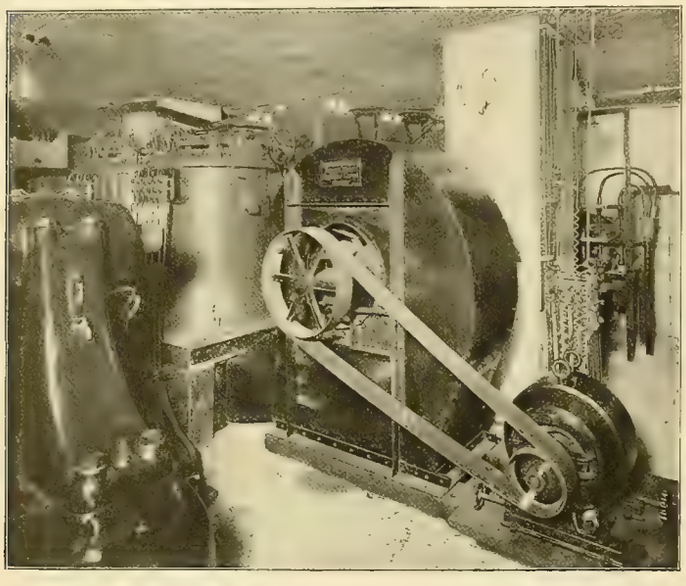


Fig. 3. Regulators, Transformers, Motor-driven Fan and High-tension Cabling.

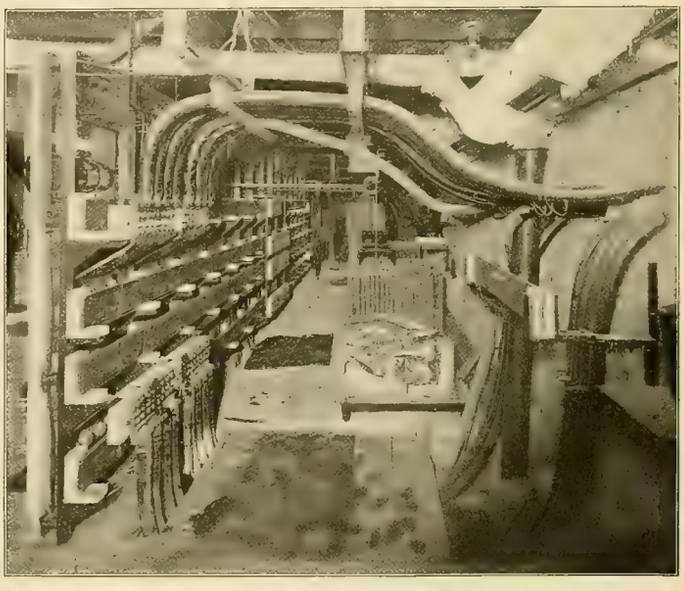


Fig. 5. Rear of Switchboards.

RANDOLPH STREET ROTARY SUB-STATION IN CHICAGO.

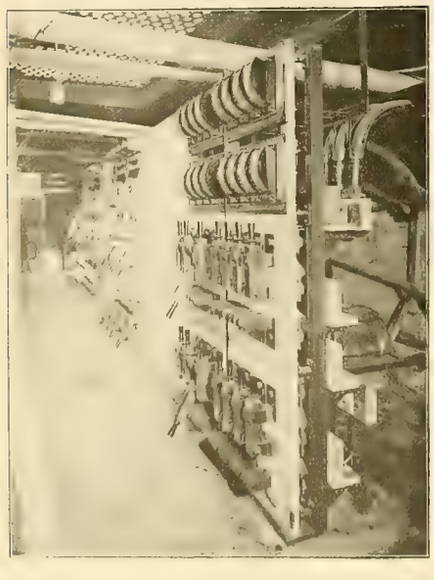


FIG. 4. RANDOLPH STREET ROTARY SUB STATION IN CHICAGO. FRONT OF SWITCHBOARDS.

At the rotary is located a terminal board to which are run all the pressure and auxiliary wires from the current and potential transformers, the oil switch, the overload coils, etc. From this board they are carried in a No. 14 19-conductor, lead-covered cable to another terminal board mounted on the back and at the top of the rotary panel of the switchboard. From this latter board the 19 conductors are run to the regulator switch, direct-current ammeter, power-factor indicator, indicating wattmeter, rotary operating switch and synchronizing switch, there being three spare wires left for future use. All pressure wires on the back of the board are of No. 12 hard-drawn copper, rubber-covered wire.

On the pressure panel or starting panel of the switchboard are mounted an alternating-current voltmeter, a pressure switch, a Lincoln synchronizer switch, a tie switch and two starting switches. On each feeder panel there are provided controlling devices for four feeders, each set comprising two ammeters and two 2,000-ampere, single-pole, double-throw switches. The two Randolph Street switchboards, as shown in Fig. 4, consist of eight rotary panels (some of which are still blank), four feeder panels, one pressure panel and one blank panel, 15 panels in all. The construction of the switchboard possesses many practical features that are embodied in all the Edison sub-station boards as an aid to the standardization of the supplies and construction. The marble panels are supported by an angle-iron frame, but are separated from the frame a distance of 3½ inches by iron spacers, thus leaving ample room for the running of the pressure wires and synchronizing buses from the terminal boards and between the panels in the safest possible manner. There are four buses, the main and auxiliary positive buses and the main and auxiliary negative buses. Each bus is set out from the marble on iron brackets supported by the iron frame. The positive cables are carried overhead and the negative cables under the slate floor to the conduit in the street. The neutral feeders come in from the street and terminate in a separate bus, located on the outside wall, as shown at the right in Fig. 5.

The Randolph Street sub-station is located in the center of a heavy and growing load in the northeast part of the business section, covered by large mercantile and office blocks. Provision has been made for a distribution from this station of a large number of feeders of 1,500,000 or 2,000,000-circular-mil capacity. The largest single customer at present that is benefited by this new station is Marshall Field & Co., whose immense mercantile establishment, as noted in the Western Electrician of September 13th, requires an enormous amount of current. This firm will eventually take one-fourth of the ultimate output of the Randolph station and also a large proportion of the output of the Dearborn Street sub-station. The Field buildings take their power from these services through 26 separate switches, located at 14 different points, and the system is provided with throw-over arrangements, so that the current can be supplied from either of the two sub-stations or the regular underground Edison distribution.

The great security given by the Edison company to its heavy customers along State Street is shown by the location of these two large sub-stations so close to each other, they being only 1,500 feet apart. In the new Randolph station, as well as in its other sub-stations, the company has taken extreme precautions of safety, no expense being spared to have the plants thoroughly fireproof and practically secure from accident. The switchboards, as well as the other electrical features of the station, are the result of a gradual development that is continually going on and which has as its end improvement in the character of the work. All the rotary, transformer,

regulator and most of the switchboard equipment in the Randolph station is of the General Electric Company's manufacture, while the high and low-tension switching apparatus is of the General Incandescent Arc Light Company's make.

British and American Pacific Cables.

After much uncertainty and delay, the all-British Pacific cable is finished. It may be of interest to know a bit of the history of this great undertaking and in that something of the men who have been foremost in its making. Numerous congratulatory telegrams have been flashed over the line since its completion, praising those whose efforts have gone to aid in the success of this great British achievement. It is gratifying to notice that among these compliments the name of Sir Sandford Fleming, as the originator and promoter of this work, has not been forgotten. In the hour of accomplishment, it not unfrequently happens that this fact of itself overshadows everything else, and that the long period of earnest work which may have been devoted to rendering such achievements possible, and to which their ultimate success is mainly due, is relegated to oblivion.

For the last 18 or 20 years this project has been in existence, in pretty much the same shape as that in which it has at last been realized. In 1886 an offer was made to undertake this work for a payment of a total annual subsidy of $500,000 for 25 years, to be divided in determined proportions between the home and colonial governments. Even then, the question of the benefit to be derived from an imperial guarantee, as opposed to the guarantee of each colony separately, was raised, and it was pointed out that should the British government become responsible for the payment of the whole amount on behalf of the colonies, the subsidy asked would be reduced to $400,000 per annum. A similar point was raised after the issue of the report of the colonial secretary on the "Pacific Cable Commission" in 1899, when it had again to be pointed out that the money for such a purpose could be borrowed at a very much lower rate of interest on an imperial guarantee, than would be the case if it were dependent on the guarantee of each colony separately, a method of finance which was adopted after some delay. The story abounds in delays, and it should be remembered that at each check effected by the opponents of the Pacific-cable project, a considerable time, sometimes years, had to elapse before the truth could be elicited. This is not difficult to realize when it is remembered that the various governments interested are scattered over the globe, and that not infrequently, inter-colonial jealousies have stood in the way of joint action.

It may not be out of place to give an example of this. At the colonial conference of 1887 the chairman of the Eastern company declared the bed of the Pacific to be covered with coral patches fatal to the life of a submarine cable, and the postmaster-general of South Australia, interested in the eastern route on account of the land lines owned by his government, gravely announced the depth to approach 12,000 fathoms, or 14 statute miles. As a matter of fact, the greatest depth of the present cable is only 3,200 fathoms, and the average depth 2,700 fathoms. In the face of such statements the colonial delegates could only pass a resolution to the effect that the Pacific cable was a "project of high importance to the empire, and every doubt as to its practicability should, without delay, be set at rest by a thorough and exhaustive survey." With this object in view they wrote a letter to the secretary of state for the colonies, Sir Henry Holland (afterward Lord Knutsford), asking him to cause the survey to be made. Sir Henry Holland's reply proved a model of diplomatic evasion. It was to the effect that the survey could not be made unless there was a prospect of laying the cable. This answer being equivalent to the well-known advice not to enter the water until one has learned to swim, left the delegates on the horns of a pretty dilemma. However, the Postal Conference at Sydney in 1888 renewed the request, and it was arranged that the Egeria, on a three years' commission to survey the Pacific Ocean, should take soundings along the route between New Zealand and Vancouver.

The above only cites one instance, says the London Electrical Review, of the many obstacles which had to be overcome before it became possible to advance this important project. Again the delegates at the conferences not being technical men, had to take their information from sources on which they might fairly expect to rely. As may be imagined, these sources were rather few and their information limited. A considerable amount of the delay was also due to the egregious estimate of cost furnished by the home postoffice officials, who estimated the cost of a Pacific cable at $16,320,000, as against a tender of $7,585,000, sent in by the Silvertown company.

Those who have followed the matter closely can be at no loss to understand the causes of the delay in bringing this work about. Apart from the instances referred to above, the vested interests involved were of such an important character, that it is hardly to be wondered at that almost everything was done that could possibly be done to avert or destroy the scheme. That the action taken by the companies concerned was injudicious, to say the least of it, even as far as their own real interests were concerned, has often been pointed out, and experience has shown, as the years went on, and as fresh developments in cable routes were effected, that the conservatism of the opposing companies was built upon a foundation of prejudice, and of ignorance of their own real interests. The finishing of this cable marks a greater step in the advancement of science than it has been the will of the public to note.

It is announced that when the cable is opened for business on December 8th the rate will be 58 cents a word for commercial and 20 cents a word for press dispatches from all points in Canada to all points in Australia.

A recent conference held at the Department of Justice, between Attorney-general Knox, representing the United States government, and Clarence W. Mackay, president of the Commercial Pacific Cable Company, George G. Ward, vice-president, and William W. Cook, general counsel for the company, practically speaking, cleared away all obstacles to the success of the American Pacific-cable project through an agreement entered into by the government and the cable company. It has been settled for some time that the Mackay company would construct a cable from San Francisco to Honolulu—in fact, it is announced that the laying of this section will commence on December 5th and that Christmas greetings may be sent to Honolulu. The principal difficulty between the cable company and the government has been in relation to a cable from Honolulu to Manila, with connections to China, and this difficulty has now been practically adjusted.

The cable company, on its part, wanted the government to turn over its cable soundings from Honolulu to Manila. These soundings were taken by the Nero, and are absolutely necessary to any company proposing to lay a cable between the two points. The cost of the soundings was approximately $150,000, and the time necessary to make them was about one year. The government has all along been willing to turn over the soundings to the Mackay company, provided it would make concessions to the government on cable rates, which it agreed to do, and would also agree to construct an all-American cable, not only from the United States to Manila, but to China as well.

To all of the conditions the cable company some time ago agreed with the exception of two provisions. The first of these was that the cable company make a connection of its own between Manila and China. That provision would have been accepted some time ago, but for the fact that the cable company was unable at the time to get a concession for making a landing at Hongkong, the point named by the United States government at which a landing should be made. Negotiations have been going on, however, and recently these were brought to a close by the cable company, resulting in a concession being granted for a landing at Shanghai, which is 1,200 miles from Manila. The company promises to have the Manila-Shanghai cable in operation within one year, and the whole line from San Francisco on is to be finished at about the same date.

It is considered important that the eastern end of the American-Philippine-Chinese cable line should be at Shanghai, on account of the growing importance of that port in a commercial way.

The second point upon which there is a disagreement was a stipulation that the cable company should be an all-American line, and should make no connections with any other companies except American companies. As the officials of the cable company read this provision they understand it to mean that they are prohibited from making connections with the land lines in China, thus barring the new company from communication with the interior of the Chinese Empire. The officers, therefore, ask that this provision be changed so as to make it clear that they will have the right to make traffic arrangements with the Chinese land lines, and thus reach points in the interior of the Chinese Empire. The attorney-general has promised to bring this matter to the attention of President Roosevelt, and have the change made at an early day, so that there need be no further delay in commencing work upon the construction of the cable for the long stretch.

The Rockford-Freeport (Ill.) electric railway is now an assured fact. Right-of-way is being secured and material and rails have been ordered for same.

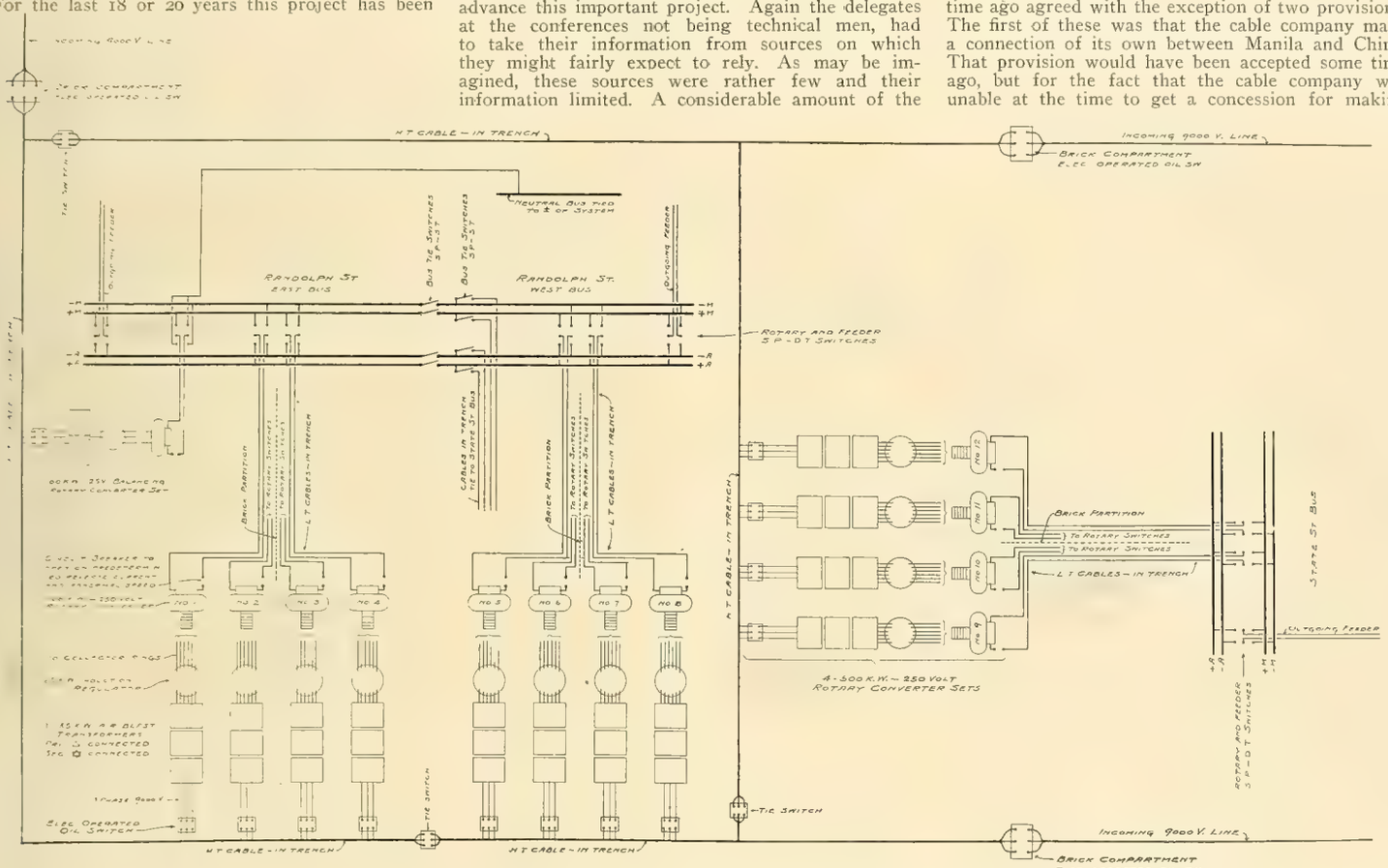


FIG. 6. RANDOLPH STREET ROTARY SUB STATION IN CHICAGO.—WIRING DIAGRAM.

ELECTRIC VARIABLE-SPEED CONTROL.

PART I.

The American Institute of Electrical Engineers held its one hundred and seventieth meeting in New York city on November 21st. President Charles F. Scott of Pittsburg presided, and after an announcement of new members, he stated that the board of directors had decided to issue the bound papers and discussions of the association for the last year in two volumes instead of one. The last volume had contained 920 pages, while this year's would have over 1,600 pages. President Scott then introduced the subject of the evening, "Electric Variable-speed Control," with the following remarks:

The applications of electricity lead to the revolution of old methods as well as to the evolution of new ones. Electrical apparatus not only replaces that which it supersedes and performs the work more efficiently, but it also broadens the field and

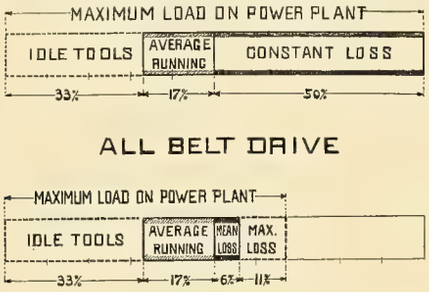


FIG. 1. OPERATION OF MACHINE SHOPS BY BELT AND INDIVIDUAL DRIVE.

leads to developments which were impossible by former methods.

In a sense speed variation is a purely mechanical matter. The two factors which determine mechanical work are speed and torque. The relations between speed and torque may be varied in definite ratios by means of belts and pulleys or by gearing. There is, however, no general mechanical solution of the mechanical problem of speed variation, or variable-speed control.

On the other hand, speed variation by the electric motor can be so successfully effected that it is quite common to think that the whole problem should properly be turned over to the electrical engineer.

Electric motors for continuous current may be divided into two general types, represented by the series motor, in which the speed varies when the load changes, and the shunt motor, which, in general, has a speed which is constant with different loads. The series motor is particularly adapted for railway service, crane service and the like. The shunt or constant-speed motor may operate at the same speed at all times, or the speed may be changed at the will of the operator, and the motor will then run at the desired speed, independent of the load. A constant-speed, direct-current shunt motor is to be preferred, per se, to a variable-speed motor.

The alternating-current induction motor, like the shunt motor, is inherently adapted for constant-speed

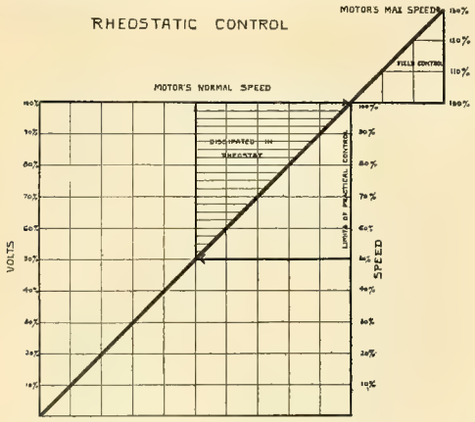


FIG. 2. OPERATION OF MACHINE SHOPS BY INDIVIDUAL MOTORS.

service. It may be used also for variable-speed work with characteristics analogous to those obtained with the rheostatic control of a shunt motor with unvaried field. It may also be wound so that either of several numbers of poles may be used, thereby securing either of several definite speeds which are sensibly constant with varying load. Just as a shunt motor may be operated at different speeds from generators giving different voltages, so the induction motor may be operated at different speeds from generators giving different frequencies. The single-speed induction motor is, however, the type usually used.

In selecting the apparatus for a new plant it is proper to consider the problem as a whole, to take a general view before concentrating attention upon specific parts. What proportion of the power is to be supplied at constant speed? What proportion of the variable-speed work cannot be served satisfactorily from a constant-speed drive with variable-pulley ratios or variable-gear ratios? What proportion of the work which requires delicate speed adjustment falls within the range of simple and satisfactory mechanical speed-changing devices? What advantage in lessened cost of equipment will be secured by group driving, by furnishing a single large motor for delivering the average power required by a number of machines instead of a large number of small motors each for delivering the maximum power of the machine to which it is connected? What advantage will there be under the particular surroundings of the installation in reducing the complication and the amount of auxiliary apparatus and putting in motors of the simplest possible type? Taking the plant as a whole, what are the general advantages of one type of apparatus over another, and does the general balance sheet show that the advantages of individual-speed control by means of the motors themselves are of sufficient moment to dictate the whole scheme and plan for the whole installation? The varying answers which will be given to these questions in different cases will necessitate different solutions to the problem of selecting the best system.

Seven papers were then presented, abstracts of which follow.

THE OPERATION OF MACHINE SHOPS BY INDIVIDUAL ELECTRIC MOTORS.

BY R. T. E. LOZIER.

The individually applied motor is now accepted as an established feature of every machine shop. From the data that has been collected on power transmission in industrial shops, it appears that if a certain maximum horsepower is required by all the tools of a shop, say, 100 horsepower, it will require at least 100 horsepower additional to transmit this effective power by belts and shafting. This loss of 100 horsepower remains constant whether the effect-

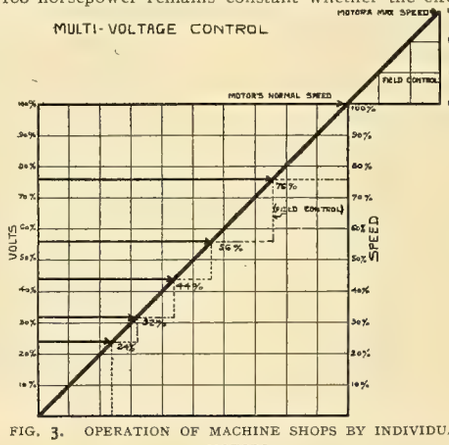


FIG. 3. OPERATION OF MACHINE SHOPS BY INDIVIDUAL MOTORS.

ive horsepower is reduced or not. This means that 200 horsepower must be generated. Should these same tools be driven by individual motors, instead of 100 horsepower being required for transmission, only 43 horsepower is required, even if every tool is running; but it is found that in the average industrial shop every tool is not running at the same time, some being shut down and others operating on lower than maximum speeds, thus requiring less horsepower. It has been determined practically that in the ordinary manufacturing establishment the mean effective power is but 30 per cent. of the total aggregate effective power which is required when all the tools are running at maximum load. This percentage is termed the load factor. In the case of belt-drive there is, then, 100 horsepower assumed loss for 100 horsepower effective load; that is, an efficiency of 50 per cent. Applying the load factor as above, it is found that there is but 30 mean horsepower to use and that it requires 100 horsepower to transmit it, thus giving the real efficiency as only 23 per cent. With the individual-motor drive the loss varies with the load. Taking the same load factor, and assuming 30 per cent. as representing the loss incurred by the 30-horsepower effective load, there is but nine horsepower loss against 100 horsepower with the belt drive. Thus, with individual drive, there is generated 39 horsepower, of which 30 is effective, giving an efficiency of 77 per cent. against 23 per cent. by the shaft and belt method. A graphic demonstration of the foregoing is to be found in Fig. 1.

To control the speed of a motor, it is necessary to apply to the armature terminals, a voltage corresponding to the speed desired. This can be accomplished in several ways:

The Rheostatic Method.—In this case the current is generated at any common source of supply at a fixed pressure or voltage. Before reaching the motor, it is passed through a resistance, which is adjusted to consume just so much of the pressure as will reduce the speed of the motor to the point desired. This method has three limitations, viz.: (a), that if the load put upon the motor varies, the portion of the voltage consumed in the rheostat is altered, and this changes the speed of the motor, a thing which may not be desirable; (b), the system is inefficient, because that percentage of the voltage which is consumed by the rheostat represents a dead loss; and (c), the dimensions of the rheostat necessary to dissipate the energy may reach an inconvenient size. Within its limitations, however, the rheostat system of control can be made very useful. Fig. 2 is a diagrammatic explanation of this system. It will be seen that the motor cannot be reduced from its normal speed more than 50 per cent., because

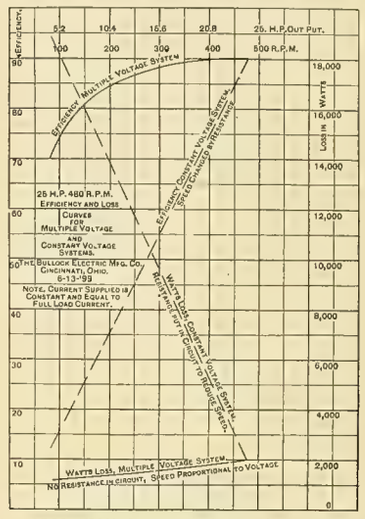


FIG. 4. OPERATION OF MACHINE SHOPS BY INDIVIDUAL MOTORS.

below that point the fluctuations in speed, due to variations in torque, are too great.

Multi-voltage Method.—This method consists essentially in supplying the motor with as many different voltages as are necessary to cover the desired range of speed. In its simplest form this method consists of generators, each adjusted for different potentials. This, however, is not necessary, because it has been found that where several motors are involved they will balance up against each other in such a way as to divide among themselves the full voltage, so as to give the respective desired speeds. It is, therefore, only necessary to supply the main generating plant with a small balancer to take up any differences that there may be. By dividing the voltage at three points, there are six possible combinations, which successfully cover the full range of speed as far as general requirements are concerned. The advantages of this system are: (a), that any one of the lower steps can be maintained constantly and quite independent of variations in the torque or load upon the motor—this is absolutely essential to successful tool operation; (b), that the system is highly efficient; (c), that appliances to control it are of very small dimensions and convenient to operate (see Figs. 3 and 4).

Special Methods.—In this class are to be found various methods which have been devised to meet the special requirements of some one power application. In this class is to be found the teaser system. Fig. 5 has been designed to take care of unusually heavy starting conditions, such as are to be found in large printing presses. In such cases they can

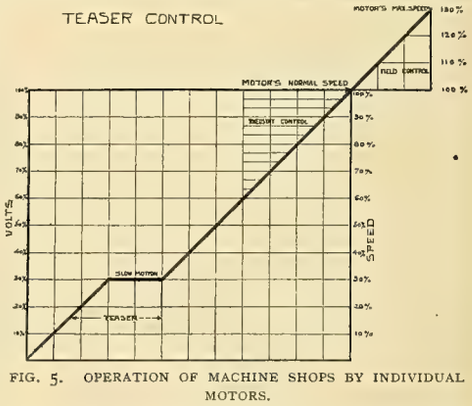


FIG. 5. OPERATION OF MACHINE SHOPS BY INDIVIDUAL MOTORS.

also be operated at a very low rate of speed. The method consists essentially in employing a small motor, which takes current from the main source of supply at the full voltage. This motor drives a small generator wound with large current capacity, which it supplies to the main working motor, when the latter starts, but at low voltage, because the speed is very slow. It is because of the latter fact, and, further, because it is in service for so small a space of time that the apparatus can be made small.

Field Control.—The foregoing methods vary the voltages applied to the terminals of the motor armature. There is a method of changing the speed by varying the field strength of the motor and in that way changing the counter-electromotive force at a given speed electromotive force. This has two lim-

itations: (a), the first one met with in practice, viz., that as the field of the motor is weakened it goes farther and farther off from its electric balance, and its distress is soon evidenced by sparking at the commutator, due to reaction of the armature upon the weakened field; (b), the torque will fail, if the field is weakened beyond a given point. Generally speaking, it is well to understand that field control, while most useful within its limitations, cannot be successfully carried beyond such limitations, and, generally speaking, such limitations represent an increase of not more than 30 per cent. of the normal speed of the motor. It must always be remembered that field control increases the normal speed of the motor and does not decrease it.

In combination with the multi-voltage system—which is available for producing certain speeds that remain constant, even with varying torque, throughout the entire range—can be used the rheostatic control for reducing any one of the fixed speeds down to the next fixed speed. Field control can also be used for increasing any one of the fixed speeds, up to its next graduation. By these means, speed increments as finely divided as one pleases can be obtained, that will carry the speed of the motor from zero to maximum, with high efficiencies and practical constancy at any one point, despite varying torque. The multi-voltage is depended upon to form the framework of the speed control, while the rheostatic and field control supplies the detailed elaboration, where such may be necessary. The multi-voltage is carried throughout the entire plant, usually by two conductors in addition to the two main circuits, while the rheostatic and field control is applied locally as circumstances may require.

Electrically Operated Coal Hoist Having Variable-speed Control.

BY P. O. KEILHOLTZ.

The use of electric machinery for coal hoisting has many advantages over steam machinery when the hoist is considerable. It has also the advantage of less cost of operation and maintenance. Its initial cost, however, is greater. There are two distinct operations in coal hoisting—raising the loaded shovel and lowering it empty. All that is required for raising is a smooth acceleration for closing and raising the shovel, and full power application as long as possible in order to decrease the time of hoisting. Full power application can be continued longer with an electric hoist than with steam, owing to the less inertia of the former. A smooth acceleration is required because the cables are without stretch and for very high hoists would introduce objectionable strains in the structure or damage to the gearing. It is in lowering the empty shovel that the

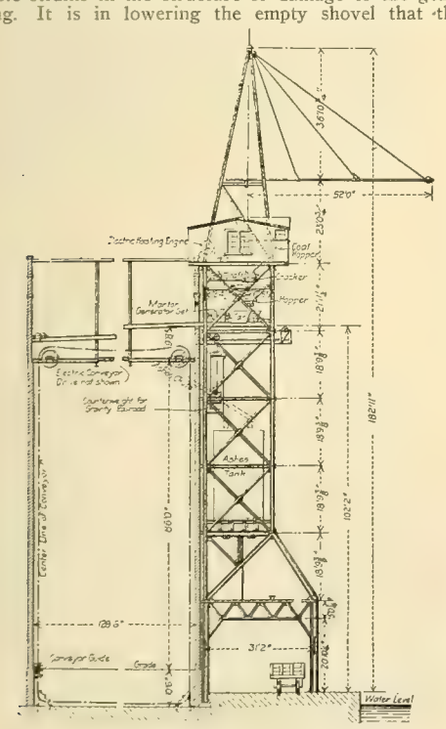


FIG. 6. ELECTRICALLY OPERATED COAL HOIST, HAVING VARIABLE-SPEED CONTROL.

electric hoist has marked advantages. With the electric hoist, owing to the perfect reversibility of the electric motor, the motor is used for braking, as a generator having a separately excited field and driven by the weight of the descending bucket. In its armature circuit is a rheostat to dissipate the heat generated. It is at once apparent that this heat dissipation can be better accomplished with a rheostat than with a brake band.

The Ward-Leonard system of control is used and the apparatus consists of a motor-generator set and a hoist motor, which receives its power from the motor-generator set, the motor of which is supplied with 550-volt direct current. The field of the generator is separately excited, and its strength is controlled by the operator by means of a foot-operated rheostat. The field of the hoist motor is excited by the 550-volt, direct current. By means of a double throw, three-blade switch the foot rheostat is cut out of the generator-field circuit and cut into the field circuit of the hoist motor, and the armature leads of the hoist motor cut from the armature circuit of the generator to the rheostat.

Fig. 6 is a sketch of the coal-hoisting tower. Fig. 7 shows a wiring diagram. The following are data of the test:

Weight of coal hoisted, average of seven shovelfuls ..... lbs.,	2,337
Weight of shovel, empty ..... lbs.,	2,900
Total weight, lifted exclusive of weight of ropes ..... lbs.,	5,237
Average lift ..... feet,	126
Readings of main motor—	
Volts	540
Average current in amperes to close shovel	57
Maximum current in amperes to close shovel	73
Average current in amperes to raise loaded shovel.	189
Maximum current in amperes to raise loaded shovel	243

Field current, not included, in above, 2.8 amperes.

It took 11 seconds to close the shovel, and from the distance-time curve 26 seconds to close the shovel and raise it to the dumping hopper. Therefore, 15 seconds is the time taken to raise the loaded shovel; and as the lift is 126 feet, the average velocity is 8.4 feet per second.

$$\text{The efficiency is, } \frac{\frac{8.4 \times 5237}{550}}{\frac{189 \times 540}{746}} = 58\tfrac{1}{2}\%.$$

The performance test showed: Coal lifted, tons, 101.86; time, minutes, 87.33; rate, 70 tons per hour.

Three-wire System for Variable-speed Motor Work.

BY N. W. STORER.

Omitting cranes, street railways, hoists and other classes of service, where the series motor with rheostatic control is used, we find that variable-speed motor work may be divided into three classes:

(1) Machines requiring a torque increasing with the speed. Blowers and fans belong in this class. The power required for the machine increases very rapidly as the speed increases, and great care should

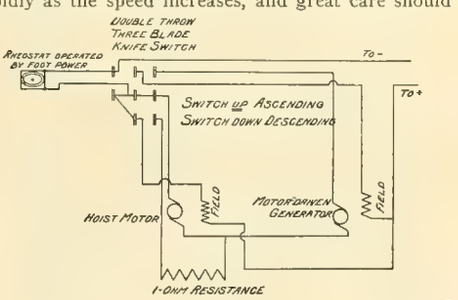


FIG. 7. ELECTRICALLY OPERATED COAL HOIST.—WIRING DIAGRAM.

be exercised in selecting motors for such service. However, as the variation required is usually small, the requirements can be met with standard motors on a single-voltage system. Motors should, preferably, be compound-wound and the speed should be varied by means of a resistance in the shunt field.

(2) Machines requiring a constant torque. In this class pumps and air compressors are the most conspicuous examples. The speed variation required for such service is usually small, and it is generally best and most economical to supply compound motors and to vary the speed by means of the shunt-field rheostat, as in the case of the fans and blowers. A series winding is especially beneficial for this class of work in preventing the heavy fluctuations of current that would take place with a constant-speed motor in passing through the different parts of the cycle. A compound motor may be used for this work, because a constant speed at any point on the controller is not necessary.

(3) Machines requiring approximately the same maximum output at any speed, or a torque varying inversely as the speed. This class includes most of the machine-tool work where automatically constant-speed regulation on any notch of the controller is especially desirable. It is, therefore, necessary to use a shunt motor having good inherent regulation.

The writer has been interested in the development of the three-wire system for this class of work, and it is the purpose of this paper to describe the operation and advantages of this system, as presented by the Westinghouse Electric and Manufacturing Company.

The type of generator which is rapidly attaining prominence is the so-called three-wire generator, consisting of a standard direct-current generator, designed for the maximum required electromotive force, having collector rings connected to the armature winding like a two-phase rotary converter. The leads from these rings are connected to auto-transformers or balancing coils, the middle points of which are connected to the neutral wire. With no external device whatever, the neutral wire is thus maintained at a voltage midway between the outside wires of the system (see Fig. 8). These generators may be operated in multiple with any standard three-wire system, whether it consists of two machines operated in series, a single-voltage generator, with a balancing set, or a double-commutator generator. Any standard single-voltage system may be changed into a three-wire system by adding collector rings to the generator and using balancing coils to support the neutral wire.

The standard type of motor is used on this system. If only a small variation in speed is desired, as about 2:1 or less, only one voltage is used, and the speed variation is secured entirely by changing the shunt-field current. If wider variations are required, it is preferable to use the two voltages of the three-wire system. It is necessary simply to make a 220-volt motor connected so that it may be operated on either 110 or 220 volts. The minimum speed is secured on the 110 or low-voltage circuit with full field strength. Any other speed less than double the minimum will be secured on the same circuit by decreasing the field current. All higher speeds are obtained on the 220-volt or high-voltage circuit in the same manner. In this manner a variation in speed of 1:6 is easily obtained. The size of

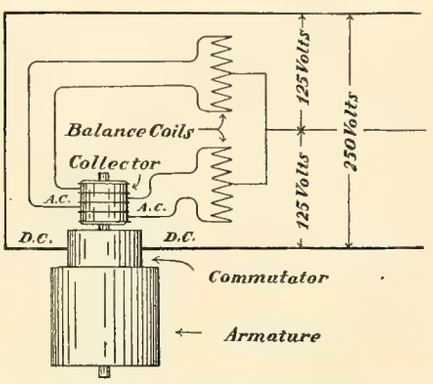


FIG. 8. THREE-WIRE SYSTEM FOR VARIABLE SPEED MOTOR WORK.

motor is determined by the output at the lowest speed, so that unless the maximum speed is excessive, the motor size will be very large for the output required, if variations even of 1:6 are required.

The advantages of the system described may be summed up as follows:

(1) Simplicity, not only in the generating plant, but in the transmission lines, motors and controller; (2) efficiency in generating plant, transmission line and motor; (3) economy in first cost of generating plant and transmission lines; (4) constant-speed regulation from no load to full load; (5) smoothness of operation in changing from one speed to another.

These advantages are all easily apparent for work where the motor output is the same at all speeds. In cases where it is impracticable to have two voltages and a wide range of speed is necessary, a double-commutator motor may be used with excellent results.

[To be continued.]

Local Organization of the Institute in Chicago.

Members of the Institute of American Electrical Engineers residing in Chicago and vicinity are making a determined effort to revive the local meetings. The first Chicago meeting of the season will be held in the rooms of the Western Society of Engineers in the Monadnock Building on Tuesday evening, December 2d. The seven papers on electric variable-speed control, presented at last week's meeting of the Institute in New York will be discussed. Prior to that, however, and beginning at 7:30 p. m., the Chicago members are requested to assemble at the place of meeting to discuss the general question of local organization in conformity with the recent recommendation of President Charles F. Scott. Mr. R. H. Pierce, the local honorary secretary, and other prominent members are much interested in this movement, and hope that all local members of the Institute will attend the meeting to the end that some definite action may be taken. It is believed that by holding the Chicago meetings about 10 days later than the New York meetings the local members will have time to familiarize themselves with the papers and be prepared to discuss them fully. It is probable, also, that the members will find it profitable to discuss topics of local interest in addition, and it is not intended to confine the discussions entirely to papers previously presented in New York. It is also suggested that a committee be appointed to cooperate with the local honorary secretary in extending the influence of the Institute and increasing its membership. In Chicago there are many electrical men who would be benefited by joining the Institute, and by forming a local organization it is thought that the membership may be largely increased. This subject is one of general interest to the Chicago members, and, as in addition all other persons interested are invited to attend the meetings, it is hoped that a large gathering will be in attendance at the next meeting and all subsequent ones.

Extent of the Universal Exposition of St. Louis in 1904.

By W. E. Goldsborough.

The achievements, history and possibilities of electricity are to receive special attention and extensive treatment and display at the Universal Exposition of St. Louis in 1904. The authorities of the exposition have given the science and industries of electricity a place of the first order in the classification of the exposition. It has been made one of the principal departments, and arrangements and appropriations have been provided on a scale that should insure to the country and to the world the greatest electrical exhibit that has ever been assembled for public and expert inspection.

This seems a significant and extraordinary statement, and must imply an extensive general plan for the exposition. All of which is true. And in this connection it should be mentioned that a mistaken idea exists generally of the scope and importance of the St. Louis Exposition. It does not seem to be understood that the Universal Exposition of St. Louis in 1904 is to be the most important and extensive universal and international exposition ever held. This, however, is the case, and too much attention cannot be directed to the words international and universal, as they really describe the nature and scope of the St. Louis Exposition. It is not to be a local or territorial or even a national exposition, as some may imagine. It is to be a world's exposition—a universal exposition in the fullest sense, and, as stated, the most extensive and important that the world has seen.

The St. Louis Exposition is to be practically a $50,000,000 exposition. Consider what this will mean for the public in the way of a world's exhibition to visit and inspect, study and delight in, especially when the splendid Columbian Exposition at Chicago involved a total outlay of only $30,000,000, and when it is known that the experience in exposition building makes it fully possible to make four dollars yield as much to-day in such work and construction

MANUFACTURES BUILDING AT ST. LOUIS WORLD'S FAIR.

as was gotten out of five dollars in 1893. These facts will make the St. Louis Exposition of almost double the elaboration, importance and interest presented to the world by the great Columbian Exposition of 1893.

The site of the exposition embraces 1,200 acres, this of splendid park territory, adjoining further rich park territory on one side, and splendid rolling country and stretches of palatial residences on the other approaches. The Chicago fair site embraced something over 600 acres—little over half of what is to be employed in St. Louis.

A comparison of the number and sizes of the various buildings of the two expositions will show in further relief the superiority of the St. Louis Exposition over that of Chicago, which, to date, is acknowledged to have been the most attractive and extensive held in the world.

The Manufactures and Liberal Arts Building was the great structure of the World's Fair at Chicago in 1893. It covered about 30 acres, its dimensions being 787 by 1,687 feet. It housed a considerable part of the exhibits of the exposition. To enclose this same class of exhibits five buildings will be provided in St. Louis, covering an area of 43 acres, almost one-third more than was used at Chicago. The separation into distinct buildings is for purposes of higher classification, for which the St. Louis Exposition will be noted. The Agricultural Building of the St. Louis Exposition will cover 500 by 1,600 feet, or nearly 20 acres; the Mines and Metallurgy Building, 400,000 square feet; the Transportation Building, 720,000 square feet; the Education Building, 400,000 square feet; the Electricity Building, 300,000 square feet. Altogether, the exhibit space under roof at the St. Louis Universal Exposition will approach 250 acres. In all there will be 16 large buildings.

St. Louis World's Fair Notes.

Chief Ockerson of the Liberal Arts Department reports that the American Society of Civil Engineers, the Memphis Society of Civil Engineers and the St. Louis Engineers' Club have decided to make exhibits in his department.

Smith & Eastman, contractors for the Machinery Building, have begun the erection of the big roof trusses of the structure. At the western end the building is 300 feet wide, and the entire width is spanned in three gigantic trusses of a 100-foot span each.

With the approval of the executive committee, President Francis on November 18th, executed the contract with John J. Dunnavant & Co. for the construction of the Manufactures Building at a cost of $719,399. The contract requires that the building be fully completed by the first day of July, 1903.

The contractors for the Electricity Building report that they will finish the building by January 1st next. The electrical work on the grounds is progressing at a satisfactory rate. The main temporary buildings have been wired. Power lines have been established, and power service is now being furnished to those contractors that need same. There has been placed on the ground 51,000 lineal feet of three-inch conduit for wire distribution.

The exposition will have light effects that have not been exploited, even in spectacular theaters. In producing these light effects, lamps and other agencies will be employed that use the latest development of electrical science. Henry Rustin, chief of the Electrical and Mechanical Department of the Division of Works, is now conducting experiments to this end. Chief Rustin's attention at present is given principally to the night aspects of the great main picture. Lighting here must be economic as well as decorative, that is, it must light the avenues and the buildings so that the exhibits stand out in their proper values, and it must, in addition, produce effects, where possible, entirely different from those produced during the day. The Nernst lamp is among those that are being tried. Mr. Rustin has considered this lamp for the ornamental lamp posts which fringe the Grand Basin, but as there are several candidates among commercial lamps for this office, no decision has yet been reached. The most curious experiments which Chief Rustin is conducting, however, are with the Cooper-Hewitt mercury-vapor lamp, made by the Sawyer-Man Company of New York. With this an initial pressure of between 50,000 and 75,000 volts is needed to start the light. Then a pressure of only 120 volts suffices to maintain its luminosity. Chief Rustin is experimenting with other vapors than that of mercury and with lamps of other patterns. He desires to use in the cascades some phosphorescent light which will not only be luminous itself but impart luminosity to the water it permeates. He believes he has found the required agent in the Geisler-tube adaptation, with which he is now experimenting. These long tubes can easily be installed in the lips of the cascade ledges, and the light coming through the falling, turbulent water is expected to produce entirely unprecedented spectacular effects.

The electrical subway was completed November 21st. The contract was let in two parts, as the subway is composed of two sections radically different in character. One section was constructed entirely of wood, with wooden shelves at the sides to carry the cables, and a passageway through the center for the linemen engaged in repairs. This portion was eight by eight feet in cross-section and 4,200 feet long. It was built by the Barwick Construction Company, and the work was completed early in the summer. The second section was completed November 21st. It passes under the lagoons and was built water-tight to keep the moisture from the lagoons from affecting the insulation of the cables. Jacob Althaus was the contractor. The work consisted of 64 tiled ducts, bedded in concrete, and surrounded on all sides by a water-tight casing of the finest Portland cement. There was installed 540 feet of this character of subway. Should repairs be necessary, the linemen will be compelled to draw the cables into the wooden subway, as no manholes are supplied in the water-tight section. Extraordinary precautions were taken to make this section of the subway absolutely water-tight. The contract specified that the outer casing of cement should be poured at one time without interruption. The object of this was to prevent leakage at the joint where work had been interrupted the day before. This specification compelled the contractor to work nights after he had begun pouring the outer casing and to employ shifts of workmen. The contract for this work was let August 2d. The subway begins at the western end of the Machinery Building, at which point will be located the switchboard from which the current from the big power plant will be distributed. It runs under the main transverse avenue, which is closed at one end by the Government Building and at the other by the French Pavilion. This avenue is convenient of access from all of the big exhibit buildings. Pump-log conduits branch off from the subway to serve all the exhibit buildings with wires and current. The largest branch will leave the subway west of the Electricity Building and east of the Textiles Building, to serve the focal points, made up of the cascades and the Terrace of States, where the lighting of the exposition will reach its climax. The cost of the entire subway was $25,985.

The West Seattle (Wash.) Electric Company has been incorporated with a capital stock of $100,000. The company purposes to equip and operate power and telephone lines. Those interested are R. W. Bender, O. M. Spear and Fred E. Sander.

Canadian Power Development at Niagara Falls.

By Orrin E. Dunlap.

The Canadian side at Niagara Falls is undergoing a vast and remarkable transformation. It has always been known as one of the most beautiful spots on earth, but even this distinction did not fully satisfy residents of the locality. From the time the Niagara Falls Power Company commenced its magnificent development on the New York side, the Canadians have looked on with wonder at the growth of the city on the opposite bank of the river, and there has been a well-defined longing to have their

FIG. 1. CANADIAN POWER DEVELOPMENT AT NIAGARA FALLS.—WHEEL PIT OF CANADIAN COMPANY.

portion of the flow of the stream pass through turbines in the development of power. While the Canadian hope has been a little slower in being realized, it has come with great vigor, and at no other point in the world are there such mammoth power plants and installations as at Canadian Niagara.

The Canadian Niagara Power Company, practically the Niagara Falls Power Company, was the first to secure franchise rights in Victoria Park, and, under an agreement with the commissioners, it now has its development progressing at a rapid rate. The methods employed in the development of power on the Canadian side by this company are quite similar to those of the Niagara Falls Power Company on the New York side, which is by means of a wheel-pit and tunnel. According to the plans, the Canadian wheel-pit will be about 480 feet long when completed, but the first section now being built and shown in Fig. 1 is but 266 feet in length. The pit will be 21 feet wide and about 170 feet deep. The present depth of the excavation is about 106 feet, and it is going down at the rate of 12 feet a

FIG. 2. CANADIAN POWER DEVELOPMENT AT NIAGARA FALLS.—SITE OF FOREBAY OF CANADIAN COMPANY.

month. The conditions of rock are nearly the same as on the American side, with the exception that a blue limestone is found near the surface. Water is met in quantities, but the flow is hardly as much as on the New York side. This pit will contain five 10,000-horsepower turbines, making the development of the section 50,000 horsepower, while the completed pit will have an output capacity of 100,000 horsepower. The methods employed in the construction of the pit are almost identical with those employed in the other big Niagara wheel-pits.

The two great power stations of the Niagara Falls Power Company stand very close to the inlet canal that brings the water supply from the river, but the

new Canadian power house will have a large forebay in front of it and extending the full length of the wheel-pit. This forebay will narrow down to 250 feet at a point where a new stone arch bridge is being built to carry the tracks of the Niagara Falls Park and River Railway and a driveway. Here the forebay becomes canal-like, but passing the bridge it again flares out about 400 feet in width. It will carry an average depth of 18 feet of water. The walls of the forebay will be of stone brought from the vicinity of Montreal. From the forebay at the north end of the wheel-pit a canal 16 feet wide will run northeasterly a distance of 500 feet to the river and this will serve as an ice run. Gates will govern the flow. It is intimated that the bridge across this forebay will be the finest stone arch in the Niagara locality, which is already rich in beautiful bridges. Its length of 250 feet will be broken into five arches, the foundations for one of which are shown in Fig. 2. The contractors on the bridge are Mumford & Lowery.

Dawson & Riley of St. Catharines, Ont., have the contract for building the wheel-pit, forebay and canal. Their plant consists of a boiler capacity of 750 horsepower, two compound Rand air compressors of 250 horsepower each, eight Sullivan channeling machines, eight Ingersoll drills, two Ingersoll gadders, two 10-ton Brown locomotive hoists and other necessary equipment. Up to recently, Dawson & Riley used derricks on the work.

The contract for the construction of the tunnel, shaft and portal is held by A. C. Douglass, a man of much experience in underground work at Niagara. In advance of the tunnel construction, Contractor Douglass sunk a shaft 10 by 16 feet to the tunnel level midway between the pit and the portal, in order to facilitate operations. The tunnel on the Canadian side will have a length of 2,200 feet, and it will be 25 feet high and 18 feet wide at the spring line inside the lining. Its height will, therefore, be four feet greater than the big tunnel on the New York side, but it is only about a third as long. The tunnel has been driven and men are now removing the bottom bench. The original plan was to line this tunnel with brick similar to the tunnel first built, but the scarcity of brick has forced the use of concrete for a portion of the lining. The concrete will be faced with vitrified brick. In making this concrete the stone from the bottom bench is being used. Concrete will be used to the extent of supplanting at least 3,000,000 brick, but 1,250,000 brick will be employed in the arch. In the concrete work Contractor Douglass will use about 20,000 barrels of Lehigh cement, furnished by the Thorne Cement Company of Buffalo. The vitrified brick will come from Beamsville, Ont. About 2,000,000 feet of timber was used in timbering the tunnel, and this was furnished by the Haeberle mills of Niagara Falls. The masonry about the portal (Fig. 3) will not be commenced until next spring, owing to the closeness of the tunnel to the base of the Horseshoe Fall. It will be very massive, and will be made of about 60 carloads of granite from Quebec and 200 carloads of limestone from Queenston, Ont.

Mr. Douglass' plant consists of two compound duplex 125-horsepower Ingersoll air compressors, operated by a 400-horsepower electric motor; two Lidgerwood double-drum hoists; 12 drills; one Otis elevator hoist, in use at the shaft, and a rock crusher.

Fig. 3. Portal of Tunnel Under Horseshoe Fall.

Fig. 4. Site of Proposed Power Station of Ontario Company.

CANADIAN POWER DEVELOPMENT AT NIAGARA FALLS.

Ontario Power Company's Big Project.

It is on the Canadian side that the Ontario Power Company has selected its point of development, but this company's plans are not yet fully announced. However, the method of development will be very similar to that of the Niagara Falls Hydraulic Power and Manufacturing Company on the American side. Instead of having a surface canal, the company will conduct its water supply through one or more large pipes. These pipes will have a diameter of something like 18 feet, it is stated, and will be concealed as they run through the park. They will carry the water to a point on the high bank over the power station, which will be located at the water's edge in the gorge. This station will not be a great distance below the Horseshoe Fall, and will almost continually be bathed in the spray cloud of the Horseshoe. A large force of men is now at work on the site, shown in Fig. 4, clearing away the debris slope, so that the building operations may begin very early next spring. The blasting on the site is something terrific, far exceeding anything of the kind ever heard at Niagara, which has known the roar of dynamite and powder almost daily for the past 12 years, as its development progressed.

In preparing for its development, the Ontario Power Company has run a cofferdam nearly 800 feet long out into and down the river above the Dufferin Islands. This has diverted the water that usually flows about the islands further out in the river, and the result is that the locality all about the islands is high and dry. Never before has such a spectacle been witnessed at the Falls, and there has been much interesting and instructive study of the rocky conditions of the river bed. On the completion of the company's work, the water will be restored to this section, so that the beauty of the spot is only temporarily destroyed.

All of the work done has the sanction of the commissioners of Victoria Park, who are carefully safeguarding the scenic features of Niagara. At one point (Fig. 5) excavated material has been dumped at the edge of the Horseshoe Fall, but in time this will all be riprapped, and will make a fine boulevard effect, adding greatly, it is said, to the delights of a visit to Canadian Niagara.

Chicago Electrical Association.

The regular meeting of the Chicago Electrical Association was held in its rooms in the Monadnock Block, Chicago, on November 21st. President P. B. Woodworth presided and the attendance of members and visitors was the largest of any meeting held this fall. The paper of the evening was presented by Howard Brooks, assistant electrical engineer of the Aurora, Elgin and Chicago Railway Company, his subject being "The Electrical Features of the Aurora, Elgin and Chicago Railway." Mr. Brooks treated his subject in an interesting and instructive manner, giving detailed descriptions of the power plant, transmission, sub-station and third-rail features of the road. He used a large number of stereopticon views reproduced from photographs and drawings to illustrate his lecture.

The discussion was led by George A. Damon, who called attention to the very heavy investment in this railway. Whereas the customary capacity for an electric railway is about 25 kilowatts per track-mile, in this case the company has installed 100 kilowatts a mile. P. Junkersfeld ascribed this as probably due to the heavy business which is expected to develop on the line, and also spoke of the growth of electrical transmission systems. Others taking part in the discussion were W. G. Carleton and Albert Scheible and E. Gontenbach, chief electrician of the company, the subject of insulators being particularly dwelt upon.

The next meeting of the association will be held on December 5th, when Captain A. DeKhotinsky, late managing director of incandescent-lamp factories at Paris, Rotterdam, Gelnhausen and Marlboro, will present a paper on "Early Development of European Incandescent Lamps."

Niagara Falls Power Tunnel Tested to Full Capacity.

If there was ever a doubt in anybody's mind in regard to the big tunnel of the Niagara Falls Power Company at Niagara Falls, N. Y., having ample tailrace capacity to carry off the body of water that would be used in the two wheel-pits in producing 100,000 horsepower, that doubt must be dispensed with, for the big hole has been tested and has demonstrated its ability to do all that it was built for.

The test was made on November 19th, from 10 o'clock in the morning until five o'clock in the afternoon. The volume of water necessary for the test was sent into the tunnel through the operation of the 10 units in wheel-pit No. 1, three in wheel-pit No. 2, and through the three next penstocks and wheel casings sufficient water was allowed to flow to make up the quantity that would be used in developing 100,000 horsepower. In addition to this volume of water, the tunnel carried off the discharge from the turbines in the wheel-pit of the International Paper Company, which produce 8,000 horsepower. The volume of water that was sent through the tunnel was greater by double than that of many notable rivers throughout the country, and still its diversion from the main stream was not noticeable on the cataract.

During the time of the tests the regular service of the Niagara Falls Power Company was maintained, with the exception that for less than an hour the big mill of the International Paper Company shut down in order that the discharge from its wheels might not be observed in connection with that of the wheel-pits of the power company. In other words, the service of the tunnel was observed with and without the flow from the paper-mill wheels. The paper mill, it will be recalled, discharges its water into the main tunnel through a lateral, and some have claimed that this stream pouring into the main body of water would act as a dam, but the result was satisfactory in every way.

Fig. 5. Broken Rock at Brink of Horseshoe Fall.

Through the test, the Niagara Falls Power Company obtains satisfactory information in regard to its tunnel some months before the completion of the installation in wheel-pit No. 2, which will not be in full operation until the latter part of next year. During the period of the test much interest was displayed by everybody in connection with the spectacle caused by the stream from the tunnel pouring into the lower river. The discharge shot clear across the river to the Canadian shore, a portion of the surface current going up stream and the other portion down stream. It is predicted that when the tunnel is discharging the flow caused by the development of 100,000 horsepower, the stream will serve to hold back the ice that comes over the falls, and thus aid in the earlier formation of ice bridges of great size.

The draft of a proposed ordinance, regulating the placing of electric poles, wires and cables, was presented to the San Francisco (Cal.) Common Council recently by the International Brotherhood of Electrical Workers, No. 151. This ordinance will prohibit the maintenance of any electric wire within 15 inches of the center of a pole and the placing of wires conducting 600 volts or over within six feet of any other wire.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome: and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Randolph Street Rotary Sub-station in Chicago. Illustrated. 377, 378, 379
Brltish and American Pacific Cables 379
Electric Variable-speed Control. (Papers and discussions before the American Institute of Electrical Engineers in New York.) Part I 380, 381
The Operation of Machine Shops by Individual Electric Motors. By R. T. E. Lozier. Illustrated 380, 381
Electrically Operated Coal Hoist Having Variable-speed Control. By P. O. Keilholtz. Illustrated 381
Three-wire System for Variable-speed Motor Work. By N. W. Storer. Illustrated 381
Local Organization of the Institute in Chicago 381
Extent of the Universal Exposition of St. Louis in 1904. By W. E. Goldsborough. (With World's Fair Notes.) Illustrated 382
Canadian Power Development at Niagara Falls. By Orrin E. Dunlap. Illustrated 382, 383
Chicago Electrical Association 383
Niagara Falls Power Tunnel Tested to Full Capacity 383
Editorial 384
Steam Pipe Covering and Its Relation to Station Economy. By H. G. Stott. Illustrated. (Association of Edison Illuminating Companies.) 385, 386
Contests Over Susquehanna River Power Development 386
Book Table 386
Pittsburg Meeting of the Institute 386
The Work of the Signal Corps. Part III 387
Development of the Telephone Field 388, 389
The Evansville Situation 388
Telephone Opposition Assured in Utah 388
Wilmington's Claim to Distinction 388
Interstate Telephone Convention 388
Ohio Telephone Notes 388
Telephone News from the Northwest 388
Southern Telephone Developments 388
New Companies 388
General Telephone News 389
Manufacturers and Dealers 389
Oral Agreement in Relation to Patent Ownership 389
Transatlantic Space Telegraphy 389
A Storage Battery Without Jars 390
Stanley Company's Transformers Non-infringing 390

DEPARTMENTS.

Correspondence 390, 391, 392
New York Notes 390
New England News 390
Southern Developments 390, 391
From the Buckeye State 391
Detroit, Mich 391
Information from Indiana 391, 392
Personal 392
Electric Lighting 392
Electric Railways 392
Space Telegraphy 392
Publications 392
Trade News 392
Business 393
Illustrated Electrical Patent Record 393, 394

DATES AHEAD.

Engine Builders' Association of the United States, Sherry's New York city, December 1st and 2d.
Interstate Independent Telephone Association, Auditorium Hotel, Chicago, December 9th, 10th and 11th.
Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

TUNBRIDGE WELLS, known to telephonic fame as an English town owning and operating its own exchange, has caused a great fluttering in the dovecotes of public ownership in Great Britain by deciding to sell its system to the National Telephone Company. It is said that this decision gives a great shock to the agitators of schemes for breaking the control of the National company through municipal competition. The British Postoffice is still engaged in the telephone business, of course, but the most promising experiment in the line of municipal telephony seems to have failed. The result is not surprising, for the telephone business lends itself still less to public ownership than telegraphy. As in the case of other quasi-public enterprises, private ownership under judicious municipal or governmental regulation undoubtedly offers the best solution of the problem of the control of what are known as public utilities.

IGNOBLE uses of electricity have sometimes the attraction of novelty, and an interest of this kind attaches to a recent surreptitious use of the electric current discovered by the Society for the Prevention of Cruelty to Animals in New Jersey. It seems that in a show recently put on in a Jersey City theater it was the part of a caged lion to roar on several occasions on the approach of the heroine of the drama, which was entitled "The Lion's Bride." An animal expert who saw the show informed an officer of the society that the lion's roars were caused by pain and not by anger or a desire to eat the bride. He also said that he believed the pain was due to electricity. The officer visited the theater and found that the bottom of the lion's cage, which was of iron, was connected with electric wires and made the lion roar whenever the current was turned on. He notified the manager that the electricity must be omitted, even if the lion refused to roar without it. The order was obeyed, and the cruelty and deception were stopped at once. Other unworthy uses of electricity, as in stimulating race-horses, burning holes in safes and operating false "tickers," have been made, but this is probably the first instance where a wild animal in capitivity has been tormented by electric shock to make a spectacle for the gaping multitude.

A FEW years ago the Chicago Edison Company, as well as other Edison operating companies throughout the country, advocated strongly the use of direct current to the exclusion of alternating current for the city distribution system. Now, however, the technical and commercial phases of electrical engineering have changed and developed so materially that one finds this company, as well as every large central-station company, using alternating current extensively in transmitting power to points of direct-current conversion and distribution and also recommending its use for light and power in outlying sections of the city. A notable example of the company's dependence on alternating current for its downtown distribution is illustrated in its new Randolph Street sub-station, which is described elsewhere in this issue. This sub-station is located in one corner of the basement of a large and very well-known office building, the Masonic Temple, and yet has an ultimate capacity, 6,000 kilowatts, that is larger than a great majority of the central stations in the United States. The equipment of this station is of the best, and the precautions that have been taken to provide against damage from fire or other accidents are especially notable. The station also is a typical example of the company's rotary-converter sub-stations, which have now been standardized and brought to a high state of electrical and commercial efficiency.

NEARLY every electric-railway company in obtaining its franchise and installing its system has experienced more or less trouble in securing consents of property owners for the use of the highways or streets on which their properties front. A decision that bears on this question has just been handed down by the Supreme Court of Ohio. The case was brought by the Hamilton, Glendale and Cincinnati Traction Company against O. V. Parrish of Hamilton, Ohio, and although the matter had previously been settled, so far as the contestants were concerned, the case was allowed to go to decision to test the point as to whether purchased consents are legal. The syllabus of the decision is as follows: First, the consents of owners of lots abutting on a street to the construction and operation of a street railroad on such street are not property rights that can be appropriated under the power of eminent domain; second, such consents are not property rights, but rights in their nature personal to each owner of an abutting lot; third, such personal rights were bestowed by the General Assembly on owners of abutting lots as a check upon the power of municipal authorities to authorize street railroads to be constructed and operated against the wishes of the owners of lots on such street; fourth, the owners of abutting lots are free to give or withhold such consent, upon such terms as to them severally may seem proper, and there is no public policy in this state [Ohio] against giving such consent for a valuable consideration moving from the street-railroad company to such lot owner. The decree of the lower court is reversed, and all of the judges agree to the decision.

UNDER the capable administration of President Scott, succeeding the energetic regime of President Steinmetz, the American Institute of Electrical Engineers is moving forward with intelligent purpose and increased energy. The membership is growing rapidly; several new local organizations have been formed or are being formed, and constant improvement is being made in the presentation and discussion of papers. The New York meeting of last week was typical of the present method of handling topics set for discussion. The subject for the evening was electric variable-speed control. Mr. Scott introduced the general subject in a brief talk; the reading of seven short papers (by the authors, with one exception) followed, and then there was a free-for-all discussion. As the result of this method a valuable record of expert opinion and experience was obtained. A report of this meeting, giving abstracts of papers and discussions, is begun in this issue. The same papers, with some additional subjects of local interest, will be brought up at a Chicago meeting of the Institute to be held next week, as announced on another page. At this meeting it is proposed to effect a local organization, with an advisory committee to co-operate with Mr. R. H. Pierce, the local honorary secretary, in extending the scope of the Institute's influence in Chicago and increasing the local membership. This is a worthy object, and the Western Electrician strongly commends it to the attention of its Chicago readers, more of whom might join the Institute to the mutual benefit of the society and themselves. Non-members will be cordially welcomed at the local meetings, and there should be a large attendance at next week's gathering.

DESPITE the anti-American tariff agitation in Canada, allusion to which, in the case of a Chicago electrical exporter, was made in these columns a few weeks ago, Canadian imports from the United States continue to grow more rapidly than those from the United Kingdom. This is in the face of the legislation of 1897 in favor of products of the United Kingdom. In that year the Canadian tariff laws were so adjusted as to give an immediate reduction, beginning with April, 1897, of 12½ per cent. in tariff rates on imports from the United Kingdom, with a further provision that another 12½ per cent. reduction should occur in 1898. In 1900 a still further reduction was made, making the total reduction of tariff rates in favor of merchandise from the United Kingdom 33⅓ per cent. Notwithstanding this preferential tariff, official statistics show that in the fiscal year 1896, the one immediately preceding the year in which the reduction of tariff in favor of products from Great Britain began, Canadian imports from Great Britain were $32,979,742, and in 1902 $49,206,062, an increase of $16,226,320. In 1896 the Canadian imports from the United States were $58,574,024 and in 1902 $120,814,750, an increase of $62,240,726. Thus, the increase of the United States, compared with Great Britain, is both actual and relative. Imports from Great Britain formed in 1896 30 per cent. of the total imports into Canada and in 1902 24 per cent., while imports from the United States, which in 1896 formed 52 per cent., formed in 1902 60 per cent. of the total imports into Canada. The Dominion is a good customer of the United States manufacturers of electrical goods, and we naturally hope that this condition will continue, although it must be confessed that there is an increasing tendency on the part of American producers to build factories in Canada. However, if Canada makes its own electrical machinery, we will view the change with equanimity, as it is likely that American capital and inventors will benefit thereby; but in electrical competition with any transatlantic country, the United States should, economically, have the lion's share of Canada's business.

Steam Pipe Covering and Its Relation to Station Economy.[1]

By H. G. Stott.

An investigation of the best engineering practice in covering high-pressure steam pipes disclosed the fact that although several tests of the efficiency of different types of covering had been made, nothing had been done toward determining the most economical thickness and the most efficient method of applying the covering, when taking into consideration the resultant station economy. Before awarding a contract for covering the steam pipes in the Manhattan Railway Company's power house, a careful investigation and test of different types and thicknesses of covering was made under the author's direction, and the results proved to be so important that it is hoped this paper giving these results may prove of value to the members of this association.

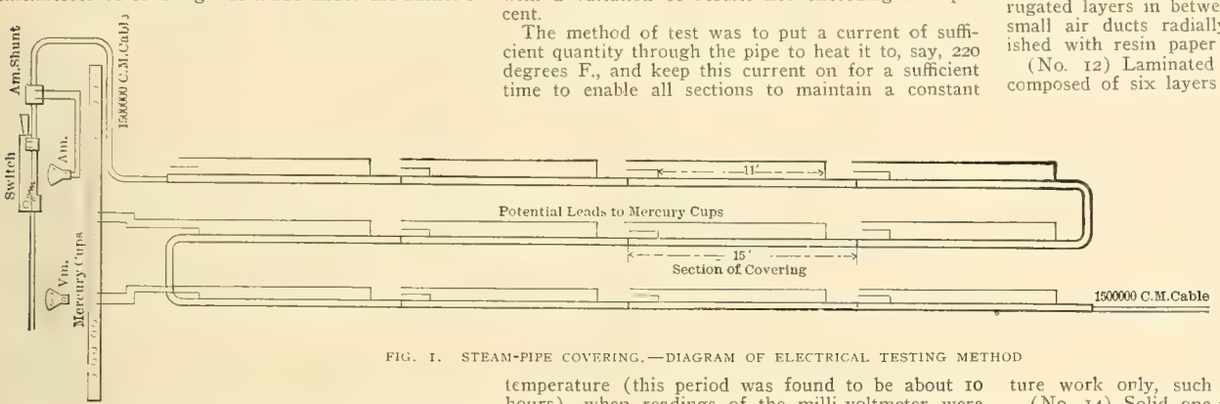


FIG. 1. STEAM-PIPE COVERING.—DIAGRAM OF ELECTRICAL TESTING METHOD

In order to get the necessary data, it was decided to carry out a complete test of the various types of covering on the market, and also to investigate the effect of varying the thickness of the insulating wall.

The usual method of test previously used was the condensation method, but this method is subject to so many errors, that it was abandoned. After mature consideration, an entirely new method of test was decided upon, which the author believes meets every requirement of accuracy and perfect fairness to all, while covering a wide range of temperatures, and so giving many points, which, when plotted in a curve, would tend to show not only the efficiency of a covering, but, at the same time, indicate any errors in taking readings.

The method adopted is illustrated in Fig. 1, and consisted in coupling up about 200 feet of two-inch iron pipe and mounting the same on wooden horses about 3½ feet from the floor, the three lines of pipe being approximately four feet apart and four feet from the nearest wall, in order to avoid any errors due to heat convection and radiation.

Sections 15 feet in length were marked off on the straight portions of the pipe, and so arranged as not to include any pipe couplings or bends; two feet from each end of each section heavy potential wires were soldered on to the pipe, and at the extreme ends of the pipe 1,500,000 circular-mil copper-insulated cables were soldered on, the openings in the pipe having been previously closed by means of a standard coupling and plug. One of these cables ran direct to one terminal of a 250-kilowatt, 250-volt, steam-driven, direct-coupled exciter, which was solely devoted to furnishing current for the test, and which could have its voltage varied within wide limits, so as to furnish any current up to 1,500 amperes. The cable connected to the other end of the pipe was then connected to three ammeter shunts in series in order to enable the readings to be easily checked, after which it was carried through a circuit-breaker and switch to the other exciter terminal.

The pipe-covering test was carried on in a vault in which there was no source of heat and no possibility of drafts of air, and arranged so that the section in which the test was being carried on could be locked up in order to prevent interference with the test.

Invitations for bids were sent to all the principal pipe-covering manufacturers and jobbers, specifying that each one would be expected to cover one or more sections of the two-inch pipe for a competitive test, and that samples from the successful bidders' covering would be analyzed in the company's chemical laboratory, and no covering accepted which departed more than three per cent. from this analysis.

A special Weston milli-voltmeter was ordered, with which readings were taken from the potential wires, the latter all being brought to mercury cups on a testing table near which the ammeters were also located.

Preliminary tests were made with a small current in order to establish the individual resistance of the 11-foot sections between the potential wires; this current was then gradually increased and more readings taken, together with thermometer readings from thermometers having their bulbs in contact with the pipe at an angle of about 30 degrees, the stems projected through the covering. From these readings a coefficient of .4649 per cent. increase of resistance per degree Centigrade was determined, and afterward used in determining temperatures of the various sections.

Current sufficient to heat the pipe to approximately 370 degrees Fahrenheit (corresponding to a steam-gauge pressure of 160 pounds) was kept on for three days continuously, in order to dry out the various coverings, after which they were allowed to cool off to the air temperatures before starting the test.

The temperature of the room was kept between 27 degreees C., and 31 degrees C. during the entire test. Each section had about 600 readings taken, and where any doubt existed in reference to readings, the entire series was gone over a second and third time, with the gratifying result that it was conclusively shown that the test could be repeated with a variation of results not exceeding two per cent.

The method of test was to put a current of sufficient quantity through the pipe to heat it to, say, 220 degrees F., and keep this current on for a sufficient time to enable all sections to maintain a constant temperature (this period was found to be about 10 hours), when readings of the milli-voltmeter were taken on each section with simultaneous ammeter readings. As all the sections were in series electrically, the current was, of course, the same, so that no error could arise, due to variation of current.

The object of leaving two feet at the end of each section, or four feet between potential wires, was to avoid any error due to conduction of heat through the pipe. Tests were made to prove the efficiency of this precaution, and showed that no perceptible error was introduced.

A constant temperature having been obtained, it is evident that the watts lost in each section give an exact measure of the energy lost in maintaining a constant temperature, and from the watts lost the British thermal units are readily calculated. Fig. 2 shows the result of the test values being reduced to loss in British thermal units per square foot of pipe surface at various temperatures in the curves, and at a temperature corresponding to steam at 160 pounds pressure in the table.

After a series of readings had been completed, the current was raised sufficiently to give approximately 50 degrees F. rise in the least efficient covering, and maintained constant for 10 hours, when another series of readings were taken, and so on until the temperature of the pipe had reached a point far above anything used in practice. The extremely high readings were taken as a matter of interest, as they were gotten when the low-efficiency coverings were only at working temperatures.

A brief description of each covering may be of interest.

(No. 2) Solid sectional covering, 1½ inches thick, composed of granulated cork, molded under pressure, and then baked at a temperature of 500 degrees F., one-eighth-inch asbestos paper next pipe finished with resin paper and eight-ounce canvas.

(No. 3) Solid one-inch molded sectional covering, composed of 85 per cent. carbonate of magnesia, finished with resin paper and eight-ounce canvas.

(No. 4) Solid one-inch sectional covering, composed of granulated cork, molded under pressure, and baked at a temperature of 500 degrees F., one-eighth-inch asbestos paper next pipe, finished with resin paper and eight-ounce canvas.

(No. 5) Solid one-inch molded sectional covering, composed of 85 per cent. carbonate of magnesia. Outside of sections covered with canvas pasted on. Finished with resin paper and eight-ounce canvas.

(No. 6) Laminated one-inch sectional covering, composed of nine layers of asbestos paper, with granulated cork in between. Outside of sections covered with canvas pasted on, one-eighth-inch asbestos paper next pipe, finished with resin paper and eight-ounce canvas.

(No. 7) Solid one-inch molded sectional covering, composed of 85 per cent. carbonate of magnesia. Outside of sections covered with light canvas pasted on, finished with resin paper and eight-ounce canvas.

(No. 8) Laminated one-inch sectional covering, composed of seven layers of asbestos paper, indented with one-quarter-inch square indentations, which serve to keep the asbestos layers from coming in close contact with one another; one-eighth-inch asbestos paper placed next pipe, finished with resin paper and canvas.

(No. 9) Laminated one-inch sectional covering, composed of 64 layers of asbestos paper, in which were embedded small pieces of sponge. Outside covered with canvas pasted on, finished with resin paper and canvas.

(No. 10) Laminated 1½-inch sectional covering, composed of 12 plain layers of asbestos paper, with corrugated layers in between, thus forming longitudinal air cells; one-eighth-inch asbestos paper next pipe; sections wired on and finished with resin paper and eight-ounce canvas.

(No. 11) Laminated one-inch sectional covering, composed of eight layers of asbestos paper with corrugated layers in between, the corrugations forming small air ducts radially around the covering; finished with resin paper and eight-ounce canvas.

(No. 12) Laminated 1¼-inch sectional covering, composed of six layers of asbestos paper, with corrugated layers, forming longitudinal air cells; outside of sections covered with two layers of canvas pasted on, and finished with resin paper and canvas.

(No. 13) Solid one-inch molded sectional covering, composed of a magnesia compound, mostly talc; one-eighth-inch asbestos paper next pipe; finished with resin paper and eight-ounce canvas. This sample was submitted for low-temperature work only, such as boiler feed and drips.

(No. 14) Solid one-inch molded sectional covering, composed of magnesian compound, principally talc; one-eighth-inch layer of asbestos paper next pipe, and finished with resin paper and eight-ounce canvas.

(No. 15) "Remanit," composed of two layers wound in reverse direction with ropes of carbonized silk. Inner layer 2½ inches wide and one-half inch thick; outer layer two inches wide and three-quarters inch thick, over which was wound a network of fine wire; one-eighth-inch asbestos next pipe; finished with resin paper and eight-ounce canvas. Made in Germany.

(No. 16) Two and one-half-inch covering, composed of 85 per cent. carbonate of magnesia, one-half-inch blocks about three inches wide and 18 inches long next pipe and wired on; over these blocks were placed solid two-inch molded sectional covering; outside covered with canvas pasted on; finished with eight-ounce canvas.

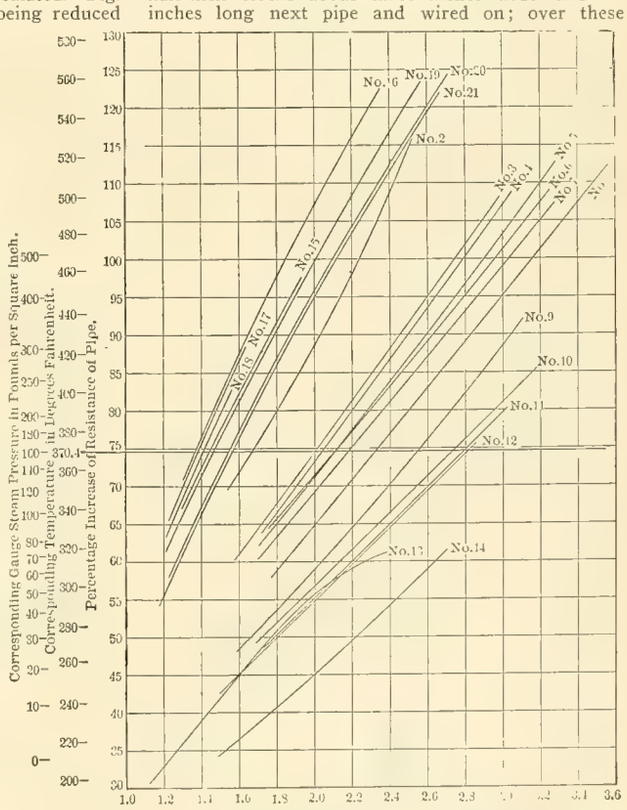


FIG. 2. STEAM PIPE COVERING. RESULTS OF TESTS.

(No. 17) Two and one-half-inch covering, composed of 85 per cent. magnesia. Put on in a two-inch molded section wired on; next the pipe and over this a one-half-inch layer of magnesia plaster covered with canvas pasted on, and finished with eight-ounce canvas.

(No. 18) Two and one-half-inch covering, composed of 85 per cent. carbonate of magnesia. Put on in two solid one-inch molded sections, with one-half-inch layer of magnesia plaster between; two one-inch coverings, wired on, and placed so as to break joints; finished with eight-ounce canvas.

(No. 19) Two-inch covering, composed of 85 per

1. Paper (somewhat abridged read before the Association of Edison Illuminating Companies at Mount Washington, N. H., September 9-11, 1902.

cent. carbonate of magnesia, put on in two one-inch layers, so placed as to break joints, and finished with eight-ounce canvas.

(No. 20) Solid two-inch molded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on; finished with eight-ounce canvas.

(No. 21) Solid two-inch molded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on; finished with eight-ounce canvas.

Nos. 2, 4, 6 and 15 were excluded by the specifications, which stated that "no inflammable material would be considered," but a test was made at the request of the manufacturers, in order to give a comparison with the other materials.

It will be noted that two samples covered with the same thickness of similar material give different results; for example, Nos. 3 and 5, and also Nos. 20 and 21, though of practically equal thickness, show quite a perceptible difference in loss per square foot. Upon investigation, the cause of this difference was found to be in the care with which the joints between sections were made. A comparison between Nos. 19 and 20, showing two coverings having exactly the same total thickness, but one applied in a solid two-inch section, and the other in two one-inch sections, proved the desirability of breaking joints.

An attempt was made to determine the law governing the effect of increasing the thickness of the insulating material, and for all the 85 per cent. magnesia coverings the efficiency varied directly as the square root of the thickness, but the other materials tested did not follow this simple law closely, each one involving a different constant.

The carbonized silk covering is the most efficient, having a relative efficiency of 86.9, while curve No. 3, giving a comparative result for 85 per cent. magnesia, comes second, with 84.2 per cent. efficiency. The two other samples of 85 per cent. magnesia (curves Nos. 5 and 7) show efficiencies of 83.1 and 83.2 per cent., thus confirming in a remarkable way the results on the other sample.

To determine which covering is the most economical the following quantities must be considered: First, investment in covering; second, cost of coal required to supply lost heat; third, five per cent. interest on capital invested in boilers and stokers rendered idle through having to supply lost heat; fourth, guaranteed life of covering; fifth, thickness of covering.

From an inspection of the first three quantities, it is apparent that the covering which shows a minimum total cost of the three at the end of a specified time is the best covering to adopt, for the loss in heat at the end of 10 years may readily cost over three times as much as the first cost of covering.

As the geometrical dimensions of the covering are a function of the cost of the increased thickness desired, it will generally be found that increasing the thickness of the material will increase the investment.

Contests over Susquehanna River Power Development.

The option of the Continental Trust Company of Baltimore to purchase the common stock of the United Electric Light and Power Company of that city and the stocks and bonds of the Mt. Washington Light and Power Company has been exercised. It is the object of the syndicate to secure power from the Susquehanna River. Complete reports from the engineers employed in inquiring into the power possibilities of the big stream are in the hands of Mr. Warfield, president of the Continental Trust Company. Just what body of capitalists will secure the monopoly of the immense power that could be derived from harnessing the Susquehanna River is a matter that is now being stubbornly fought over by Baltimore capitalists arrayed against a coterie of Philadelphia capitalists.

The contending corporations are the old Martic Power Company, which several years ago undertook the preliminary work of constructing an immense power dam near Wrightsville, and the more recently incorporated or rather reincorporated Susquehanna Canal and Power Company. Each of these companies has had for several months past separate corps of surveyors at work along the river and the abandoned canal. These surveying parties have had several contentions over claims of the opposing companies, resulting in some instances in fistic conflicts.

The incorporation of two new power companies composed of Quaker City capitalists and having for their purposes the construction of plants on the Susquehanna River is likely to lead to further complications in the situation. The new companies are known as the Long Level Power Company and the Shenks Ferry Power Company.

The scope of the prospective power achievements on the Susquehanna in Pennsylvania extends from Peach Bottom to a point just south of York Haven. These sites and the intervening points are controlled by seven separate corporations. The plan of the Baltimore people is to consolidate these. The citizens of York and the county are inclined to champion the claims of the Baltimore promoters of the power project. The scope of the operations on the lower Susquehanna in Maryland will also be of considerable magnitude, and will directly benefit the manufacturing industries and lighting interests of Baltimore.

BOOK TABLE.

THE TELEPHONE GREEN BOOK (1902). Compiled by H. Robinson, Cleveland: The Telephone Green Book Publishing Company. Pp. (six by nine inches), 231. Price, $2.

As the sub-title of this useful book of reference indicates, it is "a complete directory of the Independent telephone companies in the states of Ohio, Indiana and Michigan, together with such state and company statistics as will be of interest to those concerned in the growth of the Independent movement, and three special papers setting forth the history and describing the Independent conditions in each state, written especially for the Telephone Green Book by the following gentlemen, who are best qualified to undertake the task: Ohio, by J. B. Hoge; Indiana, by S. P. Sheerin; Michigan, by J. B. Ware." This long sentence covers the scope of the book so well that little remains to be added except the comment that Mr. Robinson, who is assistant general manager of the United States Telephone Company of Cleveland, has collected much valuable material, notwithstanding a modest prefatory note in which he deprecates the "rather crude manner in which the statistical data have been put together." The statistics of Independent telephone companies in the three states covered seem to be exhaustive and accurate, although they might be made more easily available for reference by improvement in the typographical arrangement. It is a pity that statistics of Bell exchanges could not have been included, but the compiler says that the Bell companies refused all information, and that to ascertain the number of Bell subscribers in each state he had to resort to "much circumlocution." However, as a purely Independent directory and statistical reference book the volume is of value. When the next edition is issued other states should be added, and the states should be arranged in alphabetical order.

ELECTRICITY AND ITS SIMILITUDES. By Charles H. Tyndall, Ph. D., S. T. D. 1902. New York: Fleming H. Revell Company. Pp. (five by 7½ inches), 215, with nine full-page illustrations. Price, $1.

One is familiar with works on electrotechnics, electometallurgy, electrochemistry, electrotherapeutics and the like, but this is perhaps the first book that may be styled electro-religious. Its author is a clergyman, the pastor of the Reformed Church of Mount Vernon, N. Y., but it is evident that he is also something of a student of physics, as shown by his book and by his associate membership in the American Institute of Electrical Engineers. The volume is not intended for technical men; it is really a little book of condensed sermons, based on illustrations drawn from electrical phenomena, and should be of use principally to preachers seeking fresh illustrative material. Subjects such as "Electric Conductors," "Wireless Telegraphy" and "Insulation" are considered, and appropriate moral lessons are drawn. Thus, "The mystery of electricity finds its peer in the mystery of godliness." Again, "It is a well-known fact that in the Scriptures oil is symbolic of the Holy Spirit. He is the most perfect spiritual insulation for the soul." And, further, "The similarity of this [the Leyden jar] to the spiritual life is apparent. One's life is best insulated from injurious contact with sin by keeping his inner spiritual condition at high potential." Sometimes the illustrations seem to be a little forced and to be merely unusual rather than convincing. Occasionally natural phenomena are misstated, as "It was seen that the mysterious something called electricity is a source of power." Not infrequently, too, the rhetoric seems somewhat florid to the plain electrical layman. But it is not difficult to find blemishes in any work, and the search for them may easily become too persistent; the merit of the book is that it enters a new field and, in a fresh, pleasing way, helps the reader to consider the analogy of things material and things spiritual. The most momentous thing in the book is this: "What God does in grace, that He has beautifully typified in nature, in electricity. And I believe that it is more than in type that He is manifest there. He Himself is the energy wherever seen in nature." This seems to say that electricity is God.

THE ELEMENTS OF ELECTRICAL ENGINEERING: A First Year's Course for Students. By Tyson Sewell, A. I. E. E. 1902. New York: D. Van Nostrand Company. London: Crosby, Lockwood & Son. Pp. (eight by 5¼ inches), xi., 332, with 204 illustrations and seven tables. Price, $3.

This book is based upon lectures given by the author to students in electrical engineering at the Polytechnic in London, England. Being an elementary treatment of the subject of electrical engineering, the author has, as far as possible, avoided all difficult mathematical expressions. The subjects are treated in good, clear English and the problems, of which there are a number at the end of each chapter, are worked as simply as possible and only to that degree of mathematical accuracy required in practical work.

Ohm's Law is first considered, and the treatment of it is clear and forcible, tending to impress the student with its importance in his future study of electrical engineering. The second chapter treats of electrical units involved in Ohm's Law and explains their derivation. Circuits—series and parallel—are developed in the next chapter with the methods of treating problems involving such circuits. The terms series and parallel are fully and simply explained, with accompanying arithmetical problems. In the same simple manner are treated, in the next five chapters, the heating and magnetizing effects of a current, as also its electrolytic effect. Having taken up the different fundamental ideas of current electricity as to the effects produced by it, the author then treats indicating instruments employing these effects—ammeter, voltmeter, ohmmeter and wattmeter—accompanying each description with a clear and well executed illustration. First the instruments used in the factory side of the work are given and then those more delicate instruments seen only in the laboratory.

The above more elementary work is taken up in the first 12 chapters of the book and the next two chapters treat of lighting circuits, both arc and incandescent and their corresponding lamps. Chapter 15 deals with the direct-current dynamo-bi-polar and multi-polar machines, and the methods employed in building them. The armature, field and commutator are each explained for the student, explanatory illustrations, as before, always being plentiful. The last chapter (No. 16) is given over to the direct-current motor, the description being along the same lines as in the case of the dynamos. An index covering eight pages is provided.

SELF-PROPELLED VEHICLES. A Practical Treatise on the Theory, Construction, Operation, Care and Management of All Forms of Automobiles. By James E. Homans, A. M. 1902. New York: Theo. Audel & Co. Pp. (5¾ by 8¾ inches), viii., 632, with 468 diagrams and illustrations. Price, $5.

This is a comprehensive treatise on the subject of automobiles and forms, on the whole, a valuable contribution to technical literature, although, as stated in the preface, "the treatment of subjects throughout has been kept as nearly as possible in the lines popularly called 'non-technical.'" The arrangement in general is clear and logical, although there are a few misplaced chapters. There are 45 chapters in the book, which fall into several well-marked divisions, as Nomenclature, History, General Mechanics (including frames, wheels, tires, springs, bearings, lubricants, brakes, etc.), Steam, Gas and Gasoline, Electricity and Practical Hints on Operation. Within this compass it would seem that the automobilist should find pretty nearly everything he desires to know, unless about automobilism as a sport, which appears to be disregarded as outside of the scope of the book. The construction and operative principles of steam and gasoline automobiles are treated in detail. The electrical reader will wish that a greater proportion of the book were given to the features of the vehicle of his choice, but, although this portion of the work might certainly be improved by giving greater technical attention to controllers, batteries and motors, yet the five electrical chapters give a general idea of the essential features of electrical carriages. It is, of course, true that at the present time road vehicles driven by electricity are not the prevailing type; nevertheless, it would seem that such an important electrical possibility as the new Edison storage battery, for instance, should not have been entirely ignored. Under the heading "How a Motor Carriage Turns" a full discussion of the use and functions of compensating or differential gears is given, explaining how it is possible to maintain a steady drive of the motor while the two driven wheels are rotating at different speeds, as in the act of making a corner. The chapter on "Steering a Motor Carriage" deals with the subject of stud axles and other pivoted arrangements on the forward wheels, also with the various steering connections and the situations involved in securing the proper arcs of turning on the steering wheels.

Many types of vehicles are described and illustrated, particularly those driven by gasoline engines. The chapter on speed-changers and reversing gears for gasoline carriages is one of the most elaborate in the book. The volume is fairly well printed, but the illustrations are of varying degrees of excellence, and the whole book gives evidence of haste in preparation. An index adds to the value of the work.

Pittsburg Meeting of the Institute.

A meeting of the American Institute of Electrical Engineers was held in Pittsburg, Pa., on November 10th, at the Electric Club. P. H. Lincoln presided at the meeting and the general subject of "Illumination" was discussed. Abstracts of the papers and discussion at the New York meeting and interesting additional material with respect to the Nernst, Bremer, Cooper-Hewitt and acetylene lights were presented. The several kinds of light were on exhibition. Those taking part were Professor Kintner and Messrs. Scott, Wurts, Henderson, Lincoln and Dr. Recklinghausen. Over 30 of the Institute men were present, together with a large attendance of members of the Electric Club and visitors, about 200 in all. A standing local committee was appointed, consisting of P. M. Lincoln, chairman; J. S. Peck, secretary; C. W. Rice, Professor S. M. Kintner and H. W. Fisher, to have charge of future meetings.

The Big Bend Rural Telegraph Company of Denver, Colo., has been incorporated with a capital of $10,000. The incorporators include Arthur Carter, Charles Carver, C. W. Burke and others.

The Work of the Signal Corps.

PART III.

The telegraph and cipher bureau of the White House, to place the commander in chief of the army and navy in quick and direct communication with the forces on land and sea, and with our diplomatic representatives abroad, has remained under the immediate supervision of Captain Benjamin F. Montgomery, Signal Corps. Twenty-five telegraph wires, several of which are duplexed, and 15 telephonic cables connect the telegraph and cipher bureau with the departmental lines of the government and with commercial companies of the country.

While the chief signal officer of the army, in considering fire-control matters has consistently sought the advice of the expert electricians among the officers of the Signal Corps, yet the burden of the work has fallen upon Captain Edgar Russel, assistant in charge of the electrical division of this office. In devising suitable electrical apparatus for the artillery several members of the Signal and Artillery Corps have contributed materially in suggestions and experiments. It has fallen, however, to Captain Russel to formulate specifications, make the official tests and prepare the instructions for the use of various instruments and material, of which the most important are the armored cables, master clocks, service telephones and telautographs. Through the exertions of these officers the chief signal officer of the army was able to fix upon the material, instruments and systems which it is believed would successfully solve the problems of fire-control communications as far as the Signal Corps of the Army was concerned.

As far as is known, there is no army in the world that has fully and successfully solved the problem of reliable and instant intercommunication between the men at the gun, the battery commander, and the fire-control officer. The scheme, as put forward, and as tried by tests made at the army and navy maneuvers in Long Island Sound during the past months works, even under the adverse conditions that then obtained. The materials needed for these tests were received so late that the telephones, bathe scene so late that they were assembled with as much haste as though it were a period of actual hostilities, and the results cannot but be considered with credit to both the manufacturers, to the Artillery Corps, who suggested, and to the Signal Corps, who planned and ordered.

The electrical installation of the coast defenses of the United States will cost eventually in the neighborhood of $1,000,000, and in time its annual maintenance must cost at the very least $50,000, figuring the deterioration of the electric plant at 10 per cent. Many of the costly instruments, such as telautographs, master clocks, special telephones, switches and batteries, are certain to deteriorate very rapidly unless properly cared for. The proper supervision of these elaborate and expensive electric plants will prevent what otherwise will be an enormous waste in the years to come. At present the Signal Corps of the Army has no part in the supervision or inspection of these installations, which become part of the artillery plant as soon as installed and turned over in good order.

WIRELESS TELEGRAPHY.

Early in 1899 the Signal Corps of the Army devised a system of wireless telegraphy, which was the first one ever successfully operated at a distance in the United States, it transmitting messages satisfactorily between Fire Island and Fire Island light, a distance of 10 miles.

This system, improved in details and installed more than two years since in San Francisco harbor, has worked satisfactorily the entire time, except for a few hours needful to replace broken parts. This is believed to be the longest record of satisfactory teries, master clocks and telautographs arrived on working between any stations, and it has been done not by highly paid experts but by the enlisted men of the Signal Corps, whose skill and intelligence are worthy of commendation.

It was hoped that circumstances would permit the establishment of wireless stations at suitable points in the Philippines. While the existing conditions are in many respects ideal, the constant pressure for every available man in other directions made experimental installations of this kind impracticable. The signal officer of that division considers that such installation would, in the present condition of the invention, be expensive and inefficient, in which opinion the chief signal officer of the army coincides.

The pressure of duties has rendered any extended investigations impossible for Signal Corps officers, even in the United States. Working out of hours, however, Captain Russel reports as follows: "During the months of February and March experiments with the buzzer as a transmitting instrument for earth-current telephony and telegraphy were made. The apparatus used and results obtained are embodied in the report appended. It was found that communication could be had between stations separated 1½ miles, using 200 or 300 feet of wire at each station with ends connected to earth."

Speaking further of the De Forest system, Captain Russel reports that very good results were obtained, and it is believed that this system of transmission, utilizing an alternating current with a step-up transformer in oil insulation, is theoretically the best as well as giving the most promising practical results. The alternating-current method does away at once with that most troublesome and annoying part of wireless apparatus—the interrupter. Of course, it introduces the troublesome feature of a generator and motive power for driving the alternating dynamos, but a small motor dynamo, driven by the same battery power necessary to run the ordinary induction coils used in wireless telegraphy, will be fully as compact and simple as the coil and interrupter. The transformer is a compact ironclad affair, not easily damaged, as the ordinary induction coils are. The spark given by the instruments used at New London, Conn., has all the qualities which wireless methods have demonstrated best, being intensely white, clear cut, and having a vicious tearing sound that indicates a large amount of energy being delivered across the spark gap.

Unfortunate conditions interfered with the work of the experts of the Fessenden and Marconi systems.

Steps have been taken looking to the utilization of wireless telegraphy on special sections of the Alaskan telegraph system.

As a result of proposals, awards were made to and contracts with Queen & Co. for the installation and successful operation of the Fessenden wireless system between Nome City and Fort St. Michael, and with the Marconi Wireless Telegraph Company of America for the installation and operation of a wireless system between Fort Gibbon and Bates Rapids, with the installation of an intermediate station, if necessary. As both Queen & Co. and the Marconi company have applied for an extension of time, it is evident that neither contract will be completed on October 1st. As regards extensions, the chief signal officer of the army recognizes the fact that wireless telegraphy is in a somewhat experimental stage, and proposes to be as lenient with the defaulting contractors as the public interests may permit.

Captain Russel reports that some very interesting experiments have been made in the past few months in the testing room of the Lemon Building, regarding modifications of certain types of coherers.

The most interesting forms developed by these experiments are, first, a simple tripod of three sewing needles resting on a polished plate of steel or platinum. This form is connected with a resistance wire, through which the current from a single dry cell runs, thus permitting an exact adjustment of the voltage, through the coherer and relay in circuit with it, which gives a certainty and delicacy of action that is surprising.

A sounder connected in local circuit or relay mounted on the same base as the needle coherer will respond instantly to single taps, or groups thereof, without any other decohering device, thus permitting use of the Myer code as a means of telegraphy.

The second form of coherer is that of the Castelli variety, consisting of a small glass tube, in which there is a bit of iron at the center. Two small carbon rods are pushed in, one at each end, almost touching the iron, being separated therefrom by two small globules of mercury, previously put in. This coherer is also decohering, permitting the use of a telephone receiver as the instrument for reading the message.

This simple device can be made up in a few minutes, one cell of dry battery and an ordinary telephone receiver constituting the complete receiving apparatus for a wireless station. A wire elevated by a kite or a small balloon furnishes the necessary antenna, and a receiving station in the field can be quickly extemporized and as quickly closed up and taken elsewhere.

It would appear that this method can be developed into a practical one for communicating with a cavalry or infantry column on the march. The transmitting apparatus could be made up in a portable form for emergency work, somewhat as follows: Large dry cells, or Edison battery in steel cells, could furnish the necessary current, the coils or transformers could be made sectional and assembled at the transmitting station. None of the parts need weigh over 50 pounds, permitting their carriage by pack animal, or even by the men in an emergency.

INTERNATIONAL TELEGRAPH CONFERENCE.

The chief signal officer invites attention to the fact that the subject of the rights, privileges and immunities of submarine-cable property in time of war, brought to notice during the Spanish-American war, should properly be a matter of consideration for an international cable conference.

Complications have already arisen with regard to the conditions under which wireless telegraphy should be operated between different countries, and extensive correspondence has been had with regard to international conventions for the purpose of forming international regulations regarding wireless telegraphy. It seems most advisable that international regulations should be established in regard to this invention, before serious or complex conditions arise. At such convention the Signal Corps of the Army, which by law is charged, under the secretary of war, with the construction, repair and operation of military-telegraph lines and cables, or collecting and transmitting information for the army, by telegraph or otherwise, should be represented.

PERSONNEL.

The Signal Corps now consists of one brigadier-general, one colonel, one lieutenant-colonel, four majors, 14 captains and 14 first-lieutenants. While the physical record of officers of the Signal Corps has been extraordinary, yet the effects of continued overwork, particularly in the tropical regions, have lately materialized. On October 1st practically one-quarter of the Signal Corps is physically disabled and cannot perform full duty for a long time. Five others, invalided from foreign service, are fit only for light work. It is therefore suggested that the commissioned force of the corps be increased by 20 more commissioned officers. The enlisted force consists of 810.

GENERAL REMARKS AND CONCLUSION.

The tremendous development of electricity has materially modified many military methods of long standing. Two years since the Signal Corps had not a dollar for the purchase of an electrical equipment absolutely necessary for coast fortifications. The coming year it has an appropriation of $259,000. This has necessitated the organization of a new division, for which there are neither officers nor men to spare. This division is charged with the electrical work of the Signal Corps, the selection of special and general apparatus and devices, of executive functions relative to electrical matters and fire control, and requisitions for electrical material and supplies, except such as pertain to the telegraph division. This division, since its organization, has been in charge of Captain Edgar Russel, an officer of efficient field service and of brilliant attainments, from which the Signal Corps has profited.

The evolution of electricity as applied to military operations, particularly as a means of communication, is of very recent growth, and without doubt owes its most important advances to the officers of the army of the United States. In addition to electrical appliances for use of the troops in the field, there devolves on the Signal Corps the charge of fire-control communication, a field of constantly widening extent, of the greatest importance to the country in general and to the Corps of Artillery in particular.

The following new instruments have been designed during the year: Service telephone, field telephone, service buzzer, Russel cut-in telephone, combination telegraph and buzzer table set, and cavalry buzzer. This last-mentioned instrument promises to be especially valuable during rapid field operations. The voltaplex and Ghegan repeater have been thoroughly tested. The fire-control apparatus, the artillery type of telautograph, the time-interval clock, and the anemometer have been perfected and tested. The ohmmeter, Fisher cable-testing set No. 2, and Pignolet's voltammeter and the Edison-Leland cell have been modified to meet special needs of the Signal Corps' work. A Signal Corps' type of armored cable has been devised for installation where multiple cables are required.

The multiple cable required in fire-control installation has heretofore been of the rubber-insulated type, with lead sheathing. This was satisfactory where conduits were provided, but in many cases it was not practicable to have conduits. Accordingly, a new type of cable has been devised, which has an armor of steel wires and jute serving outside the lead. This gives it great strength and freedom from damage to such an extent that experience has led to the belief that it may safely be considered as a substitute for conduit work, besides giving greater flexibility to the cable system.

The large quantities of submarine cable and of modern electrical instruments which the Signal Corps has purchased, early impressed General Greely with the importance of protecting the interests of the United States in connection therewith. Efforts have been unremitting to equip suitably with standard instruments the Signal Corps and officers and inspectors, officials charged with the duties of inspection and purchase. This policy has produced important results, and in more than one instance has raised the standard of American workmanship and manufacture. A testing room has been installed for the inspection of modern electrical instruments.

In the matter of the telegraph division, the policy has been continued of improving, by adoption of late commercial devices, and with the invention of service instruments, the efficiency of the working of the telegraph and telephone lines. There is being installed an experimental system on the Fort Duchesne-Price line looking to the simultaneous operation of this line telegraphically and telephonically with devices and methods which have been mentioned under the electrical division.

The estimates for the fiscal year ending June 30, 1904, aggregate $549,000, of which $160,000 is for the Signal Service, and $389,000 for the installation and maintenance of artillery fire-control service.

Appreciating the great importance of auto-propelled vehicles in connection with telegraph trains and balloon trains, General Greely has continued experiments with automobiles. Three different kinds of machines have been tried—the electric, steam and internal combustion. These experiences have demonstrated the practicability of self-propelled vehicles for such military purposes, and while the good points of electrical and steam-propelled vehicles have been thoroughly recognized, for war purposes the internal-combustion type seems preferable, especially one using either kerosene or heavy oil; while no perfectly satisfactory vehicle for this purpose has yet been devised, General Greely is of the opinion that the ingenuity of the American manufacturer will soon place him abreast of foreign practice.

[*The end.*]

DEVELOPMENT OF THE TELEPHONE FIELD.

The Evansville Situation.

Almost $70,000 worth of stock in the municipal telephone company at Evansville, Ind., has been subscribed. Mayor Covert says one week more will raise the amount to $125,000, and the construction company that is expected to do the work on the municipal plant will take what stock remains unsold. Owing to the fact that the ordinance giving the Cumberland company 90 days in which to leave the city was not published until a month after its passage by the council, the company is not required to quit the city until December 17th. The Indiana correspondent of the Western Electrician says the Cumberland company all along seemed unable to comprehend that it had lost the Evansville field. Its franchise has been revoked and it is under orders to remove its apparatus from the public streets. During the last week the Cumberland company submitted a proposition to Mayor Covert as follows: That the matter of rates to telephone patrons and of compensation to the city for the franchise be left to referees, one to be appointed by the company and one by the city, these two to select a third, their report to be accepted by both parties. This proposition is not even being considered by the mayor, for the reason it leaves all other would-be competing companies out. He holds that by reason of the expiring franchise, Evansville is in a position to offer the exclusive telephone service of the city to the company presenting the best offer; that there must be but one telephone system and that the best in service, rates and compensation that presents itself.

Mayor Covert has received a letter from J. C. Haynes, president of the Luce and Ohio township telephone companies in which he speaks of the importance to the city of Evansville of having connection with the Independent telephone systems now surrounding Evansville. He says there isn't a town of any importance within a radius of 75 miles of Evansville, except Booneville, which has not an Independent telephone company. His company will have long-distance connection within a short time with Owensboro, Louisville, New Albany and Indianapolis, and hopes soon to have connection with Evansville.

Telephone Opposition Assured in Utah.

The City Council of Salt Lake City on November 24th granted a 50-year franchise to the Utah Home Telephone Company, thus ending a long and bitter fight. The Home company numbers among its officers and directors Heber M. Wells, governor of Utah; John Henry Smith, brother of the president of the Mormon Church, and a number of prominent Mormon and non-Mormon business men of Salt Lake City. The promotion of this enterprise has been in the hands of E. W. Hammer and associates of Chicago, who are receiving congratulations. The plans of the Utah Home Telephone Company contemplate a complete telephone system to cover the entire state of Utah, and with its powerful local influence and strong eastern connections, the new system bids fair to become one of the prominent ones of the country. It is the intention to begin construction as soon as material can be delivered. This is the first Independent telephone franchise to be granted in the state of Utah.

Wilmington's Claim to Distinction.

[From the Wilmington (O.) Journal.]

A news note in an exchange says: "America has certainly gone far ahead of England in popularizing the telephone. It appears that one person in every 40 is a member of a telephone exchange. In San Francisco, which leads the world in this respect, the proportion is one in 12." The error in the above is the assertion that San Francisco leads the world. This town of Wilmington has that distinction. The Clinton Telephone Company has 689 subscribers connected with its Wilmington exchange, 145 of whom reside in the country round-about and 544 in the town. As our population, according to the last census, was 3,613, there is a telephone in Wilmington for every 6½ persons. There is no other town or city in the world showing such a ratio. In Sabina the ratio of the same company is a telephone for every 7½ persons.

Interstate Telephone Convention.

Preparations are almost completed for the convention of the Interstate Independent Telephone Association, to be held in Chicago on December 9th, 10th and 11th, and indications point to a most successful meeting. As has been mentioned before in the Western Electrician, the headquarters of the association will be the Auditorium Hotel, where, already, quite a number of rooms have been reserved. The entertainment committee has prepared an interesting programme for the delegates, and no doubt the visitors will be kept busy.

Ohio Telephone Notes.

Nothing definite has been announced as to what plan will be taken to get the Federal Telephone Company on its feet, but President Dickson and the other officers are making a very thorough investigation, and when that is completed, they will be in position to formulate some plan of improvement and enlargement. E. W. Moore was in New York the latter part of last week in consultation with Mr. Everett in regard to this and other matters, and it is possible that some arrangements will be made by which the financial affairs of the company will be arranged as soon as matters are in condition to do so.

It is said that the stockholders of the Sandusky Telephone Company have refused to sell their holdings to the Huron County Telephone Company, of which Senator Laning is the head, because the price, $40 per share, is less than they think it is worth. This will prevent the contemplated merger with the other companies, unless the financial offer is increased.

The Keyser and Piedmont Telephone Company of Keyser, W. Va., organized some little time ago, has purchased the property of the Union Telephone Company, which covers a large part of the country about those towns.

J. T. Carbin will put in a local telephone plant at Republic, this state, and expects to use the Globe automatic system.

The Champaign Telephone Company of Rosewood, Champaign County, has been incorporated with a capital stock of $15,000. E. M. Wenner, T. J. Heck, M. L. Stemble and W. R. Fedderjohann are the incorporators.

An Independent telephone exchange is being installed at Pataskala, which will be connected with Newark by a toll line. Work on the exchange at Utica is almost completed, and the new plant at Newark will be in working order within a week or two.

The Independent telephone company at Toledo, besides its two exchanges at Toledo, will have exchanges at Maumee, Sylvania and Whitehouse, with something like 75 miles of metallic-circuit toll lines. The company is capitalized at $1,100,000, all the stock issued, with the same amount of bonds issued. It is believed that, within six months, the company will pay a four or five per cent. dividend on the stock. The plant was built by the Central Construction Company, of which Ed. L. Barber and James S. Brailey, Jr., of Wauseon are the principal owners. Mr. Barber is the president of the telephone company and Mr. Brailey, treasurer. Robert E. Hamblin is the general manager.

Reports from Detroit are very encouraging to the Federal Telephone Company, which has about $400,000 in the plant of the People's Telephone Company there. It is thought the fact that the Co-operative company has joined hands with this company and that an application for a new franchise has been made, will bring new life to the enterprise. Under the proposed franchise the company will be allowed to charge $40 per year for residence and $54 per year for business telephones, based upon a plant of 6,000 instruments. In case the service exceeds that number, then the company will be allowed to add $1.50 per year to the price per 1,000 extra telephones in service. It is expected this plant will be completed by the Federal, as soon as the franchise is granted and arrangements can be made to do so. The plant at Jackson, Mich., has been completed and has 1,000 telephones in operation. The Federal company has $90,000 in that plant.

Rev. John Porter of Yellow Town, on the Ohio River, has organized a company to build a line from that point to Mercerville. He is at the head of a company which owns an exchange in his town.

O. M. C.

Telephone News from the Northwest.

The Rural Telephone Company has begun work for a local exchange at Morgan, Minn.

The Jackson Telephone Company of Jackson, Minn., has filed articles of incorporation with $50,000 capital stock.

The Independent Telephone Company has secured permits for conduit-excavation work at Sioux Falls, S. D.

The Wisconsin Telephone Company has awarded contracts for the erection of a new exchange building for its Eau Claire office.

The Central Telephone Company is rapidly constructing a system of rural telephones from Iowa Falls, Iowa, which will cover Hardin, Franklin and Wright Counties.

The council of Winona, Minn., has tabled the request of the Wisconsin Telephone Company to string its wires across the high bridge over the Mississippi River into Winona. The Northwestern Telephone Exchange Company's franchise expired last year and the council will not consider any applications from other Bell companies until the Northwestern shall have adjusted its franchise.

The Hawkeye Telephone Company is stringing 800 miles of copper-wire circuit from Des Moines, Iowa, to surrounding towns on four different routes. Of this, half is for the use of the company and the remaining half will be leased to the Weare Commission Company, for which it is being constructed.

The American Telephone and Telegraph Company has opened a long-distance line from Davenport, Iowa, to St. Louis, Mo.

The Adams Telephone Company of Hastings, Neb., has been incorporated. Its capital stock is $3,000.

The Farmers' Mutual Telephone Company of Greene County was voted a franchise in Jefferson, Iowa. The request for a franchise grew out of differences arising in negotiations for making connections with the local system. It is thought that the local company will now make agreeable terms.

A local company was formed at Cambridge, Iowa, and a telephone exchange will be installed there without delay. The capital stock of the company is $10,000.

The granting of a franchise to an Independent company at Burlington, Iowa, is expected to give connection with a large number of Independent telephone lines in the surrounding country.

The Audubon (Iowa) Telephone Company is building 140 miles of wire for the Weare Commission Company. It will start from Carroll and will run to Manning, Audubon, Harlan and other points.

Representatives of 16 Independent telephone companies met lately at Waterloo, Iowa, and formed the Northeastern Iowa Independent Telephone Association. Its object is to secure better connections and to regulate the toll rates.

Citizens of Anacortes, Wash., complained over the rates of the Sunset Telephone Company and have received a reduction from $1.75 to $1.50 for party lines.

R.

Southern Telephone Developments.

The Southern Bell Telephone Company has begun work on a $35,000 annex in Atlanta, Ga. There will be accommodations for a total of 10,000 telephones.

The Bell Telephone Company has rushed men and material to Pensacola, Fla., for the purpose of putting its wires underground, but the City Council has unexpectedly failed to pass upon the application, which has been referred to the city attorney, this being done, however, to determine the bearing of such action upon a suit for back taxes from the telephone company now pending.

The Cumberland Telephone Company has been at work in Water Valley, Miss., for two months reconstructing the local telephone system. A long-distance connection has also been completed.

The new switchboards for the local exchange at Chesterfield, S. C., are being installed by a telephone company of Sumter, S. C.

The Cumberland Telephone Company has let the contract for a new exchange and office building at Hopkinsville, Ky., to cost $15,000.

Some comment has been occasioned by the large number of Independent systems being absorbed in South Carolina by the Southern Bell Telephone Company, but, under the charter granted by the state, the Legislature can repeal, modify or amend the Bell charter at pleasure. The Railroad Commission also holds jurisdiction over the telephone companies in the state.

The Asheville (N. C.) Independent Telephone Company proposes to build a new telephone exchange at Hendersonville. The material has been ordered. It is said that the Bell company had also projected a system in the same town.

A new Strowger telephone exchange will be installed at Waynesboro, Ga., by the Augusta Telephone and Electric Company.

L.

NEW COMPANIES.

The Marshall County Telephone Company of Benton, Ky., has been incorporated with a capital stock of $5,000.

The Stewardson (Ill.) Telephone Company has been incorporated with a capital stock of $2,500. The incorporators are T. P. Mantz, D. M. Duddleson and W. Frede.

The Uneeder Telephone Company of Newtonia, Mo., has been incorporated with a capital of $3,500. The incorporators are J. A. Hundson, D. P. Weems, G. W. Harrison and others.

Articles of incorporation of the Pearl City Independent Telephone Company were recently filed at Freeport, Ill. Dr. W. E. Clay, Ira Lowry and Calvin Barlow are the incorporators, each having subscribed $5,000, making a capital stock of $15,000.

The Sabine Valley Telephone Company has been organized at Center, Texas, to construct and operate a telephone system through the counties of Shelby, San Antonio, Panola, Jasper, Newton, Tyler, Jefferson and Sabine. The incorporators are E. C. Branch, W. A. King, Jr., J. T. Polley and J. W. Sanders. The capital stock is $20,000.

The Bell Telephone Company of Buffalo, N. Y., certifies to an increase in capital stock from $5,000,000 to $10,000,000. The certificate of increase, filed with the secretary of state, was signed by Edward S. Hall, chairman, and Joseph S. Baecker, secretary, of the meeting of the stockholders.

GENERAL TELEPHONE NEWS.

The Jasper County (Ill.) Telephone Company certifies to an increase in capital from $5,000 to $10,000.

The George Telephone Company of Georgetown, Ky., it is reported, will expend $20,000 in improvements.

The Prince William and Loudoun Telegraph and Telephone Company of Evergreen, Va., proposes the extension of its lines.

The two ends of the Rambler-Laramie (Wyo.) telephone line have been united and the company is now ready for business.

The Delaware (Ind.) and Madison County Telephone Company will soon have all its instruments in operation. The company has 1,400 subscribers to begin with.

The telephone line installed by E. H. Dulmage of Greer, Idaho, between Pierce City and Greer, has been extended to Orofino, Cal., where it connects with the Pacific States Telephone Company's line.

The Southern New England Telephone Company is to install a new common-battery switchboard at New Haven, Conn. The company has over 20,000 telephones in service, 3,700 of which are in the New Haven division. Nearly all towns in Connecticut are connected by telephone.

The telephone system of Lafayette, Ind., is undergoing important changes which will result in an improved service, wide extension of the lines and better facilities of every kind. The company will expend several hundred thousand dollars in the betterment and extension of the system.

The Taunton Telephone Company is endeavoring to obtain a franchise in Attleboro, Mass., but is being vigorously opposed by the Providence Telephone Company. The Attleboro selectmen have the matter under consideration. The Taunton company intends to apply for franchises in Rhode Island. It has obtained franchises in Taunton, Dighton and Raynham, Mass., and it proposes to connect Fall River, New Bedford, Taunton, Middleboro, Brockton and Attleboro, Mass., and Providence, R. I.

The Niagara County Home Telephone Company, which company is a merger of the home companies in the Tonawandas, Lockport and Niagara Falls, N. Y., has held its first meeting and elected the following-named officers: President, Dr. W. R. Campbell of Niagara Falls; first vice-president, Albert R. Smith of North Tonawanda; second vice-president, W. T. Ransom of Lockport; secretary-treasurer, F. H. Surde, Niagara Falls. After January 1st the principal office of the consolidation will be in Niagara Falls.

The extension of the Maryland Telephone and Telegraph Company to York, Pa., has been completed and will be opened for service in a short time. The company has planned to confer upon the mayor of York the honor of being the first to talk over the lines. He will send a greeting to Mayor Hayes of Baltimore. The extension will open communication with Gettysburg, Hanover, Columbia, Harrisburg, Chambersburg and surrounding territory. Work on the line to Philadelphia is in progress and will be completed in about two weeks. A line has also been extended to Mt. Washington.

As a result of the application of a new company for a franchise in competition with the Bell company at Hamilton, Ont., a committee appointed by the council made an investigation of the telephone situation in 21 cities in Canada and the United States, visiting Detroit, Grand Rapids, Toledo, Cleveland, Pittsburg, Rochester and Buffalo. The substance of its report is that competition is not desirable unless to regulate some very grave evil; that it raises rates to business and professional men and lowers rates to the resident, and that the best solution is government ownership of the trunk lines and local or municipal ownership of the local lines.

Frank Lappin is the inventor of a patented design for a combined metal curb and conduit which is intended to replace the present system of buried conduits for telephone and telegraph cables and to carry the cables where they can be reached for inspection, renewal or repair, without dragging them out. The troughs have cast-iron covers and the cables are carried on wooden strips. The internal dimensions of the conduit are nine by 16 inches at the pavement and nine by 12 inches crossing the street, flush with the bed of the pavement. This will accommodate four cables of 500 pairs each and two cables of 300 pairs each. The conduits are designed to be water-tight, and as the cast-iron covers can be easily removed, the cables are accessible for inspection and tapping at any point.

MANUFACTURERS AND DEALERS.

Jones & Winter, telephone contractors, Chicago, have commenced the installation of an Independent telephone exchange at Canton, Ill. They have other contracts at Jackson, Tenn., and Paducah, Ky.

The Boston Telephone Selector Company, organized at Portland, Maine, has filed its certificate of organization with the Maine secretary of state. It has a capital of $500,000, $500 paid in. J. F. Fanning of Portland, Maine, is president, and A. C. Perry of Portland, Maine, is treasurer.

Oral Agreement in Relation to Patent Ownership.

The case of Frank B. Cook against the Sterling Electric Company of Lafayette, Ind., et al. is of general interest to electrical men, both from the prominence of the parties and the principle involved. The facts in the case and a decision on one point involved are given in the following decision of Judge Baker, recently handed down:

On April 19, 1902, Frank B. Cook, complainant herein, filed his bill against the Sterling Electric Company et al., in which he alleges that he was the first and original inventor of a certain new and useful improvement in telephone switchboards, and that on January 16, 1900, letters patent No. 641,373 were duly granted him therefor. He further alleges that the defendants unlawfully and without his license have made, used and sold sundry specimens of the apparatus covered by his patent, and are threatening to continue so to do, to his great wrong and injury; and he asks for an injunction restraining the defendants from making, using or selling the invention covered by his patent, and for damages. The application for the patent was filed in the Patent Office on February 8, 1898.

The defendants have filed a plea to the whole bill which, omitting the caption and formal parts, is as follows:

"That prior to any of the acts complained of in said bill the complainant herein on or about the 3d day of October, 1899, and prior to the issuance of said patents, made with the Sterling Electric Company, defendant herein, an oral agreement purporting to grant thereby to said Sterling Electric Company, and to its officers and directors in its behalf, the exclusive right to make, use and sell, and to license others to make, use and sell various improvements, among which was the improvement in telephone switchboards described in United States letters patent No. 641,373 for the full term of the life of the said patent throughout the United States, in consideration of 400 shares of the capital stock of said Sterling Electric Company of the value of $40,000 and $8,000 in cash, which was paid to said complainant.

"That since the making of said oral agreement said complainant, Frank B. Cook, has repeatedly stated orally and in writing to these defendants and to others that the corporation defendant and the individual defendants, who are officers and directors of said corporation, in its behalf, have been authorized and exclusively licensed to make, use and sell and to license others to make, use and sell the apparatus described and claimed in said letters patent through the United States by him, the said Frank B. Cook, the patentee of said patent, during the entire life of said patent; all of which statements these defendants aver to be true, and they plead said license to the said complainant's bill and pray judgment."

The plea has been set down for argument by the complainant, who insists that the same does not state facts sufficient to constitute a bar or defense to his bill. The various contentions of the complainant are reducible to the single proposition that the oral agreement of sale set up in the plea is void at law, and that being void at law it must be regarded as void in equity; or, stated in other words, that an oral agreement for the sale of an invention made after application for patent and before it is granted, is valid both at law and in equity when pleaded as a bar or defense to a bill by the patentee for infringement.

The court entertains no doubt that an oral agreement for the sale of an invention, founded on a sufficient consideration, made pending an application for a patent, is valid in equity and constitutes a good defense to a suit brought by such inventor after he has obtained a patent for the invention. The inventor of a new and useful improvement acquires thereby no exclusive right to it until he obtains a patent. The exclusive right is created by the patent, and no suit can be maintained by the inventor against anyone for using it before the patent is obtained. But the inventor of a new and useful improvement is vested by law with an inchoate right to its exclusive use which he may perfect and make absolute by proceeding in the manner which the law requires. Cook possessed this inchoate right at the time the oral agreement of sale was made. The invention had then been made and an application was pending to obtain a patent.

This inchoate right to the exclusive use of the invention was a property right and the subject of bargain and sale unless forbidden by the statute. The statute (Section 4898 R. S. U. S.) does not prohibit such bargain and sale. It applies solely to the assignment, conveyance or grant of a patent or an interest therein, and not to the sale of the invention before the issuance of a patent. The statute does not profess to deal with the invention until the inchoate right to its exclusive use has been perfected and made absolute by the obtaining of a patent. Before the patent is granted, the sale of the inchoate right to the exclusive use of an invention is governed by the general principles of the law relating to bargains and sales.

The case of Gayler V. Wilder, 51 U. S., 477, decides that the inchoate right to an invention may be sold and assigned before a patent therefor has been granted. In that case, it is true, the assignment was in writing, but unless a right of property existed in the invention before the patent was issued, the assignment would have been invalid for want of a subject-matter on which it could operate. In this country, where the principle of the patent laws is recognized, where an invention is regarded as property which may be set apart for a person's own exclusive use, why is it not assignable without an enabling statute? What reason can be assigned why an invention which is regarded as property shall not be transferable like other propery, there being nothing in the statute to prohibit it? In my opinion, it can be done. An oral assignment or sale of invention, before the issuance of a patent therefor, is valid, and invests the purchaser with the equitable title, and the inventor who, after such assignment or sale, obtains a patent, holds the legal title in trust for the owner of the equitable title.

These cases [referring to citations omitted here] establish the doctrine that an oral agreement for the sale and assignment of the inchoate right to the exclusive use of an invention before a patent has been granted therefor is not within the statute of frauds, nor within Section 4898 of the Revised Statutes, requiring the assignment of a patent or of an interest therein to be in writing, and that such an agreement may be specifically enforced in equity upon sufficient proof thereof.

It is claimed that whatever may be the equitable rights of the defendants under the agreement, the legal title is in the complainant and that the oral agreement cannot be set up as a defense, and that the defendants should file a bill setting up their equitable rights and compel a transfer of the legal title.

It suffices to say that this contention overlooks the fact that this is a suit in a court of equity, where, in matters within its jurisdiction, an equitable title is as good as a legal title as to all parties affected by such equity. It cannot be maintained in a court of equity that a party holding the equitable title will be denied his equitable rights by the holder of the naked legal title. In such a case the holder of the legal title stands, in a court of equity, as a mere trustee for the use and benefit of the owner of the equitable title or estate. It certainly would be against conscience to permit a complainant, while holding the consideration for the oral agreement of sale, to pursue the defendant as wrong-doers.

No objection, either in point of form or substance, has been pointed out to the plea by any exception thereto. When a plea is set down for argument without any replication, no objection can be taken to its form or regularity. Such objection can only be made by exceptions. By setting the plea down for argument the complainant tests its legal sufficiency and, in effect, demurs to it. The truth of all facts stated in the plea which are well pleaded are admitted, however inconsistent with or contradictory of the allegations of the bill.

The plea is allowed as sufficient, with leave to the complainant to reply thereto, if so advised, within 20 days; failing to reply, the bill will be dismissed.

It thus appears that Frank B. Cook brought suit against the Sterling Electric Company charging infringement of patents owned by him, the Sterling Electric Company answering that it owned the exclusive right to the patents sued upon, by virtue of an oral agreement. The plaintiff Cook raised the legal question, at the outset, whether, assuming the oral agreement, it was valid under the statute requiring such agreements to be in writing. The court decided that, in an equity suit, such an agreement, if proved, would constitute a defense, and gave the plaintiff Cook 20 days within which to join issue on the fact. This has been done, and the next move will be to try the case on the merits, the Sterling company affirming and Mr. Cook denying the existence of the oral agreement in question.

Transatlantic Space Telegraphy.

William Marconi recently made the statement that the Italian cruiser Carlo Alberto had been in continual communication with the Poldhu station in England during the entire trip across the Atlantic Ocean. This is the first official statement given to the public, although rumors that the above had taken place have been afloat ever since the arrival of the Carlo Alberto off the coast of Nova Scotia. In the present instance, messages were received instead of the single letter (S), which was transmitted across the Atlantic Ocean last year to St. Johns, N. B. The new station at Table Head is soon to be finished, and then it is claimed that there will be absolutely no trouble in transmitting any message whatsoever. The Morse code is used.

J. M. Carter, vice-president and general manager of the Belton and Temple (Texas) electric railway, is reported to have said that a representative of the company will visit Chicago, Cleveland, Cincinnatti, Pittsburg, Baltimore, Philadelphia and New York to purchase material for the construction of 12 miles of railway between Belton and Temple. Sixty-pound steel rails, standard ties and poles will be used. Orders will be placed for rolling stock, or the entire construction and equipment will be let to a contractor.

A Storage Battery Without Jars.

Malcom O. Smith, formerly an employe of one of the largest storage-battery companies in the country, has invented a tray-plate storage battery, now being placed on the market by the Smith Storage Battery Company of Binghamton, N. Y. A decrease in weight, to accomplish a given amount of work, of 40 per cent., a gain of one-third in compactness, a reduction in cost of one-third, and a substantial gain in efficiency in every way, are the claims for this battery, which the makers are now prepared to demonstrate.

Mr. Smith has made a radical departure from the beaten path of battery manufacture in the style and form of his battery. Patent experts say that this is the first storage battery, in many years, for which patents have been granted on every claim presented, without modification. The inventor first tried to devise improvements in the style and method of processing, in which he has been successful. He then dispensed with the use of jars altogether by designing his tray batteries, in which the lead plates themselves are used for holding the electrolyte. The gridded plates are formed into oblong travs, pointed toward the bottom, so as to permit of nesting.

In making up one of these batteries, any desired number of trays can be nested on top of each other, separators of perforated sheets of hard rubber or other suitable acid-proof material keeping the trays from contact with each other. As nested, there is sufficient space between the trays to hold the electrolyte, which is as much in contact with the bottom of the tray above it as with the inside of the one which holds it. This permits of an equal chemical action upon the upper side of one plate and the under side of the one above it.

In preparing the plates, the under side of each tray is chemically treated to become oxide, and the upper side peroxide of lead. This makes the upper side of each tray the positive side and the under one the negative side of what in other batteries would be a single cell.

By adding another tray to the nest, the potential is increased by two volts, the same as adding another cell to an ordinary battery. The under side of the bottom tray and the upper side of the upper one are plain, and are inactive. The voltage of any battery will accordingly be twice as much as the number of trays, minus one. A battery of 11 trays will accordingly give 20 volts, being the same as an ordinary battery with 10 cells. In fact, the discharge potential is said to be 2.1 volts per cell for a good share of the time on a normal discharge.

For regular work there is no connection between the plates of the battery, except the electrolyte. It is possible, however, to obtain any combination of series-multiples or multiple-series connections that can be obtained in any battery.

One of the advantages of this type of battery is its extremely low internal resistance. This results in another great advantage—the rapid or uneven manner in which it can be charged or discharged without fear of buckling. The discharge at all times from the entire surface, it is claimed, results in a remarkably even potential, no matter how variable may be the load. The voltage is also maintained at the regular pressure until the battery is nearly exhausted. These features are of great advantage for any kind of work where batteries may be employed, but it is particularly so for automobile use, electric-railway power houses, isolated electric-lighting plants, etc.

A great saving in both cost and weight is made by dispensing with the use of jars, either of glass or hard rubber. The arrangement of the trays also results in obviating the trouble of deposit in the bottom of the jars of active material.

Stanley Company's Transformers Non-infringing.

Considerable interest has centered in the suit brought by the Westinghouse Electric and Manufacturing Company against the Orange County Gas and Electric Company, in which the complainant asked for an injunction to restrain the defendant from using transformers of the AO and G types made by the Stanley Electric Manufacturing Company and alleged to infringe Stanley patent No. 469,809, owned by the Westinghouse company. Judge Lacombe of the United States Circuit Court for the Southern District of New York has handed down a decision denying the motion for injunction, the court holding that, in view of the repeated and concurrent testimony of the many experts called by the defendant, the claim of infringement could not be considered. This suit was notable for the number of prominent electricians who presented expert testimony. Among those who submitted affidavits for the Stanley company were Dr. F. A. Perrine, Professors Crocker, Pupin and Franklin, A. E. Kennelly and Carl Hering.

P. J. Ramoin of Syracuse, N. Y., is said to have invented an automatic self-cleaning switchpoint which operates successfully. The Syracuse Rapid Transit Company is reported to have made tests of the invention, which were entirely satisfactory. The owners of the patents are the inventors, J. E. Shackford, Jr., and C. J. Wheaton.

CORRESPONDENCE.

New York Notes.

New York, November 22.—Herbert H. Vreeland, for years the head of the Metropolitan Street Railway Company, has resigned, and William E. Elkins is now president of the company. Mr. Vreeland resigned to become president of the Metropolitan Securities Company, the holding company of the Metropolitan railway interests. He has also been elected president of the Interurban Rapid Transit Company, which operates the lines absorbed in the recent Metropolitan merger.

Rumor has been afloat in the stock exchange all week that the Manhattan Railway Company was to be leased to the Interborough Rapid Transit Company, which is commonly known as the Subway Company. A seven per cent. guaranteed dividend basis is reported as the foundation of the deal. No official announcement concerning the affair can be obtained; nevertheless, while the deal is pending, Manhattan stock is attracting all the attention on the exchange and its price is soaring high, having reached 154.

On close inspection it was found that the recent fire on the new Brooklyn Bridge did little damage, although it created a great disturbance and caused much trouble. The main cables were not damaged.

The nominal horsepower in engines now installed in New York for the operation of light and power purposes is 139,100, and the kilowattage in generators amounts to 96,500. The overload capacity of the engines will bring their maximum horsepower up to 205,000, and the generators are equal to a load of 137,000 kilowatts. The new plants and improvements now in hand will add almost 200,000 horsepower to the present rating.

The Magnetic Club, composed of members of the telegraphic fraternity in New York and vicinity, including electricians and the operators in the Western Union and Postal Telegraph and Commercial Cable offices, gave a dinner in the Hotel St. Denis last Saturday evening, and about 300 guests were present, including officers of the telegraph companies. The members of the Western Union staff wore violets and those of the Postal white carnations.

Two French commissioners were in Brooklyn last week inspecting the lines of the Brooklyn Rapid Transit Company. They were taken to Brighton Beach by Assistant Master Mechanic Kelley, after which they were taken in a parlor car to Prospect Park and to the power houses. They were then dined at the Brooklyn Club by President J. L. Greatsinger. J. F. Calderwood, assistant to President Greatsinger, is in Hot Springs for his health.

The annual stockholders' meeting of the Metropolitan Street Railway Company will be held in this city on December 1st. A special stockholders' meeting will be held on the same day for the purpose of voting upon several propositions of minor importance.

R. G. Monroe, commissioner of water supply, gas and electricity, has announced that all telephone, telegraph, gas and electric-light companies operating in Brooklyn must begin to place all wires underground at once. He adds that the Brooklyn Rapid Transit Company has been directed to bury its feed and all other wires, except the trolley wires. According to the commissioner the work must be finished by May 1st next, but the charters of the various companies give them 30 days' grace.

The Pennsylvania Tunnel franchise was before the Board of Aldermen last Tuesday, and the final action was the reference of the franchise to the railroad committee to hold a public hearing on November 26th.

Just at present purchasing agents for the city's railways are having considerable trouble in obtaining a sufficient supply of anthracite coal, notwithstanding the fact that the railroad companies are doing their best to meet the demand. The streets of the city are filled with soot, and all efforts to suppress the smoke nuisance seems for the present non-productive of results.

An important consideration has come up before the Rapid Transit Commission on several occasions and has received some slight comment in the daily papers. It is as regards the building of pipe-galleries in the Broadway subway in which to install the many pipes which lie under Broadway and so frequently cause the street to be torn up. These galleries could be entered from suitable manholes and any damaged pipes repaired without in any way inconveniencing the general public through the tearing up of the pavement. The original plans for this subway provided for this gallery, but political interference caused the Rapid Transit Commission to push the tunnel and leave the side issue out. It is to be hoped the commission will find its way clear to finance the project which most surely means a great deal to a city like New York.

O.

New England News.

Boston, Mass., November 21.—The Danbury and Harlem Traction Company, which is building an electric railway between Danbury, Conn., and Golden's Bridge, N. Y., has elected a new board of directors consisting of Henry Bernd, John R. Hill, Joseph A. Serre, Henry W. Hoyt, D. E. Loewe, John McLean, Timothy H. Foster and Philip Simon of Danbury, Stebbins Quick and W. H. I. Howe of North Salem, N. Y.; E. B. Brady of Golden's Bridge, R. F. Demere Lemon, Edward Shedd and J. Herbert Shedd of Providence, R. I., and Samuel A. Coe of Ridgebury, N. Y. Complications caused by the absorption of a controlling interest in this company, by the Westchester Traction Company, led to a suspension of construction work last spring, but operations will soon be resumed. Most of the grading has been completed, some rails have been laid, and the power house and car barns are nearly finished.

Three officials of the Northeastern Railway Company of England inspected the third-rail system of the New York, New Haven and Hartford railroad last week. N. H. Heft, chief of the railroad company's electrical department, acted as guide.

The Boston Merchants' Association has adopted resolutions indorsing the Washington Street subway bill and calling upon Boston voters to vote for its adoption at the coming municipal election. The Central Labor Union of Boston has adopted resolutions calling for the defeat of the bill on the following grounds: "According to the statement of Senator Jones, when he was advocating the defeat of the labor clause in the subway bill, such defeat would result in a saving of $1,200,000 in the construction of the subway. The whole of this $1,200,000 would necessarily be extorted from the poorest paid labor in the community for the sole benefit of the Boston Elevated Railway Company. We protest against having the most helpless class of laborers exposed to the extortion of greedy corporations and contractors. We recognize the urgent need of the Washington Street subway, but we believe that the citizens of Boston are willing to wait for such subway until the Boston Elevated Railway Company is ready to do justice to the laborers who construct it."

The people of Southern Vermont are favoring the consolidation of the various electric-railway companies in that section, believing that better and cheaper service will result. Electric-railway companies operating in the middle and northern counties of the state are considering the extension of their lines into New Hampshire.

The American Automatic Switch Company has filed its certificate of incorporation with the Connecticut secretary of state. N. B. Coulter, J. W. Mahoney and E. W. Wightman are the incorporators.

A brick boiler house, 23 by 28 feet, is being built at the power station of the Enfield (Conn.) electric-light plant. A cross-compound engine of 300 horsepower has been set up and a new line of shafting will be put in. The lighting capacity will be doubled without increasing the steam plant.

By agreement of counsel, Judge Loring of the Supreme Court has entered a decree for the plaintiff in the suit of the Holyoke (Mass.) Water Power Company against the city of Holyoke. The company sued to recover damages incurred by the city's taking its gas and electric-light companies. By the decree the company gets $707,000 for the plant and $18,000 per year for power.

At this week's meeting of the Boston Board of Aldermen Alderman Norris introduced a resolution which stated that, in the opinion of the City Council, the city of Boston should not pay more than $75 per arc per annum for its electric lighting, pending the establishment of a municipal electric-light plant, and, that, in the opinion of the City Council of the city of Boston, the establishment of a municipal electric-light plant will result in a great saving to the taxpayers. The mayor was requested to petition the General Court, at its next session, for the passage of an act that will enable the city of Boston to secure, at the earliest possible date, its electric lighting at a minimum cost.

After a long delay caused by trouble in obtaining a location in Whately, Mass., the Greenfield, Deerfield and Northampton Street Railway Company Association has been granted a charter, the location having been obtained by means of a "missing-link" decision of the Massachusetts railroad commissioners. The company is to build an electric railway seven miles long from Deerfield to Hatfield, Mass., via Whately. Its capital is $20,000. Those interested are J. B. Bridges, W. W. Sanderson, W. H. Belden, Oscar Belden and others.

The Derby (Conn.) aldermen have granted a franchise to the Connecticut Railway and Lighting Company, thus probably insuring the early building of an electric railway betwen Derby and New Haven. The Fair Haven and Westville Railway Company has built a large portion of the New Haven section of the road.

B.

Southern Developments.

Charlotte, N. C., November 21.—It is stated that all preliminaries have been arranged for constructing a trolley line from Summerville, S. C., to Charleston, and negotiations are now pending for the issuing of bonds. Ohio capital is behind the scheme.

The lighting facilities of Nashville, Tenn., are to be increased during the coming year by the addition of 100 arc and 1,000 incandescent lights. The capacity of the electric plant may be doubled later.

The street-car system of Macon, Ga., J. T. Myan superintendent, will be vastly improvel by the addition of new cars and rails. A capacity of 750 horsepower will also be added to the electric plant.

John Trees of Louisville, Ky., has visited Vicksburg, Miss., to inspect the local electric street-railway system, in the interest, it is said, of prospective purchasers. J. C. Shaffer is president of the road.

Announcement has been made of a close alliance between the W. S. P. Shield Electric Company and the Hampton Roads Railway and Electric Company in Virginia. This is said to be the first step toward a consolidation. The former company recently established a plant for electric lighting in Phoebus, Va.

The City Council of Lawrenceburg, Tenn., has passed an ordinance for an election, on December 16th, on the question of issuing $20,000 bonds for water and electric-light plants. L.

From the Buckeye State.

Cleveland, Ohio, November 22.—Professor C. H. Benjamin, former smoke inspector of Cleveland, has suggested to the owners of large business and power buildings of the city that they establish a central heating and lighting station, in which hard coal is to be used as a fuel, as a means of doing away with a large part of the smoke. This is to be run on the co-operative plan, and he contends that it will not only do away with a great deal of smoke, but will be cheaper as well. However, he would have to include power in this plan, as many of the buildings operate their own electric-power plants.

The Ohio Messenger and Telegraph Company of Cincinnatil has been absorbed by the American District Telegraph Company. Secretary C. R. Johnson goes to New York as auditor of the parent company, but the other officers will be continued as they are. The change will take place on December 1st.

The Toledo, Fostoria and Findlay Railway Company has sold $1,000,000 of bonds in the East, which will enable it to complete its line from Toledo to Findlay. It is in operation between Findlay and Fostoria.

A story is going the rounds that the Widener-Elkins syndicate is ready to take over the traction interests at Wheeling, W. Va., and that an interest has been secured in the Columbus, Buckeye Lake and Newark line, which will not only be extended to Zanesville, but to Barnesville and Wheeling. How much of truth there is in this is hard to tell, but it has not heretofore been supposed that this syndicate held any interest in the Appleyard properties.

C. C. Tennis of Cincinnati will shortly accompany a party of Boston and Philadelphia capitalists to Tennessee, where rights and franchises for an electric railway on both sides of the Tennessee and through the city of Nashville are owned by Pittsburg parties. The road will be about 115 miles in length.

The Columbus, Delaware and Marion road has received one of the six new cars ordered from Newark. It is 50 feet long and will seat 56 persons. The power consists of four 75-horsepower motors, with a multiple-unit controller. The outside is of the regular Pullman color. The other five will be similar in construction and finish.

An electric power plant will be installed at the Pennsylvania docks at Ashtabula for operating the ore-hoisting machinery. It will be installed during the coming winter and will be a large one of its kind. It is probably the first on the lakes for that purpose.

It is said that a company, known as the Cincinnati Car Building Company, will be incorporated within a short time to lease the shops now operated by the Cincinnati Traction Company, and that all the cars used by the Widener-Elkins syndicate will be manufactured there.

The Burt Manufacturing Company of Akron, incorporated in Delaware, with a capital stock of $50,000, has been authorized to do business in Ohio. W. F. Warden is the president, and H. J. Blackman secretary.

A line is being surveyed between Youngstown and Canfield for an electric road, in which Max P. Goodman of Cleveland is said to be interested. It is said to be the first of a series of roads that will connect Youngstown with the Ohio River and that a number of Cleveland capitalists are backing it.

A resolution has been presented to the City Council of Toledo providing for the submission to a vote of the people the question as to whether a municipal light plant shall be erected. The Toledo Railways and Light Company has the contract at present.

For some time the Columbus Railway Company has been having much trouble with corrosion of its steel poles about two inches below the surface of the ground. In the downtown district the damage seems to be worse, and the officials came to the conclusion that this is due to the salt used in cleaning the sidewalks in winter. To prevent the damage the company is using a sand-blast machine to take off the rust, and then after putting on a special preparation of paint, a sleeve of cement is being put on. This extends from about one or two inches above the surface to a foot below. It is thought this will prevent further damage.

The Cleveland Press estimates that there is about $50,000,000 invested in stocks and bonds of electric railway companies, either owned or managed in Cleveland or in process of construction, consolidation or reorganization. They are scattered through Ohio, Indiana, Illinois, Maryland, New York, Michigan, Wisconsin, Texas and Kansas.

It is believed that the Monroe and Detroit line will be built within the next six months by the Black-Mulkey syndicate, of which Charles R. Hannan of Council Bluffs, Iowa, and Matthews Slush of Mt. Clemens, Mich., are at the head. It will connect with the Toledo and Monroe at Monroe.

Senator Foraker and other Cincinnati men have become interested in the Urbana, Mechanicsburg and Columbus line, and there are now 500 men at work on it. There is little question that it will be completed now as soon as possible. It would seem that the politicians in Ohio are greatly interested in electric-railway matters. O. M. C.

Detroit, Mich.

Detroit, Mich., November 22.—The Jackson and Battle Creek Traction Company, capital stock $1,500,000, has been organized in Philadelphia to complete the Boland-Foote electric line between Jackson and Battle Creek. The officers of the new company are: President, C. M. Spitzer of Toledo; vice-president, A. L. Spitzer of Toledo; treasurer, N. S. Potter of Jackson; secretary, W. A. Foote of Jackson, and chief engineer, W. G. Fargo of Jackson. A large force of men is now laying the third rail between Marshall and Marengo and a force is also putting up iron poles and wire in Marshall. The company wishes its franchise extended from December 1st to February 1st, when it is expected cars will be running between Kalamazoo and Grass Lake.

Cars will be running to Amherstburg, Ont., by Christmas, on the new Windsor, Sandwich and Amherstburg interurban road, provided the construction work is not hindered by unfavorable weather.

At a special meeting of the Common Council of St. Thomas, Ont., last night, the city took control of the street-railway line. The company forfeited the line to the city by failing to operate it for 60 days and $50,000 bonds will be given for the property of the railway company. The city expects to get the line in running order within a week.

The Muskegon Traction and Lighting Company has been making extensive improvements and changes. The old power plant, now rendered useless for power purposes by the erection of the new power station on the lake front, has been converted into a repair shop. A new building has been erected for the accommodation of employes, and it also provides for a train despatchers' office.

A party of four engineers from New York passed through Detroit recently on their way to Grand Rapids to make an inspection of the Grand Rapids, Grand Haven and Muskegon railway in the interest of Sanford & Porter of New York. They are to be shown the operation of the third-rail system by J. D. Hawks, the president of that road.

A dispatch from Laporte, Ind., says electric-railway extensions have been decided upon which will establish a continuous line between Chicago and Toledo, and the new Elkhart-Kalamazoo line will thus have a Chicago connection.

Congressman William Alden Smith of Grand Rapids says the money necessary to construct the electric road between Battle Creek and Lansing via Charlotte, and also Grand Rapids to Charlotte, has been secured, and articles of incorporation are being prepared. The company will consist of W. A. Smith and A. W. Tateum of Grand Rapids and Samuel McCall and George H. Lyman of Boston, and will be capitalized at $2,500,000. The entire system will be furnished power from a plant at Charlotte, the site for which has been donated by that city. The survey and setting of grade stakes has been completed and the work of building the lines will be pushed as fast as possible.

The Railway Companies General, a Philadelphia concern which, among other companies, owned the Michigan Traction Company, operating lines in Battle Creek, Kalamazoo and Augusta, has been sold to a syndicate of New York and Philadelphia capitalists, who will develop and extend its various systems.

Smith & Nelson of Muskegon have been given the contract for the construction of the bridges by which the Grand Rapids, Grand Haven and Muskegon Railway will cross Grand River and enter Grand Haven. In addition to the bridges there will be half a mile of trestle to construct.

John F. Keys has been appointed assistant division superintendent of the Detroit United Railway. He started six years ago as office boy in the office of President Hutchins and has worked in both office and operating departments.

The Detroit United Railway has recently acquired four lots in the city of Flint for the construction of terminal facilities, and it is understood a fine passenger and express depot will be erected in the near future.

There is a story in electric-railway circles that H. A. Everett's dream of a big electric system connecting Port Huron and Detroit with Cleveland, to be run under one management, is about to be realized, and that steps are now being taken to consolidate the interests into one great company in which the Detroit United, the Detroit and Toledo and the Lake Shore electric companies will be merged. Officers of these companies who have been approached in regard to this rumor say that they have no information to give out in connection with the story. Clarence A. Black says: "We will build our lines from Monroe this way. While our relations with the Detroit United Railway interests have always been very friendly, there has yet been no definite arrangements made between us regarding any of the operations of the Detroit and Toledo electric railway. The consolidation of these lines seems to me to be perfectly feasible, and I believe it has got to come sooner or later. There will be fast time made between here and Toledo, and I cannot see why fast time cannot be made clear through to Cleveland. The interests are interwoven, and I can see no reason why they should not be consolidated."

The new storage-battery plant that is being installed by the Grand Rapids Edison Company has a capacity of 8,000 horsepower and will be ready for use in a few days. C. G. W.

Information from Indiana.

Indianapolis, November 24.—The commissioners of Vigo County have given a franchise to the Terre Haute street railway for an interurban line on the Lafayette road, from the north city limits to the county boundary line of Park County. The road as already surveyed runs through part of Park County to reach Clinton, a prosperous town in Vermillion County. The railroad company was not asked to give Vigo County any remuneration for the 50-year grant.

At a meeting of the officers and stockholders of the Indiana Central Electric Railway Company at Seymour on the 20th inst., steps were taken to build a line connecting with the Indianapolis, Greenwood and Franklin line at Columbus and running down to Seymour, Brownstown, French Lick and West Baden. A. E. Cranshaw, an electrical engineer, was employed to make the survey and furnish estimates. The first assessment of five per cent. against the stock was made, to be paid at once.

Normal City, an incorporated suburb of Muncie, thinks 99 years too long a time for which to grant the Union Traction Company a right-of-way, and a hitch has resulted between the town authorities and the company. This grant is desired for the Muncie-Alexandria line which is now being built. The company submitted a second proposition, but the town trustees will not agree to it until it is greatly modified and the term reduced.

The first Union Traction passenger car to make the trip over the new extension from Elmwood to Tipton was run on the 21st inst. The car was occupied by Charles Baldwin, general passenger agent; W. H. Bloss, chief engineer; E. B. Sampson, treasurer; M. G. Drum, general manager, and E. C. Cox, road master. The new line is superbly constructed, and for the entire length has scarcely a curve in it. The ballasting is almost completed and a regular schedule will be adopted soon.

Gardner F. Wells succeeded J. Peyton Clark as general manager of the Terre Haute Electric Company on the 21st inst. This company owns the Terre Haute street-railway system, the interurban line between Terre Haute and Brazil, and the electric-lighting plants in both cities. It is understood that Mr. Clark will remain with the company, but in what capacity is not stated.

J. M. Smith, vice-president and general manager of the Indiana Electric Railway Company, which owns the lines connecting South Bend, Mishawaka, Oceola, Elkhart, Dunlap and Goshen, and is building a line between South Bend and Niles, Mich., has assured the promoters of lines to be built from Wabash, Warsaw and points in that vicinity to South Bend that he will willingly make traffic arrangements at Goshen, whereby they can enter any of the interurban cities over the Indiana Railway Company's lines. This is regarded as a liberal proposition.

Evansville is preparing to have an exhibition of "The Evolution of the Street Car." It will be held by the local street-railway company and is intended to illustrate the progress made in rapid transit methods in the last 10 or 15 years. One feature of the exhibit will be a procession of street cars which will represent the various epochs of development in the street car, from the old-time one-mule car to the present commodious and luxurious electric coach.

The International Brotherhood of Electrical Workers has organized a local union at Shelbyville and made W. J. Smith president.

Mayor Bookwalter of Indianapolis has received an invitation to become a member of one of the more important committees for a municipal ownership convention to be held in New York in January. The object of the convention is to listen to papers and arguments on muncipal ownership of electric street railways, electric lights, water, and other public utilities.

The New Castle and Muncie Traction Company filed articles of incorporation on the 21st inst. The company proposes to construct and operate street railways in the cities and towns of New Castle, Mount Summit, Springport, Oakville, Cowan, Muncie, Alexandria, Hartford City, Portland, Bluffton, Marion, Fort Wayne, Cambridge City, Knightstown, Dunreith and Connersville, to supply the same with electric power and steam heat and to construct and operate interurban lines connecting the towns and cities mentioned. The original capital stock of $10,000 will be largely increased. E. T. Ice, F. W. Nixon, C. B. White and C. C. Hunt are the incorporators and the home office will be in New Castle. F.

PERSONAL.

C. W. Simonson of Dayton has been appointed general passenger agent of the Columbus, Delaware and Marion railway, with offices in the Ruggery Building, Columbus.

Sir William C. Roberts-Austen, president of the Iron and Steel Institute and honorary general secretary of the British Association for the Advancement of Science, died last Saturday in London, England. He was 59 years old.

W. G. DeCelle, vice-president and general manager of the Gas, Electric and Heating Company of Owatonna, Minn., has resigned his position as manager. He is succeeded by C. L. Powell of Chicago, who is a heating expert. Mr. DeCelle goes to Chicago.

Edward B. Ellicott, city electrician of Chicago, read a paper on "Transmission of Fire Alarms" before the Western Society of Engineers in Chicago last week. William H. Musham, fire marshal, also presented a paper, his subject being "Fire Extinguishment in Chicago."

Jackson I. Case, son of Jerome I. Case of Racine, Wis., is seriously ill at his home. Jerome I. Case was the founder of a large thrashing machine company in Racine, and at his death some years ago the son took charge of the business. Jackson Case is interested in street railways in Racine and vicinity, and has done much to improve the systems. He is 37 years of age.

The Chicago Chronicle takes occasion to say that "Published portraits of M. Jusserand, the new French ambassador at Washington, show him to be a 'ringer' for our energetic fellow townsman William J. Lloyd, superintendent of the Western Union Telegraph Company, and the resemblance does not end there. In the matter of suavity and diplomacy in gathering in a hesitating patron from a hated rival Mr. Lloyd can give cards and spades to any Frenchman that ever came up the boulevard."

Mr. T. C. Martin of New York has been appointed "editor of progress in the field" by President L. A. Ferguson of the National Electric Light Association. The office is a new one, created at the recommendation of Mr. H. L. Doherty, Mr. Ferguson's predecessor as president. Mr. Martin, who is excellently well fitted for the position, will present the first annual summary of current practice in the electric-lighting art at the Chicago convention of the association next year.

Joseph M. Wilson, a well-known architect and engineer, died suddenly of heart disease on November 24th in his office in Philadelphia, Pa. He was born in Phœnixville, Pa. Mr. Wilson was chairman of a board of expert engineers appointed by a joint committee of Congress to investigate the construction of the Washington aqueduct. He was also a member of a board of experts appointed by the Rapid Transit Commission of New York city to report on the feasibility of an underground rapid-transit system for that city.

Thomas Orton, formerly manager of the supply department of the Western Union Telegraph Company in Chicago, died on November 25th at Evanston, Ill., of cancer of the stomach. He resided at 2951 Michigan Avenue, this city. Mr. Orton was born in North Cuba, N. Y., in 1856, and came to Chicago in 1869, becoming at once connected with the Western Union Telegraph Company, of which his brother, the late William Orton, was then president. Mr. Orton remained with the company for 24 years, rising to the position of manager of the supply department and retiring from active business in the year 1893. He is survived by a widow and four daughters.

ELECTRIC LIGHTING.

The Holly (Mich.) Electric Light and Power Company has been incorporated with a capital stock of $10,000.

The Auer Light Company of Montreal, Ont., recently sustained a loss by fire amounting to $5,000. The loss is covered by insurance.

The Odell Electric Company of Odell, Ill., has been incorporated with a capital of $5,100 to furnish light, heat and power. The incorporators are W. M. Buchanan, Anna K. Buchanan and W. N. Buchanan.

ELECTRIC RAILWAYS.

Royal assent has been given to all bills relating to the Yerkes' "tube"-railway plans in London, England. The bills providing for the construction of roads cover an aggregate of 100 miles of underground and surface tracks.

The Pueblo (Colo.) and Suburban Traction Company has been incorporated with a capital stock of $3,500,000. It will bring power over copper wires from Beaver Creek Falls to Pueblo, a distance of 50 miles. The power will be used for running street cars and for lighting.

The Metropolitan Street Railway Company of Dallas, Texas, has been incorporated with a capital stock of $4,500,000. The board of directors comprises A. K. Bonta, John Frost, C. H. Bryne and H. C. Koke, all of Dallas, and Guy E. Tripp of Boston, Mass. It is stated that the company, in addition to absorbing local electric-railway lines, proposes to construct important interurban lines between Dallas and adjacent towns.

The Bernay Traction Company of Salamanca, N. Y., has been incorporated to operate a 4½-mile electric railway. The capital stock is $10,000. The first board of directors comprises S. A. Holbrook, A. J. Edgett and W. K. Harrison.

It is reported that the Vandergrift Construction Company of Philadelphia has asked for a franchise for the construction of an electric road from Ponce to San Juan in Porto Rico. The estimated cost of the construction of the road is $2,800,000.

Conductors and motormen on the Chicago Union Traction Company's lines have received their back pay due them under the recent decision of the arbitration board. Each man received from $12 to $35, a total of nearly $60,000 being distributed.

The Oklahoma Traction Company of Guthrie, Okla., has been incorporated to build either an electric or steam railroad 75 miles long, connecting Guthrie, Oklahoma City and Fort Reno. The directors are John W. Shartel, Selwyn Douglass and L. M. Spitter of Oklahoma City, and George S. Green and U. C. Guss of Guthrie.

President H. H. Pearson of the New Orleans Railways Company and his officials, charged with violating the separate-car law, have been discharged. Counsel for the company had demurred to the affidavits on the ground that the law is unconstitutional. The judge sustained the demurrers. The case will probably go to the state Supreme Court.

Indications point to the immediate building of an electric railway in the Yakima (Wash.) Valley with one terminus at North Yakima, Wash. J. F. McNaught, representing Seattle and eastern capitalists, has been in the east three weeks in conference with the head officials of the Northern Pacific relative to transfer rates and other concessions. He has sent word that an agreement has been signed with the comapny.

The opening of the Trenton and New Brunswick railway on November 9th makes it possible now to travel by trolley from New York to Philadelphia. Bound Brook is reached from New York via Newark, Elizabeth, Plainfield and Dunellen, and thence from Bound Brook to New Brunswick via the Middlesex and Somerset Traction Company's line, to Milltown, to Interstate Fair Grounds, Trenton, via Trenton and New Brunswick Railroad, to State and Clinton Streets, Trenton, to Broad and Stanton Streets, via Trenton Street Railway; Stanton Street, Trenton, to Burlington, via Camden and Trenton Railway; ferry to Bristol; Philadelphia, Bristol and Trenton Railway to Red Lion Inn, thence over the Philadelphia Rapid Transit lines to the center of Philadelphia.

PUBLICATIONS.

The Atlas Car and Manufacturing Company of Cleveland, Ohio, has issued new catalogues of its industrial railway equipment, including dryer cars, portable tracks, rail supplies, etc.

The October issue of the Transactions of the American Institute of Electrical Engineers has just been published. It contains in full the army and navy papers read before the Institute at a recent meeting, besides much else of interest. Extra copies may be obtained from the secretary of the Institute, Ralph W. Pope, 95 Liberty Street, New York city.

A new catalogue of the Queen self-regulating X-ray tube has just been issued by Queen & Co. of Philadelphia and New York. The publication contains 40 pages and has been prepared with excellent taste and special attention to the features and advantages of the tubes. A striking novelty in catalogue making is the use of illustrations showing in actual colors the appearance of the X-ray tube when operating properly and under different conditions. This is said to be the first attempt to produce anything of the kind, and as it is very difficult to describe in words the condition of an X-ray tube which is punctured, whose vacuum is low, or through which the current is running in a reverse direction, the great assistance afforded by this catalogue will be highly appreciated by anyone in his first efforts to operate a tube. The construction and operation of the tubes are explained, and autograph testimonial letters from Roentgen and Lord Kelvin are given.

TRADE NEWS.

The Orange Ice, Light and Waterworks Company of Orange, Texas, is about to prepare estimates for the adding of 20 to 25 tons additional tankage; also to install a new engine for a dynamo. W. C. Stewart is superintendent of the company.

J. J. Bellman and Henry Sanford, 2d., have opened offices at 14 Church Street, New York, to transact a general engineering and contracting business. The business is started under the most favorable auspices, as both Mr. Bellman and Mr. Sanford are practical men. They will make a specialty of power-plant work, and will take complete contracts for the entire equipment of central stations and isolated plants.

The district office managers of the Westinghouse Electric and Manufacturing Company, representing all the principal cities of the United States, spent last week in their usual annual visit to the works and offices of that company at East Pittsburg. On the evening of November 19th a very enjoyable dinner, in honor of the visitors, was given at the Duquesne Club, at which the engineers and executive officers of the company were also present.

Among the orders issued by the Treasury Department at Washington, D. C., recently was one directing the collector of customs at Philadelphia to allow, on the exportation of electric storage batteries manufactured by the Electric Storage Battery Company, of that city, in the manufacture of which refined lead from base bullion is used, a drawback equal in amount to the duty paid on the lead appearing therein, less the legal deduction of one per cent.

The Niagara Electrochemical Company has awarded John Sandstrum the contract for a very substantial addition to its plant. This company's works are located on the lands of the Niagara Falls (N. Y.) Power Company, and several times since the original plant was erected it has been enlarged, until it now covers several acres. The new addition will be of brick and iron, 200 feet long by 50 feet wide. The addition will materially increase the company's facilities.

The Federal Electric Company of Chicago has received an order from the Philippine Islands for one of its all-metal interchangeable-panel electric signs of special size. This sign is to be 12 by 2½ feet in dimensions and is to be suspended vertically in front of a prominent confectionery establishment in Manila. It is equipped with 96 lights, 48 on each side, on two separate circuits, alternate lamps being on a separate circuit and operated with a flasher. This order came unsolicited to the Federal Electric Company, which concludes that the Filipinos know a good thing when they hear of it.

The organization of the Modern Electric Light Company was perfected recently at Lincoln, Ill., by the election of the following-named officers: President, Joseph Hodnett; vice-president, Samuel Forster; secretary, A. A. Rolf; treasurer, J. S. Haller. These gentlemen and James W. Forster are directors of the company. The company is capitalized at $500,000 and will have its general offices and factory at Lincoln. The company will manufacture a new type of incandescent lamp invented by James W. Forster, and consisting of a mirror reflector, united with the glass bulb around which the filament is attached. The lamp is said to have almost double the illumination of an ordinary lamp and seems to give excellent satisfaction. The lamp has been patented in this country and in European countries and it is expected that arrangements will be made to manufacture it abroad.

The Chicago Fuse Wire and Manufacturing Company of Chicago announces that it has installed at 187 Pratt Street, Buffalo, N. Y., in connection with the Union Manufacturing and Specialty Company, a complete equipment for the manufacture of its well-known lines of fuse wire, fuse strip, fuse links and telephone and telegraph specialties. This move has been occasioned on account of the steady growth of the company's business and a desire to do everything possible to give the best service to its customers in all sections of the country. The headquarters of the company will remain at Chicago, but the eastern factory at Buffalo will be in charge of competent men, who are thoroughly trained in the details of the business. W. R. Goodman, secretary of the Chicago Fuse Wire and Manufacturing Company, further states that the company's new plans contemplate extensions in its field of work.

The Nernst Lamp Company has appointed the Commercial Electrical Supply Company of St. Louis its agent for the following states: Iowa, Nebraska, Kansas, Arkansas, Mississippi, Louisiana, Tennessee, Missouri, Southern Illinois and the territories. The selection of the Commercial Electrical Supply Company to fulfill the office of what might be called the Nernst Lamp Company's "southwestern depot," is a compliment to the standing and energy of this enterprising St. Louis institution. The Commercial company itself has forcibly demonstrated its confidence in the universal appreciation of the Nernst lamp by central-station men, by laying in at its St. Louis warehouse, a large stock of Nernst lamps. These lamps are made for stock for 110, 220 and intermediate voltages for alternating-current circuits. The single-glower 50-candlepower lamp is adapted for either 110 or 220-volt circuits, whereas the multiple-glower lamps can be used only upon 200 to 220-volt circuits. The company issues the necessary bulletins which explain the operation and advantages of the lamps. The Commercial Electrical Supply Company was never in a more prosperous condition than at the present time. Since the first of the year the business of the institution has increased to a remarkable degree. In evidence of this it may be stated that the company has been awarded the contracts for the entire lot of electrical supplies which will be used by the Louisiana Purchase Exposition Company. These contracts, in the aggregate, amount to approximately $125,000.

BUSINESS.

The Central Electric Company of Chicago is distributing samples of IXL weatherproof wire, and calls attention to the quality of insulation which it claims is the best on the market. Any prospective buyer not having received a sample can obtain it upon request.

The new dry battery recently placed upon the market by the Electric Appliance Company of Chicago has successfully stood the severe tests that were required of it to decide its usefulness as a distinct advance in dry batteries. It has been placed upon sale as the Eaco dry battery.

The Mayer Engineering Company, Monadnock Block, Chicago, has resumed the manufacture of the Mayer telephone drops. The company is now filling orders and reports good prospects. This company is manufacturers' agent for other electrical specialties, such as magnetic chucks, battery gauges, etc.

The Chicago and Alton Railway has decided that the wooden platforms around its stations must be abolished in the interests of safety and durability. They will, as rapidly as possible, be replaced by concrete. These platforms can easily be kept clean and are much more durable and but little more expensive than the old ones.

Charles H. Besly & Co., 10 and 12 North Canal Street, Chicago, having had many inquiries for a grinder with 18-inch disks somewhat cheaper in price than their regular No. 4 Gardner grinder, have brought out a new machine known as the No. 10 grinder. The new machine has a floor setting-up press, two 18-inch spiral-grooved steel disks, two tilting tables, large spindle bearings and improved countershaft.

A. C. Becken, the well-known jeweler of Chicago, states that the demand for the Paillard non-magnetic watches, largely used by those who come in contact with dynamos and motors, is greater than the supply. It is said the manufacturer cannot turn out these watches fast enough, which is indeed a worthy recommendation. Mr. Becken also states that the Paillard watch is endorsed by some of the best electricians and scientists.

The Osburn Flexible Conduit Company, with general sales offices at 21 Park Row, New York city, has recently been obliged to enlarge its manufacturing facilities. This has been found necessary owing to the increased demand for its well-known Flexduct for interior wiring.

Mr. Spiro of the Great Western Smelting and Refining Company, Chicago, who has charge of the company's manufacture for electric-railway and light concerns, states that the company's copper-hardened babbitt is now in constant use by over 75 per cent. of the electric railways, and that it is a matter of only a short time when its XXXX nickel will be in constant use by practically all of the electric-light concerns in the United States. This concern assuredly has had a remarkable success in placing its babbitt on the market.

The American Blower Company of Detroit, Mich., manufacturer of the well-known American blower and the "A. B. C." system of mechanical draft, is doing more business than at any time in its history. "A. B. C." products are used not only in every section of the United States, but in most of the civilized foreign countries as well. Its mechanical-draft system is said to be the solution of correct and saving boiler service. It is claimed to be less expensive in its initial cost than a chimney or stack and besides saves in the quality and quantity of fuel required.

The Marshall-Sanders Company of Boston, Mass., the well-known manufacturer of electrical goods, is calling especial attention to its baby knife switches, which are claimed to be the original baby switches. N. Marshall, president of the company, on his recent visit to Chicago, made arrangements with Hart & Co., Monadnock Block, for the agency of the Marshall-Sanders Company in Chicago and vicinity. A complete stock will be carried here and a large increase is expected to follow in the company's present flourishing business in sockets, switches and plug receptacles.

A battery of Chloride accumulators, consisting of 264 elements, capable of discharging at the rate of 1,200 amperes in regulating the fluctuations, has been contracted for by the Cleveland (Ohio) Electric Railway Company. The Electric Storage Battery Company will install this battery at Windermere, a point five miles from the railway power house. The battery is designed not only to care for the fluctuations on the line at this point, but to maintain the voltage during the hours of peak load. It is also intended to assist in carrying the load on the Euclid Beach line, which is very heavy during the summer months.

Among the engine and heavy-machinery sales of the Allis-Chalmers Company of Chicago for October may be mentioned the following: Indiana Rolling Mill Company, Newcastle, Ind., one 26 by 48 and one 28 by 48 1890 Reynolds-Corliss engine; Wyckoff, Seamans & Benedict, Ilion, N. Y., one 14 and 28 by 30, 1890 frame Reynolds cross-compound, direct-coupled, Corliss engine; Compania Minera De Penoles, Mexico, one straight-line Riedler express air compressor, with steam cylinder 14 by 18, air cylinder, 10½ and 18 by 18; Chicago Edison Company, Chicago, 32 and 64 by 60 vertical cross-compound, direct-coupled, Reynolds-Corliss engine; International Paper Company, New York city, two 22 by 42 1890 frame Reynolds-Corliss engines; National Tube Company, Pittsburg, Pa., six 22 and 42 by 42 vertical, cross-compound, direct-coupled, Reynolds-Corliss engines and one 44 and 84 by 60 vertical blowing engine; Brogon Cotton Mills, Anderson, S. C., 30 and 64 by 60 cross-compound Reynolds-Corliss engine; F. E. Kreatz, St. Cloud, Minn., 18 by 36 girder-frame Reynolds-Corliss engine; Euston & Co., Chicago, 18 by 42 1890 frame Reynolds-Corliss engine, 72-inch by 16-foot boiler; National Biscuit Company, Chicago, Ill., 20 by 36 1890 direct-coupled Reynolds-Corliss engine; Carnegie Steel Company, Pittsburg, Pa., 48 and 78 by 60 combined vertical and horizontal Reynolds-Corliss engine; city of Milwaukee, one 8,000,000-gallon vertical triple-expansion pumping engine; Pennsylvania Railroad Company, Pennsylvania, two Sederholm boilers, 384 horsepower each; New Jersey and Hudson River Railway and Ferry Company, New Jersey, one 28 and 56 by 48 horizontal cross-compound condensing Reynolds-Corliss engine.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, November 18, 1902.

713,586. Filament for Incandescent Electric Lamps Known as Nernst Lamps. Ricardo Arno, Milan, Italy. Application filed February 8, 1900.

The filament comprises a flat body composed of a conductor of the second class, three equidistant terminals forming part thereof and adapted to be connected to a three-phase line to load the same symmetrically.

713,589. Brush-holder Support. Herbert A. Balcome, Jamaica Plain, Mass., assignor to the B. F. Sturtevant Company, Boston, Mass. Application filed March 8, 1902.

In combination with a dynamo-electric machine are a commutator, a brush-supporting ring and supports for the ring which are adjustable toward and from the commutator.

713,599. Trolley Pole. Theodore C. Buder, St. Louis, Mo. Application filed April 4, 1902.

A trolley pole with a detachable trolley fork is described.

713,601. Rheostat. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 10, 1901.

In a rheostat for railway cars are combined with insulating supporting rods, a number of resistance grids each provided with perforated hubs by which it is mounted on the rods, so that its greater portion is separated by air spaces from adjacent grids, and end plates covering and protecting the end grids and adapted to bear upon only the hubs of the end grids for clamping the grids on the rods, the plates being constructed and arranged to be secured to the bottom of a car and perforated to permit free access of air to the grids.

713,603. Dynamo-electric Machine. Alexander Churchward, Chicago, Ill. Application filed January 2, 1900.

A dynamo-electric machine combines with a number of laminæ in the form of rings provided with projections for constituting the field poles of the machine, clamping rings for securing the laminæ together and clamping bolts passing through the clamping rings and laminæ to secure the laminae upon the rings, the laminae being provided with enlargements at holes through which bolts pass to compensate for the metal removed at the holes from the laminæ.

713,604. Dynamo-electric Machine. Alexander Churchward, Chicago, Ill. Application filed January 2, 1900. Renewed December 9, 1901.

A field core for dynamo-electric machines, having a polar projection provided with a diagonal slot is described.

713,605. Transformer. Alexander Churchward, Chicago, Ill., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 13, 1899. Renewed December 9, 1901.

A transformer combines with the transformer coils, a shell core therefor comprising U and T-shaped plates, the T-plates being inserted in through the coils alternately from opposite sides thereof and engaging the base portions of the U-plates placed about the coils from opposite sides thereof, and fastening means for securely uniting the transformer coils and core, the head portions of the T-plates being disposed between the legs of the U-plates.

713,652. Thermo-electric Generator. Isidor Kitsee, Philadelphia, Pa. Application filed February 9, 1900. Renewed April 19, 1902.

A thermo-electric cell is described which consists of two conductors, having interposed between them a material normally in its solid state but melting in its water of crystallization, if subjected to heat.

713,668. Switchboard for Illuminating Electric-light Signs. Mortimer Norden, New York, N. Y., assignor to the Norden-Bittner Electric Company, New York, N. Y. Application filed March 11, 1902.

The switchboard combines with side frames and connecting devices and stepped platforms secured thereto, series of pivoted movable contact bars and series of magnets connected to the platforms, and spring-blades in pairs and in series forming circuit-selectors, and electric conducting wires connected to the parts.

713,677. System of Electric Distribution. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 21, 1902.

An alternating-current system of distribution, combines with four distributing conductors, three transformers having star-connected primary windings and each having two secondary windings only, which are of substantially the same length and are reversely connected to one of the distributing conductors.

713,678. Controller for Electric Motors. Thomas S. Perkins, Idlewood, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 6, 1902.

The controller combines with a manually actuated reversing switch and a rheostatic switch, a spring connection between the switches and means for locking the movable member of the rheostatic switch until the reversing switch is in circuit-closing position.

713,700. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Gustave P. Gehring, Philadelphia, Pa. Application filed June 10, 1901.

Combined in a receiver for electrical oscillations are an imperfect electrical contact, a main relay circuit therewith, and permanent magnets provided each with an air-gap of an intense magnetic field, through which the relay circuit passes.

713,711. Brush-holder for Motors, etc. Bernard A. Stowe, Cleveland, Ohio, assignor to the Jandus Electric Company, Cleveland, Ohio. Application filed July 12, 1902.

One claim reads: In a brush-holder the combination with an arm and a fixed jaw at one end thereof, of a jaw pivoted to the arm and co-operating with the fixed jaw to form a housing, and a spring within the housing and bearing at one end against the end of the pivoted jaw and adapted to bear at its other end against a brush inserted into the housing.

713,712. Switch for Electric Circuits. Harve R. Stuart, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 6, 1902.

In a controller for electric motors are combined with a frame and circumferentially arranged contact-plates comprising eight sets, a concentrically pivoted four-armed spider having one or more brushes in each arm to make contact with two sets of the plates, and having a radial slot or groove in one of its arms, an eccentrically pivoted operating lever having a roller and a supporting pin therefor located in the groove or slot, whereby a limited movement of the lever in either direction serves to move the spider in the same direction through one-eighth of a revolution.

713,720. System of Electrical Distribution. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 19, 1901.

The method of maintaining a substantially constant current in a circuit containing a variable number of translating devices possessing inductance consists in producing in the circuit a comparatively large leading electromotive force and neutralizing more or less of the electromotive force as the translating devices are cut into or out of circuit.

713,721. System of Electrical Distribution. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1902.

Combined with a source of alternating current of constant potential are a combination of reactances of opposite sign for deriving from such source a current of constant value, and means in circuit with a reactance or reactances of one sign for suppressing harmonics.

713,741. Means for Preventing Accidents at Railway Crossings. Cyrus E. Brown, Johnstown, Pa., assignor to the Lorain Steel Company. Application filed April 16, 1902.

A means for preventing accidents at railway crossing combines an obstruction placed in one of the intersecting lines adjacent to the crossing and arranged to be manually operated to clear the line, and a spring acting upon the obstruction in opposition to manual efforts, an electromagnetically operated locking device, a circuit therefor, and means for controlling the circuit situated at the opposite side of the crossing from the obstruction.

713,742. Contact Shoe for Electric Railways. William M. Brown, Johnstown, Pa., assignor to the Lorain Steel Company. Application filed November 30, 1901.

An electric contact-shoe is a cushion composed of a number of separate blocks or sections of elastic material interposed between and secured to the contact strip and its carrier and capable of independent vertical compression.

713,744. Telephone System. Charles G. Burke, Brooklyn, N. Y., assignor of one-half to John Q. A. Whittemore, Boston, Mass. Application filed May 23, 1901.

A telephone system combines with a circuit composed of two sections, a number of induction coils in each section, a telephone receiver inductively connected to one of the coils, a transmitter circuit connected to another of the coils, the coils in each section being connected together in series by unlike terminals and the two groups or series being connected through the line by like terminals.

713,753. Combined Electric Log and Speed Recorder. Francis N. Denison, Victoria, Canada. Application filed September 26, 1901

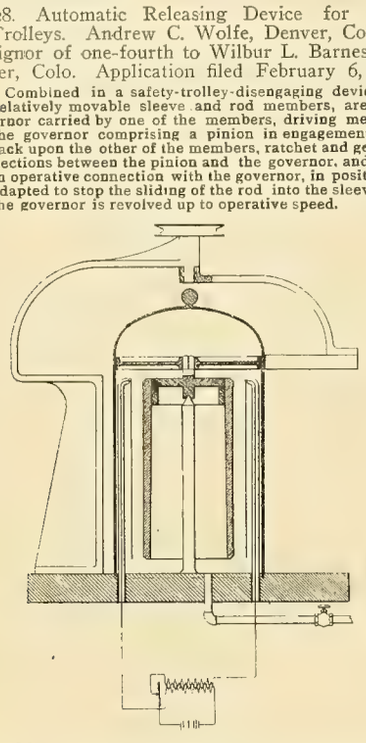
One claim reads: In a knot-recording device, the combination with the log provided with make-and-break electrical contacts, of an electromagnet connected by a suitable circuit passing through a battery and provided with a pivoted armature, a recording disk supported on suitable standards having a suitable graduated scale inscribed thereon and provided with a ratchet gear secured to its lower face, a stationary pointer secured to the standard, a vertical arm secured to the magnet, a spring-pressed dog designed to engage with the ratchet and means for bringing the armature back to its normal position.

713,822. Electric Railway. Earl P. Wetmore, London, England, assignor to the Lorain Steel Company. Application filed November 30, 1901.

A contact-box for electric railways combines with itself and its contact devices or electrodes and a supply cable or feeder having within the box an unbroken loop, a conducting member electrically connected with one of the electrodes of the box and making a conducting engagement with the loop.

713,828. Automatic Releasing Device for Safety Trolleys. Andrew C. Wolfe, Denver, Colo., assignor of one-fourth to Wilbur L. Barnes, Denver, Colo. Application filed February 6, 1902.

Combined in a safety-trolley-disengaging device with relatively movable sleeve and rod members, are a governor carried by one of the members, driving means for the governor comprising a pinion in engagement with a rack upon the other of the members, ratchet and gear connections between the pinion and the governor, and a pawl in operative connection with the governor, in position and adapted to stop the sliding of the rod into the sleeve when the governor is revolved up to operative speed.



NO. 713,863.—PROCESS OF COATING PHONOGRAPH RECORDS.

713,829. Telephone. Ernest E. Yaxley, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed October 9, 1901.

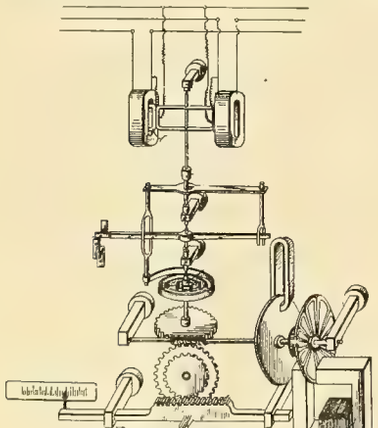
A wall telephone is described which is built up of two flat boards or sections hinged together at their side edges.

713,831. Fuse. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 26, 1901.

A fuse for an electric circuit is described.

713,832. Lamp Support. William J. Bailey, Newark, N. J., assignor to the Climax Manufacturing Company, Newark, N. J. Application filed November 29, 1901.

An adjustable table support for an electric incandescent lamp is described.



NO. 713,934.—WATTMETER.

713,836. Electrical Warp Stop Motion for Looms. William H. Baker, Central Falls, R. I., and Frederic E. Kip, Montclair, N. J., assignors to the Kip-Armstrong Company. Application filed August 30, 1901.

Combined in a loom are an electrical warp stop motion, provided with an electric terminal having in it a space or chamber to receive an aeriform fluid under pressure and a jet outlet for the fluid, a drop device, and means for supplying the fluid.

713,858. Latch for Controller Handles. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 12, 1902.

Combined with a notched rack are a handle co-operating therewith, a pivoted latch in the handle, and an automatically actuated support carried on the latch to support the same when it is lifted out of a notch.

713,861. Variable-speed Electric Motor. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 29, 1902.

Combined with a working electric motor are a supply circuit, a motor-generator, and means for connecting the motor end of the motor-generator with the supply circuit, and the armature of the generator end with the armature of the working motor in a separate closed circuit, for varying the field strength of the generator end of the motor-generator, and for finally open-circuiting the motor-generator and connecting the working motor directly with the supply circuit.

713,863. Process of Coating Phonograph Records. Thomas A. Edison, Llewellyn Park, N. J. Application filed June 16, 1900.

One claim reads: The process of making a matrix or mold of a phonograph record, which consists in maintaining the record in an exhausted chamber in proximity to an electrode of the metal of which the deposit is to be made, and in establishing a silent or brush electrical discharge between the electrode and a second electrode placed on the other side of the phonograph record, whereby the latter will be located between the electrodes. (See cut.)

713,864. Electric Hand-setting Mechanism. Oscar A. En Holm, New York, N. Y. Application filed August 30, 1901.

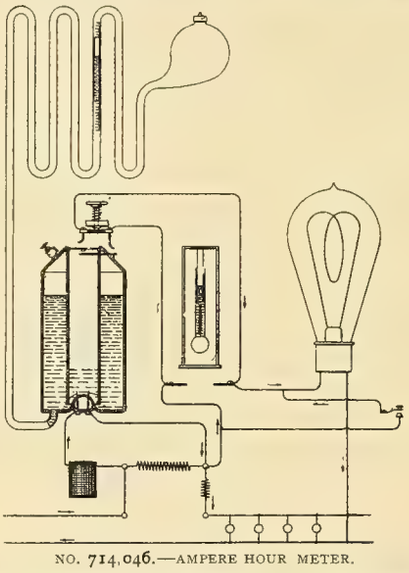
Combined in a clock mechanism are a rod adapted to be oscillated, means for oscillating the rod, a hand-carrying shaft, a cam mounted on the hand-carrying shaft for turning the same, and an arm pivoted intermediate of its ends and having a hinge connection at one end with the rod and engaging at the other end with the cam to rotate the latter.

713,887. Circuit-breaker. Thomas J. Johnston, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 1, 1899.

A circuit-breaker for circuits carrying a large amperage is described.

713,901. Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 28, 1900.

A fluid-cooled transformer and casing are described.



NO. 714,046.—AMPERE HOUR METER.

713,904. Insulator for Telegraph Lines. John E. Murray, Washington, Pa. Application filed April 19, 1902.

A telegraph-line insulator is described.

713,925. Apparatus for Leveling and Closing the Covers of Cans, Jars, etc. Frank L. Tapscott, Brooklyn, N. Y. Application filed February 3, 1900.

An electrical method of leveling and closing the covers of cans, jars, etc., is described.

713,934. Wattmeter. Vittorio Arcioni, Spoleta, Italy, assignor to Camilo Olivetti, Ivrea, Italy. Application filed June 25, 1902.

Combined in an electric measuring instrument are two fixed coils in series on the line, two movable coils in shunt on the line, acted upon by the fixed coils, and a reversible electric motor automatically thrown into operation by the movement in one direction or the other of the movable coils, for counterbalancing the action of the current thereon. (See cut.)

713,992. Ratchet-operated Electric Switch. William Kingsland, London, England. Application filed April 22, 1902.

An electric switch having a step-by-step motion and operated by a ratchet and other mechanism is described.

714,020. Electric Interrupter. Lars G. Nilson, New York, N. Y., assignor to Siegfried M. Fischer and Harry S. Fischer, New York, N. Y., and Huldah Anderson, Des Moines, Iowa. Application filed May 14, 1902.

An interrupter is described comprising an electromagnet arranged in an electric circuit, a vibratory strip extending across the poles of the electromagnet and a divided or double armature arranged on the strip.

714,022. Electric-lamp Socket. Mortimer Norden, New York, N. Y., assignor to the Norden-Bittner Electric Company, New York, N. Y. Application filed June 5, 1902.

A lamp socket for electric incandescent lamps is described.

714,046. Ampere-hour Meter. Walter A. Sherlock, San Francisco, Cal. Application filed June 18, 1902.

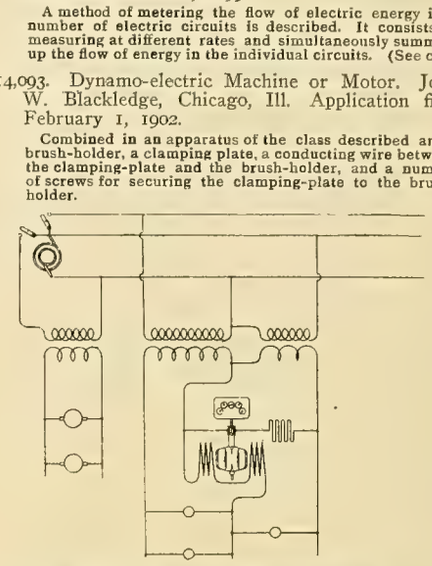
The inventor describes an ampere-hour meter, comprising a receptacle containing an electrolyte, of a kind in which the electrical conductivity is increased by heat. Means are provided for passing a current through the electrolyte for the purpose of producing gases, also means for measuring the volume of the gases, likewise a resistance, the conductivity of which is diminished by heat, the resistance being in circuit with the electrolyte, and means controllable at will for heating the electrolyte, the gases and the resistance to a predetermined temperature. (See cut.)

714,055. System of Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 6, 1899.

A method of metering the flow of electric energy in a number of electric circuits is described. It consists in measuring at different rates and simultaneously summing up the flow of energy in the individual circuits. (See cut.)

714,093. Dynamo-electric Machine or Motor. John W. Blackledge, Chicago, Ill. Application filed February 1, 1902.

Combined in an apparatus of the class described are a brush-holder, a clamping plate, a conducting wire between the clamping-plate and the brush-holder, and a number of screws for securing the clamping-plate to the brush-holder.



NO. 714,055.—SYSTEM OF DISTRIBUTION.

714,115. Self-oiling Trolley. James R. Stanley, Boulder, Colo., assignor of one-half to Louis Goodnow, Boulder, Colo. Application filed May 17, 1902.

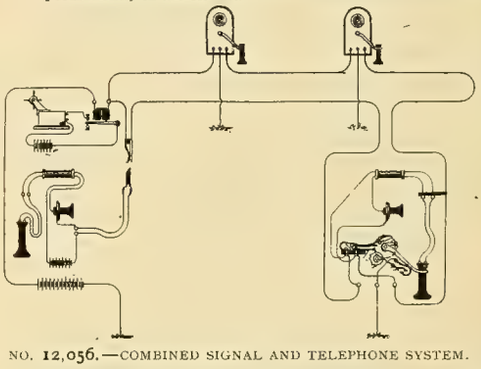
A self-oiling trolley combines with a harp and trolley wheel, a two-part spindle mounted thereon, the body portion of the spindle having a lubricant chamber formed therein, and closed at one end by the other spindle part which is screwed thereon, the spindle being provided with inlet and outlet openings, the former being normally closed.

714,116. System of Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed March 6, 1899. Divided and this application filed March 24, 1902.

Combined with a number of electric circuits provided with a common-return conductor is a meter having a number of field coils less in number than the total number of supply conductors, one of which field coils is inserted in the common return.

714,118. System of Electrical Distribution. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Original application filed December 19, 1901. Divided and this application filed April 3, 1902.

The invention employs the combination of a source of constant-potential current, a series circuit supplied thereby, transmitting devices possessing reactance of one sign adapted to be cut into or out of the circuit, and a device possessing reactance of the opposite sign connected permanently in the circuit.



NO. 12,056.—COMBINED SIGNAL AND TELEPHONE SYSTEM.

714,119. System of Electrical Distribution. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Original application filed December 19, 1901. Divided and this application filed May 31, 1902.

Combined with a source of constant-potential current are a consumption circuit connected thereto, translating devices possessing inductance adapted to be connected in series in the circuit or cut out of the circuit, a device possessing the effect of capacity connected permanently in the circuit, and means in the circuit for suppressing harmonics.

Reissue.

12,056. Combined Electric Signal and Telephone System. Otto P. Yurgae and Robert H. Yurgae, Milwaukee, Wis., assignors, by mesne assignments, to the Signalphone Company, Milwaukee, Wis. Application filed July 26, 1902. Original No. 655,144, dated July 31, 1900.

One claims reads: The combination of electric telephones in series on a metallic circuit, signaling mechanism associated with each telephone and operatively connected to the circuit, a ground wire for each signaling mechanism, a main-station talking battery and electric telephone operative on the metallic circuit, and a main-station signal battery and signal-indicating instrument electrically connected to the metallic circuit and the ground, whereby conversation may be carried on and signals transmitted at the same time without interference. (See cut.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, DECEMBER 6, 1902. No. 23

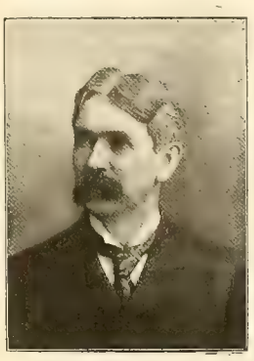
Interstate Independent Telephone Association.

Although young in years, or rather in months, the Interstate Independent Telephone Association is a remarkably lusty infant. Organized in Chicago on April 11th last, this association, which embraces the states of Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin, already contests the position of the Independent Telephone Association of the United States as the strongest telephone association in the country. From this statement it does not necessarily follow that the two organizations are rivals, for in the constitution of the Interstate Association it is expressly stated that that association is to "co-operate with and assist the Independent Telephone Association of the United States of America in its undertakings in the general Independent telephone interests." But the younger society covers a compact section of the Middle West in which the Independent movement is strongest and has been received with marked favor. The meeting for organization in the Sherman House last April was marked by great enthusiasm and a large attendance. The first regular annual convention of the Interstate Association is to be held in the Auditorium Hotel, Chicago, next week (December 9th, 10th and 11th), and there is every indication that the gathering will be the largest convention of telephone men ever held.

George N. Bandy of Iowa.

J. C. Harper of Wisconsin, Treasurer.

L. A. Frazee of Indiana.



H. K. Cole of Kentucky.

I. A. Lumpkin of Illinois, Vice-president.

H. C. Raney of Iowa, President.

E. M. Coleman of Kentucky, Secretary.

J. B. Ware of Michigan.

Chas. E. Hull of Illinois.

A. L. Hutchinson of Wisconsin.

J. W. Layne of Missouri.

OFFICERS OF THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

Each Independent telephone company operating in the states mentioned is entitled to become a member of the association upon the payment of $5, and to one vote at the meetings of the association, although as many representatives of the company may be sent to meetings as is desired. Manufacturers and supply dealers may become associate members of the association on the payment of $5, but they are not entitled to vote at any of the meetings. The constitution adopted last spring provides for annual meetings in December of each year, the time and place being decided by the executive committee. The nine states embraced in the association cover the principal Independent telephone section of the country, and contain probably over 3,000 exchanges, representing an investment of perhaps $30,000,000. The large majority of the factories and supply houses that cater to the telephone trade are also located in these states, so that a convention of the association held in Chicago, the center and metropolis of the section, should result in a notable gathering.

The present officers of the association consist of the following-named gentlemen:

President—H. C. Raney, Fairfield, Iowa.
Vice-President—I. A. Lumpkin, Mattoon, Ill.
Secretary—E. M. Coleman, Louisville, Ky.
Treasurer—J. C. Harper, Madison, Wis.
Executive Board—H. K. Cole, Owensboro, Ky.; J. B. Ware, Detroit, Mich.; Charles E. Hull, Salem, Ill.; George N. Bandy, Des Moines, Iowa; J. W. Layne, Carthage, Mo.; A. L. Hutchinson, Weyauwega, Wis.; L. A. Frazee, Connersville, Ind.

The program for the convention, as given out by Secretary Coleman, is as follows:

TUESDAY MORNING (DECEMBER 9TH) 9 TO 12 A. M.

Reception of members and friends, by the executive committee and officers at the secretary's headquarters.

Announcement of the time and tickets to the banquet.

TUESDAY AFTERNOON (DECEMBER 9TH) 2 TO 5 P. M.

Address of Welcome—Hon. H. S. Taylor, prosecuting attorney of Chicago.
Response—President H. C. Raney, Fairfield, Iowa.
Report of executive committee.
Report of the secretary.
Report of the treasurer.
Selection of nominating committee by the states to report on call of the president.
Adjournment.

WEDNESDAY MORNING (DECEMBER 10TH).

The manufacturers and supply houses of Chicago will take charge of the delegates this morning from 9 to 12.

WEDNESDAY AFTERNOON (DECEMBER 10TH) 2 TO 5 P. M.

Paper—"Rates, Measured Service," by George N. Bandy, Des Moines, Iowa.
Paper—"Sliding Scale Rates for Exchanges," by Dr. H. S. Herr, Ottumwa, Iowa.
Paper—"Toll Rates," by H. H. Robinson, Cleveland, Ohio.
Discussion.
Paper—"Restriction of Municipal Authority, and Synopsis of the Law."

Ohio—W. F. Lauback, Akron, Ohio.
Iowa—U. S. Alderman, Nevada, Iowa.
Wisconsin—J. C. Harper, Madison, Wis.
Minnesota — E. E. Webster, Minneapolis, Minn.
Michigan—J. B. Ware, Detroit, Mich.
Indiana—E. W. Pickhardt, Huntingburg, Ind.
Illinois—M. Savage, Champaign, Ill.
Missouri—H. Linton Reeber, St. Louis, Mo.
Kentucky—D. L Pendleton, Winchester, Ky.
Discussion.

THURSDAY MORNING (DECEMBER 11TH) 9 TO 12 A. M.

Paper—"Settlement of Toll Business Between Connecting Companies," by A. L. Hutchinson, Weyauwega, Wis.
Paper—"Enforcement of Message Time Limit," by H. E. Ralston, Maitland, Mo.
Discussion.
Papers — "Independent Telephone Securities as an Investment."
(a) "From a Banker's Standpoint," by Col. J. D. Powers, Louisville, Ky.
(b) "From a Small Investor's Standpoint," by J. H. Layne, Carthage, Mo.
Discussion.
Paper—"The Berliner Patent, Bell's Claims of Infringement and Litigation Now Pending," by J. J. Nate, Chicago, Ill.
Paper—"Suggested Methods for Improving Long-distance Telephony," by Senator C. F. Hull, Salem, Ill.
Adjournment.

THURSDAY AFTERNOON (DECEMBER 11TH).

The Chicago manufacturers and supply houses will take charge of and entertain the attending delegates from two o'clock on.

LOCAL ARRANGEMENTS.

The local arrangements for the convention have been ably looked after and everything promises a most enjoyable time for the visitors. The headquarters of the association will be the Auditorium Hotel. The meetings will be held in the hotel banquet room, located on the sixth floor. Manufacturers and dealers will have rooms for exhibition purposes on this floor and also on the parlor floor. An alphabetical list of exhibitors, with their rooms by number, is given on the next page. All rooms numbering between 100 and 200 are located on the parlor floor, those between 600 and 700 on the sixth floor. As may be seen by the list, a large number of rooms has been secured, and interesting displays are anticipated.

A complimentary banquet will be held on one even-

ing of the convention, probably the last, December 11th. The committee in charge has decided to have J. E. Keelyn, the Independent pioneer, make the opening address and formally turn the evening's affairs over to President H. C. Raney, who will then call upon whomsoever he pleases of those in attendance to respond to toasts. The banquet, which will be held in the banquet hall on the sixth floor, will be tendered to the delegates by the local manufacturers and dealers.

The financing of the entertainment features has fallen to the following committee, made up of manufacturers and dealers of the city, which has most ably performed its duties: P. C. Burns, Chas. Messer, A. Stromberg, L. D. Kellogg, C. F. Pierce, D. Clark and W. C. Slingluff. The arrangement of the many details of the convention has devolved in a great measure upon the entertainment committee, which is composed of the following-named local gentlemen: James Wolff, C. W. Farr, H. B. McMeal, W. E. Doolittle, S. A. Dinsmore, F. B. Patten and J. J. Nate. This committee, although acting under the name of the entertainment committee, has shouldered much of the worry attendant upon such occasions as this, and merits praise for its efficient work.

A rate of a fare and a third on the certificate plan has been secured for the convention on all lines in the section covered by the membership of the association. All persons who desire to take advantage of this rate are requested by the secretary to purchase a first-class ticket (either limited or unlimited) to Chicago, and at the same time procure a certificate from the ticket agent. If a through ticket cannot be secured a certificate must be obtained from each ticket agent where purchase is made. Tickets for the return journey will be sold at one-third the first-class tariff fare, only to persons holding certificates of the standard form, duly signed by E. M. Coleman, as secretary (on dates of the meeting). No certificate will be honored that was issued in connection with a ticket for going passage that cost less than 75 cents. Certificates or tickets are not transferable.

In fairness to all, the choice of rooms for exhibition purposes was decided by lot. The names of the firms who wished exhibition space were placed in a hat and drawn out one by one. The rooms were written down in their order of preference and as each firm's name appeared it was written opposite the number following the last one allotted. Among those who secured rooms the following manufacturers and dealers may be mentioned:

American Carbon Company, Noblesville, Ind., Room 650; American Electric Fuse Company, Chicago, South Parlor; American Electric Telephone Co., Chicago, Rooms 128 and 130; American Telephone Journal, New York city, Room 646; Automatic Electric Company, Chicago, Room 610; F. Bissell Company, Toledo, O., Room 632; H. B. Camp Company, New York city, Room 142; Central Telephone and Electric Company, St. Louis, Mo., Room 638; Chicago Telephone Supply Company, Elkhart, Ind., Room 642; Electric Appliance Company, Chicago, Room 612; Eureka Electric Company, Chicago, Room 651; Farr Telephone and Construction Supply Company, Chicago, Room 140; Holtzer-Cabot Company, Brookline, Mass., Room 658; International Telephone Manufacturing Company, Chicago, parlor, sixth floor; Jones & Winter, Chicago, Rooms 601 and 602; Kellogg Switchboard and Supply Company, Chicago, Room 614; Lindsley Bros. Company, Chicago, Room 218; Maltby Lumber Company, Bay City, Mich., Rooms 242 and 244; McDermid Manufacturing Company, Chicago, Room 654; W. G. Nagle Electric Company, Toledo, O., Room 652; National Carbon Company, Cleveland, O., Room 132; Naugle Tie Company, Room 126; New Haven Novelty Machine Company, New Haven, Conn., Room 662; Nungesser Electric Battery Co., Cleveland, O., Room 626; North Electric Company, Cleveland, O., Room 138; Standard Conduit Company, Room 647; Standard Pole and Tie Company, New York city, Room 660; Standard Underground Cable Company, Chicago, Room 134; Sterling Electric Company, Lafayette, Ind., Rooms 604 and 606; Stromberg-Carlson Telephone Manufacturing Company, Chicago, Room 136; Swedish-American Telephone Manufacturing Company, Chicago, South Parlor; Telephony, Chicago, South Parlor; Varney Electrical Supply Company, Indianapolis, Ind., Room 644; Vought-Berger Company, La Crosse, Wis., Room 640; Western Electrician, Chicago, Room 140.

Athens County's Record.

Athens County, Ohio, has in operation 1,600 Independent telephones, which is said to be more than there are operated in any other county in Southern Ohio. The Athens County Telephone Company started its system 2½ years ago, and by building and organizing other companies in the county, is now able to reach every postoffice in the county. Athens is reached over the United States Long-distance Company's lines, and local lines extend to half a dozen adjoining county seats. Farmers' lines are also a successful feature. C. L. Jones is superintendent of the Athens County company.

The Michigan Central Traction Company has asked the city of Battle Creek for an ordinance permitting the entrance to that city of a projected electric line, which will approach the town from Grand Ledge and will be in operation (according to the terms of the franchise) by September, 1903.

Dayton's Automatic Exchange.

Dayton, O., is much interested in the new telephone system soon to be placed in operation by the Home Telephone Company of that city. The system is to be of the Strowger automatic type, and the exchange will be installed in the company's new building, erected for the purpose.

The Home Telephone Company of Dayton was organized about one year and a half ago with an authorized capital of $750,000. It succeeded the Dayton Home Telephone Company. From the first, the new company has had public sympathy and support, and no new telephone enterprise in Ohio ever started with so large a list of preliminary subscribers. This list now numbers something over 4,000 names and promises to reach 5,000 before the first of January, about which time it is expected the system will be put into operation.

The construction of the plant has involved several distinctive features. One of these is the underground system to be used in the downtown portion of the town, distributing poles being set at the rear of dwellings in convenient centers so that from one point as many subscribers as possible may be reached. Another feature, probably the most interesting, is the automatic system of telephones to be installed. The telephone company has contracted with the Automatic Electric Company of Chicago for the installation of a plant with a capacity for 6,000 subscribers and possessing an ultimate capacity of 19,000 for future use.

While furnishing telephones for office use and the like, the telephone company will also install intercommunicating systems in hotels and factories and will connect the same with the main exchange switchboard where the customer so desires. Ample sized cable is employed to allow for growth, and sufficiently large conduit is being laid in the subway work to allow of a substantial increase to the number of cables. Four hundred and twenty thousand feet of conduit will have been laid when the plant is ready for operation. The pole lines are to be erected according to the best practice. In round numbers the system will require the placing of some 5,000 poles, ranging in height from 25 to 70 feet.

The building for the exchange is being erected on the corner of Fourth and Jefferson Streets, on a lot 50 by 100 feet in size, owned by the company. This exchange building is to be a five-story brick and stone structure, and will cost when completed $40,000. On the fourth floor of the building will be the general offices of the Home Telephone Company. On the fifth floor the automatic telephone exchange and the engineering department will be located. On the first floor, in the room in the rear of the building fronting on Fourth Street, will be the cashier's office, making it convenient for the general public to do toll business, as there will be a long-distance pay station placed therein. It will also be convenient for telephone subscribers to pay their rentals from time to time as the payments become due. The second and third floors will be fitted into office rooms and rented. The plant will cost when completed approximately $700,000.

The long-distance service from Dayton will be given over the lines of the United States Telephone Company, a switching station for which will be located on the fourth floor of the exchange building. The new company will also construct lines of its own throughout the surrounding counties.

The officers of the Home Telephone Company of Dayton are: President, John T. Barlow; vice-president, H. C. Kiefaber; secretary and treasurer, J. C. Reber; engineer, D. H. Brooks; general manager, W. C. Frickett, and auditor and cashier, R. D. Funkhouser.

Rockford Home Telephone System.

Among the many up-to-date telephone plants that have been built this year there is perhaps none that has started off under more auspicious circumstances than that of the Rockford Home Telephone Company of Rockford, Ill. This company was organized in September, 1901, by Bills & Wortham, promoters, who succeeded in interesting some of the most substantial business men of Rockford in the project. The result was a home company in the fullest sense of the word and one which has not only the usual commercial and financial interest in the undertaking but one that is also thoroughly imbued with local pride and public spirit. The contract for building the plant was awarded to Jones & Winter of Chicago, and work was commenced in February, 1902.

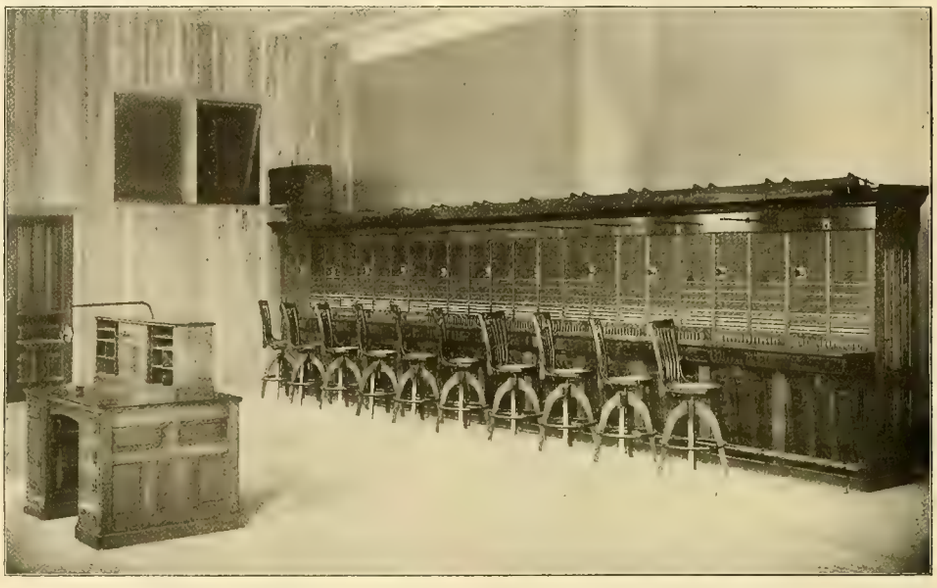


FIG. 1. ROCKFORD HOME TELEPHONE SYSTEM.—SWITCHBOARD AND TOLL BOARD.

The exchange opened for business on August 30th last with 700 subscribers, and at the present is giving excellent service to over 1,200 subscribers, with orders for 100 more to put in, and new contracts coming in daily. All this has been accomplished without any solicitation whatever.

The company now has in use 30,800 feet of aerial cable, 24,800 feet of underground cable, 17,200 feet of underground conduit, and 17 miles of pole lines, the poles of which are all of Idaho cedar, from 40 to 55 feet in length. In addition to the above, the present and prospective increase in the company's business has made it necessary to order 10,650 feet of additional underground cable and 5,650 feet of aerial cable, which will be put in during December. These figures mean that the exchange will more than

FIG. 2. ROCKFORD HOME TELEPHONE SYSTEM.—REAR OF SWITCHBOARD.

double its original capacity in the first year and certainly speaks well for the management of the company and the service it is giving.

The exchange apparatus and subscribers' telephones were furnished by the Sterling Electric Company of Lafayette, Ind., and comprise the common-battery, lamp-signal, multiple switchboard of 3,000 ultimate capacity, shown in Fig. 1. This board has 11 operators' positions, with 22 panels, and is made of quartersawed oak with golden finish. Light is furnished by the trough system, the light being protected from the eyes of the operators, but thrown upon the board. The chief operator's and toll desk is equipped with the necessary apparatus to supervise the service of the operators at all times and

J. H. Camlin, Secretary.

Robert H. Gibboney, Manager.

ROCKFORD HOME TELEPHONE COMPANY.

make the required trunking connections for toll-line service with the county and adjoining Independent telephone systems. The rear of the switchboard is shown in Fig. 2 and illustrates the simplicity of the apparatus. The sliding paneled dustproof doors that are used to enclose the board were removed before the photograph was taken.

In Figs. 3 an 4 are shown the intermediate distributing racks, provided with terminal blocks and complete system of protective devices, and the relay rack. Only one relay is required for each line, thus reducing the amount of auxiliary apparatus to a minimum. A fully equipped power plant (Fig. 5) is installed, including a Holtzer-Cabot charging machine, ringing machines, storage battery and black slate switchboards.

The system is of the central-energy type, all current for the various operations being furnished from the central exchange. In calling for a connection it is only necessary for the subscriber to take his receiver from the hook, which instantly lights a small lamp corresponding to his number at the central office, thereby notifying the operator that she is wanted. As soon as a conversation is completed the act of replacing the receiver on the hook also notifies the operator of the fact, and she disconnects the parties without the necessity of "listening in" or making any inquiry whatever. The result is naturally rapid and satisfactory service, and the people of Rockford are showing their appreciation of it.

E. W. Brown, president of the Rockford Home Telephone Company, has held the office of mayor of Rockford for three successive terms, is vice-president of the People's Bank and Trust Company and local agent of the Illinois Central Railway. He was born and raised in Rockford and has held numerous positions of responsibility and trust. J. H. Camlin, secretary of the company, has been a resident of Rockford since his boyhood days, and while still a young man, is associated with many of the industries of his city. F. F. Wormwood, treasurer, is another Rockford boy, a man rapidly coming into notice as a keen financier and one enjoying the confidence of the entire community. He holds the position of cashier of the People's Bank and Trust Company.

To Robert H. Gibboney, perhaps more than any other man, belongs the credit for the growth and excellence of the new exchange. As superintendent and manager, his ability and tact equip him to meet all emergencies. Mr. Gibboney began life in the drug business, but in 1879 forsook the mortar and pestle for the more seductive occupation of manager for the Central Union Telephone Company at Dixon, Ill. In 1887 he was transferred to the superintendent's office at Springfield, and in 1888 was sent to Rockford as the manager of the Bell exchange at that point. This position he held continuously until his resignation, on February 1, 1902, to accept his present position. Mr. Gibboney is assisted in the duties of his office by James Corcoran, assistant manager and chief inspector, a young man who has been associated with his chief for eight years.

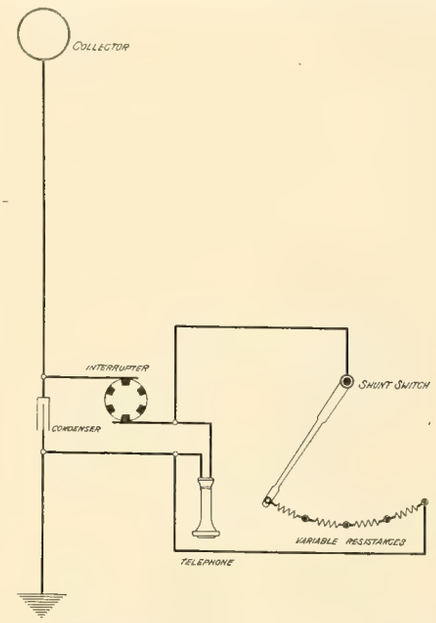
The directorate of the company consists of the following-named gentlemen: President E. W. Brown; H. F. Forbes, president Rockford Malleable Iron Works; Frank H. Worthington, druggist; H. H. Clough, president Rockford and Janesville Interurban Railway Company; Judge R. N. Baylies of Chicago, president Rockford Interurban Railway Company; William G. Sharpe of Elyria, Ohio, and Bethune Duffield of Detroit, Mich., attorney. With a personnel like this, and the ambition, resources and equipment possessed by it, the Rockford Home company seems assured of a prosperous career.

Receiving Device for Wireless-signal Systems.

In any wireless-telegraph or telephone system current from the surrounding medium, whether earth or atmosphere, is apt to disturb the receiving of messages. To do away with such disturbances and in general to note the electrical changes in the atmosphere, J. J. O'Connell, engineer of the Chicago Telephone Company, has devised the simple yet ingenious apparatus which is illustrated diagrammatically in the accompanying cut. The current from the atmosphere or earth is received by the collector, and, flowing to the condenser, charges one plate of the latter positively and induces an opposite charge on the plate connected to earth, or vice versa. The condenser is now discharged through a telephone or other receiving instrument, and the amount noted. When a receiver is used, as shown in the diagram, the volume of sound is noted. The sound produced by the ordinary atmospheric charge is now shunted out through a variable resistance, so that only charges produced by current from wireless-signal stations may operate the receiver.

Mr. O'Connell says that it is surprising to note the amount of charge which can be collected from the atmosphere with a simple apparatus of this kind. The receiver alone will not detect it, perhaps, on account of its great impedance to an oscillatory current and the small amount flowing as a consequence; but by placing an accumulator or condenser only in the circuit, and allowing it to charge, then suddenly discharging it, a result is produced which can be readily detected. Then by altering the variable resistance until the effect is overcome the collecting system is placed in such condition that messages may be easily received.

Any ordinary form of circuit-interrupter may be used, and a speed giving 25 contacts a second has been found desirable. The plan of using a con-



RECEIVING DEVICE FOR WIRELESS-SIGNAL SYSTEMS.

denser in a similar manner for operating a receiver to give a click as a busy signal to the operator, has been in use on multiple telephone switchboards since Mr. O'Connell introduced it in 1889.

Long-distance Telephone Connections in New York State.

As soon as the Independent telephone plant at Buffalo is completed, the United States Telephone Company will complete its line from Erie to Buffalo to connect with it. It is said that the new Buffalo plant has every assurance of success, and that this connection will open up a large part of western New York to the long-distance service. Just at this time there are two Independent companies operating long-distance lines in that state, and it is not yet certain which will form the connection through Buffalo with the United States company. The Inter Ocean, which formerly had headquarters in Cleveland, it is said, lays claim to an understanding that it is to have that privilege, while the Independent Union Telephone Company, owned by the Rawsons of Elyria, Ohio, makes the same claim. The United States officials say they will have to settle their own differences, as their company is ready to operate in connection with any other Independent company that may wish to make the arrangements.

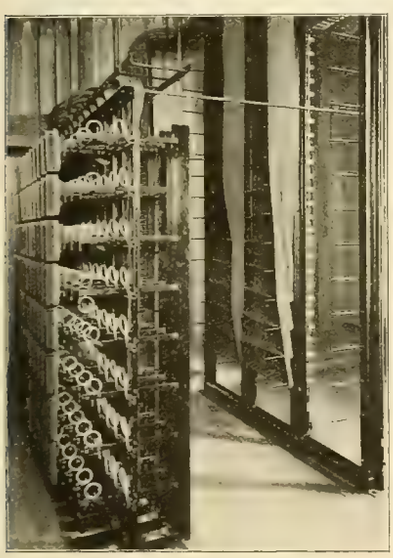


Fig. 3. Distributing and Relay Racks.

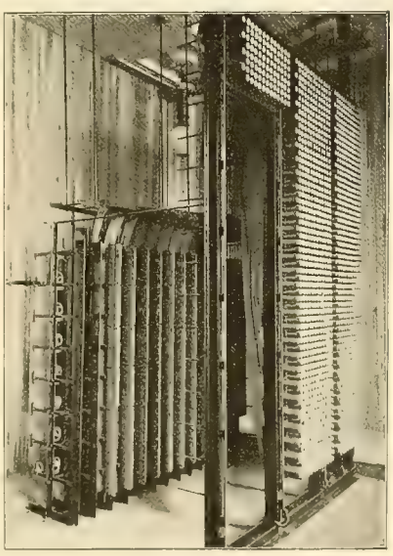


Fig. 4. Distributing and Relay Racks (Another View).

ROCKFORD HOME TELEPHONE SYSTEM.

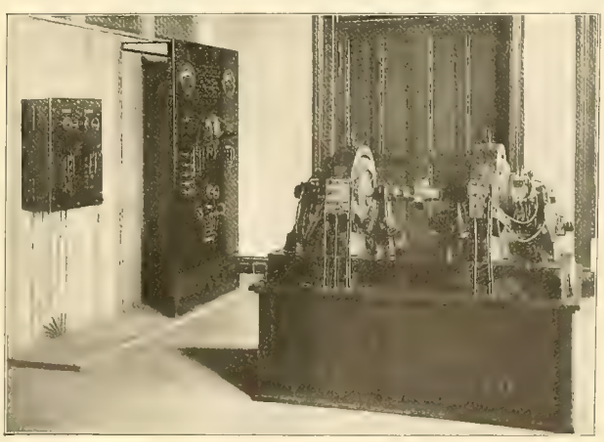


Fig. 5. Power Plant.

Municipal Ownership Plan Defeated.

A plan looking toward the municipal ownership of the street railways in San Francisco, Cal., was defeated by the voters of that city on December 2d at a special election. The proposition to issue bonds to the amount of $700,000 for the purpose of equipping and operating the Geary street railway was frustrated by a vote of 15,120 for to 11,334 against. To authorize the issue, a two-thirds majority was required.

Selective Telephone Switch for Party Lines.

A switching device to enable any two or more telephone instruments on a party line to be brought into use without molesting other instruments upon the same line has been invented by John A. Warrick of Sheldon, Ill., and has some interesting features. The apparatus is meant chiefly for use upon the kind of party lines in which there is no central station and where each subscriber may call up any other subscriber upon the line and talk to him without interference from any source. It is, however, applicable also to party lines having a central station. In his invention Mr. Warrick desires to lessen the resistance in the circuit and to prevent piracy of

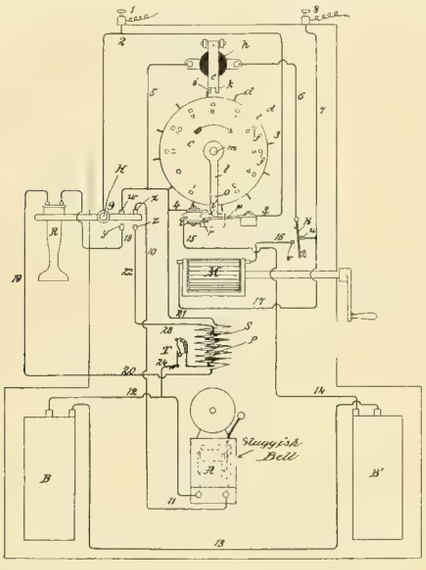


FIG. 1. SELECTIVE SWITCH FOR PARTY LINES.—STATION WIRING.

the telephone messages. By the system any reasonable number of telephones may be placed in the same circuit and any subscriber may select and talk to any other subscriber without danger of eavesdroppers hearing what is said. Furthermore, code signals are not necessary with the system.

Fig. 1 is a diagram showing a telephone office using the system. Fig. 2 is a diagram showing several of the switches in action. The switch proper consists of a train of spring-driven clockwork, wound for the purpose of actuating a revoluble disk (c). This disk is provided upon its inner face with pins (d) and upon its outer face with notches (f), the number of pins corresponding with the number of notches less one. The notches are provided with numerals ranging from "1" to "11." The character zero is not provided with a notch. The movement of the disk (c) is restricted and governed by an escapement, which is adjusted by means of a spiral spring and actuated by an electromagnet (h), which is normally connected with the main line. When the electromagnet (h) is excited by a current, the escapement is drawn downward, thus allowing one of the teeth to pass from pallet to pallet, the space traversed by the disk representing one-half of the distance between two consecutive pins. By this means the disk (c) can be actuated at will by throw-

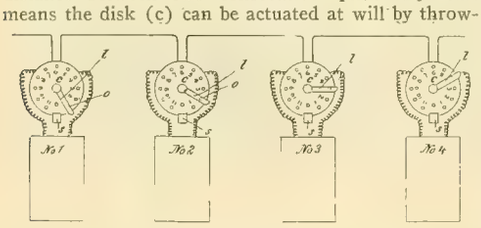


FIG. 2. SELECTIVE SWITCH FOR PARTY LINES.—GROUP OF SWITCHES.

ing currents into the main line, so as to excite the magnet (h) intermittently.

Mounted adjacent to the face of the disk is a hollow knob (m), provided with an arm (l), rigidly connected therewith, the arm being provided with a single boss (o). A spring normally holds the knob and its arm (l) close to the face of the disk. By pulling the knob outward slightly, however, the boss (o) is disengaged from the disk, so that the arm (l) can be moved radially around at will. Upon the baseboard is mounted a rigid post, provided with an overhang, located a slight distance from the edge of the disk, so that the arm (l) can easily pass under the overhang if the boss is in one of the notches (f), yet will not permit the arm (l) to pass unless the boss (o) is thus engaged. The arm can never pass the overhang, therefore, except when close to the disk. By this means each subscriber, by moving his knob, can turn the arm around at will; but the arm cannot pass under the overhang without causing it to engage and move the disk.

Supposing now that several stations are established, as shown in Fig. 2, and that subscriber No. 1 on the left desires to communicate with some one of the other subscribers—say the one on the right—No. 4. To do this, subscriber No. 1 moves the arm (l) to the numeral "4" on the disk (c) and causes the boss (o) to enter the notch (f) adjacent to the numeral "4." He then, by means of his magneto, sends a series of excitations through the main line, thus actuating all of the electromagnets (h) at the same time, thus causing the several magnets to rotate the several disks (c). The disks each rotate one step at a time, and, of course, it is an easy matter for subscriber No. 1 to cause all four of the disks to turn a distance represented by four numerals. The result is that as he places his arm (l) upon the numeral "4" and as subscriber No. 4 normally keeps his arm upon his proper numeral, which is "4," the same degree of revolution is necessary in the two disks to bring the two arms under their respective overhangs at the same time. When this is accomplished, subscriber No. 1 is in communication with subscriber No. 4, and subscribers Nos. 2 and 3 are not disturbed. The bell of subscriber No. 4 soon rings automatically, and is the only bell that answers.

Suppose now that subscriber No. 2 wishes to listen to the conversation carried on between subscribers Nos. 1 and 4. Subscriber No. 2 can, of course, move his arm (l) around over the disk (c), but he cannot get the arm under the overhang in any manner except to cause it to engage one of the notches and move his disk. In doing this he moves the disks of the subscribers who are talking and throws them out of connection with each other. It is therefore impossible for another subscriber to listen to any conversation, for the reason that in throwing his instrument into connection subscriber No. 2 throws out of connection the instruments which are used in talking. If subscriber No. 1 wishes to talk, say, to subscribers Nos. 3 and 4, he calls them separately and instructs them how to arrange the respective arms upon their respective disks, which, being done, he can talk with the two at the same time. Any number of telephones can thus be connected up.

Each subscriber has a particular numeral, and his arm (l) is normally adjacent to his numeral. He only moves the arm from his numeral to call a desired number, and when he is through talking he moves his arm back to his own numeral. After using the telephone each subscriber sees that his arm is placed upon his proper number, and some one of the subscribers actuates the electromagnets until all of the disks are restored to their normal position—say with the zero down adjacent to the overhang, as shown at the left in Fig. 2. The number of subscribers is commensurate with the number of numerals used upon the disk.

These instruments are preferably connected up as follows: Supposing the line wires enter an office through the binding posts 1 and 8. The currents for actuating the magnets may be supplied from any source, such as a magneto (M), as shown in Fig. 1. For signaling there is used a separate electric bell (A), well known as a "short-circuit bell," actuated by local batteries (BB'), and set to ring after the circuit has been completed for a predetermined period. The ringing of the bell (A), therefore, is accomplished by the local batteries (BB'), the ringing circuit being switched out of the main line when each subscriber takes down his receiver.

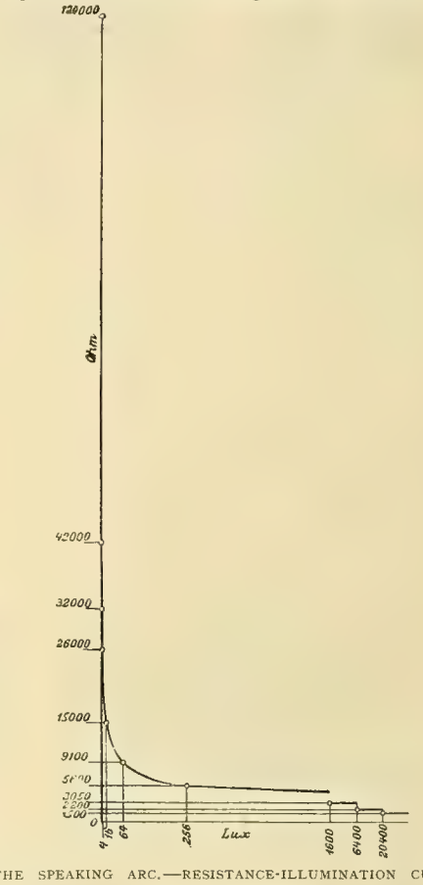
Suppose now that subscriber No. 2 is called. His arm (l) will be placed in the position shown in Fig. 1 by the pulsations sent through his electromagnet. The current traversing the contacts (pq) will be broken and will pursue the course (pr). The effect is that the bell of subscriber No. 2 to call the subscriber rings by being actuated by the local battery. Subscriber No. 2 now takes down his receiver, which has the effect of throwing his bell out of circuit and of throwing his secondary coil into the main-line circuit and his primary coil into the battery circuit, as is the case with ordinary telephone systems. He is now ready for conversation. A push button (K) is pressed against the contact (v) and disengaged from the contact (u) by the operator when he desires to call any other subscriber. The contacts (wxyz) upon the receiver hook are arranged in the usual manner relative to the other parts of the apparatus.

The object in omitting the notch from that part of the disk denominated "zero" is to have upon each disk some one point representing the vacant space which cannot be readily reached by the radially moving arms, because of its proximity to the overhang, the disks being in their normal positions—that is to say, each arm can be swung around radially, but cannot, readily, make a compete circle, because of the overhang being in the way at one point—and it is this idle point which is represented by the character zero.

Mr. Warrick's invention, herewith described, has been patented.

Improvement in the Speaking Arc.

It is only about four years since the first experiments were made on the speaking arc lamp; and to those to whom these first experiments were shown, it seemed that what they then saw demonstrated was only of the nature of an interesting scientific toy. But already a great development has taken place, which promises to make the matter of some practical importance as a solution of the problem of wireless telephony. Ernst Ruhmer contributes to a recent issue of the Electrotechnische Zeitschrift an interesting description of his latest experiments in this direction. By the means adopted he has been able to telephone with good effect for a distance of seven kilometers, by day as well as by night, the only precaution necessary in the former case being that the receiver must



THE SPEAKING ARC.—RESISTANCE-ILLUMINATION CURVES OF SELENIUM CELL.

be protected from the direct action of the sun's rays by means of a shade or umbrella. For military and naval purposes this distance is sufficient to be of considerable service, one great advantage over other systems of signaling, including wireless telegraphy, being that the signal cannot be read or intercepted by the enemy.

The principles underlying optical telephony are fairly well known, says a writer in the Electrical Review of London, basing his remarks on the German article. Suffice it to say that, if the variations of current produced by a telephone transmitter be suitably superimposed on the direct current through an arc, the words spoken into the transmitter are heard again proceeding from the arc. This is caused by the changes in volume of the arc following the changes in temperature of the same caused by the varying current density. The changing temperature of the arc is also the cause of a corresponding varying emission of light, and it is the latter which is used to transmit the wireless-telephonic message. The fluctuations in the light emission are so quick that they cannot be seen by the eye; a receiver has, however, been found which is able to follow and respond to them.

In order to send the message in the required direction, Ruhmer employed a parabolic reflector made by Messrs. Schuckert, with a diameter of 350 millimeters. A hand-fed arc lamp supplied with current from a battery was used, the current strength for one to two kilometers being four to five amperes; for three to four kilometers, eight to 10 amperes, and for five to seven kilometers, 12 to 16 amperes.

The receiver consisted of a similar parabolic mirror, in the optical axis of which a cylindrically formed selenium cell was placed, in series with two telephones and a battery. Selenium has the property of chang-

ing its resistance with the illumination falling upon it. The varying-light beam from the transmitting station is concentrated by the receiver mirror on to the selenium cell, the resistance of which varies in accordance with the microphonic currents in the transmitter. The current through the receiver telephone varies likewise, with the result that the word-sounds spoken into the microphone are repeated therein. This appears, at first sight, to be very simple, but, of course, before it could be done, a great deal of experimenting had to be carried through. The chief difficulty has been the selenium cell. The cells formerly used were hardly effected by short light waves (those made use of in optical telephony), but Ruhmer has now constructed cells which are especially sensitive for these; in fact, he can render them sensitive for any wave length he chooses. It was also necessary that the cell should change its resistance quickly, so as to follow the quick variations. There are two modifications of selenium obtained by the transformation of the amorphous into the crystalline variety, the "hard" and the "soft" modification. The former is better for use in the daytime and the latter at night. All the various good qualities necessary are combined in Ruhmer's cells, which he encloses in a vacuum inside a thin glass tube. The diagram shows the resistance-illumination curve of one of the cells.

The experiments were carried out on the Wannsee and the Haver, near Berlin, where seven kilometers was the longest distance available. Further experiments are now in hand at another place for a distance of 15 kilometers.

Evansville Telephone Situation.

The developments of last week in the Evansville telephone situation which is attracting much interest in Southern Indiana, have brought out the purposes of the Cumberland Telephone Company, and there is prospect of long and bitter litigation between the city and the company. As the time approached for the company to quit the city, it was forced to a defense of its right to use the streets, and it came out with the claim to have a perpetual franchise in the city; and on that ground it will make a fight through the courts to remain and do business.

In 1882 a franchise was granted to the Evansville Telephone Exchange. No limit was placed on this franchise, as to its life. In 1886 E. S. Babcock assigned the franchise to the Cumberland Telephone Company, and it is now in its possession. In 1887 the Cumberland company went before the City Council and secured a franchise for 15 years, the final section of which declares that "all ordinances or parts of ordinances in conflict with this ordinance are hereby repealed." The contention of the Cumberland people is that nothing in the franchise of 1887 conflicts with the franchise of 1882, while the city holds that the earlier contract was repealed in its entirety by the new one. Whether this is the fact will be the subject to be decided by the courts. In support of its contention, the company's attorneys insist that the franchise of 1887 was not intended to take the place of the one they had secured from the Evansville Telephone Exchange, but was merely supplementary to it. It contained provisions not specified in the earlier contract, which was crude and not at all comprehensive.

It is not known how issue will be joined, but the presumption is that the company will wait until the city attempts to remove its poles and wires and then seek to enjoin the city. The crisis is near at hand, and the city is determined to carry out its plans of ouster, unless perpetually enjoined from so doing.

The Arlington Telephone Company of Arlington, Rush County, Ind., has filed articles of incorporation. The capital stock is $4,000, and the directors are J. M. Cross, Charles Sampson and others. The company will construct and operate a telephone plant at Arlington.

Progress of the Work for the St. Louis World's Fair.

The plans which Henry Rustin, chief electrical engineer of the Louisiana Purchase Exposition, and his associates are developing, promise to result in water and light effects that as yet have not been approached, even in the spectacular effects recently introduced on the stage. Although over a year will elapse before the gates of the exposition will be thrown open, the work is being rapidly pushed, and, of the many schemes under consideration, several have been finally adopted, including the lighting and color scheme for the "main picture," as the cascades, grand basin and main avenue are called.

The main exhibit buildings are grouped to form a triangle, the apex of which is the cascade—the focal point of the exposition—to which Chief Rustin is directing the greater part of his attention, and which will be replete with sculptural, horticuitural, aquatic and lighting effects that, it is predicted, will far surpass anything ever attempted.

A good idea of the present state of the work on the exposition grounds is given by the accompanying illustration, which is a view from about half way up the hill that will form the basis of the cascades. The picture shows the Electricity Building on the left, its location being of the best. On the right is the Education Building, formerly the Textiles Building. The towers of the Electricity Building are now nearly covered with staff and the Education Building, as may be noted by the illustration, is still further advanced.

The cascades are arranged in a semicircle about the south end of the Grand Basin, natural hills affording the desired elevation, and, as the name implies, consist of a series of miniature waterfalls, the total height of which is 110 feet. The main cascade is 38 feet wide at the top, and spreads out to 162 feet at the lowest sill, the two flanking cascades being somewhat smaller.

Water will be supplied to the main cascade through a 56-inch pipe, the pump house being located in the side of the hill. Water will be drawn by the pumps from intakes located at points in the lagoons, so arranged as to create a circulation of the water sufficient to prevent stagnation.

Some idea of the lavish use of light in connection with this magnificent water spectacle can be gained when it is stated that over 6,500 kilowatts will be devoted to this portion of the lighting feature. The lighting scheme, as now outlined, will consist of three color pictures, a brief description of which follows:

First—The semicircular colonnade, 50 feet high, flanking the Festival Hall, the height of which will be over 250 feet, will be lighted with incandescent lamps, placed with due regard to the detail of ornamentation, as well as the tout ensemble. Groups of incandescent lamps will also light the gardens between the cascades, and the water will be flooded with the dazzling white of searchlights.

Second—The entire "picture" will be a mass of amethyst, the colored incandescent lamps being so disposed as to alter the aspect of the buildings crowning the hill. A novel and unprecedented effect will be obtained by the lavish use of metallic-vapor lamps, placed behind the successive waterfalls, transforming the cascades into a turbulent mass of living phosphorescence.

Third—The amethyst lamps will be replaced with emerald globes, and the cascades will be the objective of colored light from numerous searchlights, placed along the waterways.

As each of the cascades can be controlled separately, there will be nine possible combinations, and with the variety of colors that can be utilized in this last picture, a constantly changing display can be made.

Searchlights will be placed on the Electricity and Education Buildings, and when these are turned on to the colonnade and cascade, the illuminating effect of the thousands of incandescent lamps will be rendered nil, and they will appear only as points of light. These searchlights will be used when making a change in the light effect, the result being a gradual transformation from one to the other.

Mr. Rustin is also considering the advisability of installing an electric fountain on a huge scale, but as the final disposition of the entrances has not been determined, it is only tentative.

The lamps will be mostly eight and 16-candlepower, and current will be distributed at 110 volts, on three-phase, four-wire circuits. The primary voltage will be 6,600. Arc lamps will be used only in the buildings, and in all probability Nernst lamps will enter into the lighting of the main avenues.

World's Fair Notes.

Roberto Piscicelli Taeggi of Naples, the Italian engineer, who recently invented an electric automatic mail-collection and delivery system, mentioned in a previous issue of the Western Electrician, is desirous of exhibiting his invention, on a large scale at the St. Louis Exposition. World's Fair Commissioner Zeggio, writing from Florence, Italy, states that a company has been incorporated in England to exploit this invention and will at the proper time apply to the exposition for a concession to exhibit it. Mr. Piscicelli is now in London, where he expects to continue negotiations already opened with the Brtish postal authorities for the introduction of his system into that country. Mr. Piscicelli wants the postmaster-general to give him permission to construct an experimental line and dispatch by it.

Thomas M. Moore, chief of the Department of Machinery in the Exhibits Division, has received a telegram from Lieutenant Godfrey L. Carden, one of his assistants, now in Europe, that an 800-horsepower, marine tube boiler, manufactured at Düsseldorf, Germany, by the Düsseldorf-Ratinger Rohrenkessel Fabrick, successor to Durr & Co., would be shipped to New York by the steamer Moltke, which was to leave Hamburg November 22d. The boiler will be put in service in the exposition's power house and entered also as an exhibit. This shipment will be the first one from a foreign country for the Louisiana Purchase Exposition.

The mechanical-draft feature of the Union Electric Light and Power Company's plant, which will be used for lighting the World's Fair grounds at St. Louis, will be an installation of unusual interest to engineers. The plant is to be equipped with both forced and induced-draft apparatus, which is unusual, as a mechanical-draft plant usually consists of but one type of apparatus. There will be 26 boilers of 700 horsepower each, and they will be equipped with automatic stokers. Fans will be used for the forced draft and the boilers will also be operated under induced draft. The forced-draft fans will be four in number, of the full-housing type, size 160 inches. They will be driven by 10 by 10-inch vertical engines direct-attached. The induced-draft fans will be two in number and of a size quite in keeping with the basis upon which the exposition is being built. Each fan will be of the full-housing type, size 230 inches, and will be driven by nine by 10-inch double-cylinder, double-acting upright engines, this type being selected to secure the maximum power in limited space. The Buffalo Forge Company of Buffalo, N. Y., is building the fans and engines for this equipment.

The Powder River Telephone Company, whose headquarters are to be at Buffalo, Wyo., incorporated in 1891, has made phenomenal growth since that date, its lines now covering 275 miles, with 13 stations recognized by the Western Union. Its system now extends to the Big Horn Basin, where it connects with the Bell telephone system connecting Buffalo with all the counties in Wyoming but Crook and Wilson.

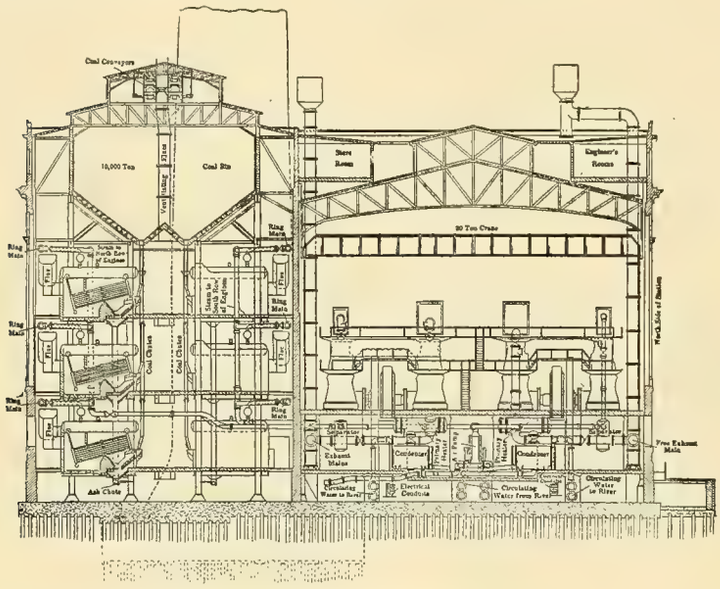
Electricity Building. Education Building.

PROGRESS OF THE WORK FOR THE ST. LOUIS WORLD'S FAIR.

Five New York Power Stations.

At the recent convention of the Association of Edison Illuminating Companies W. F. Wells presented the following data of five New York power stations. The plants treated are located as follows: Metropolitan Street Railway Company, Ninety-sixth Street and East River; Manhattan Railway Company (elevated), Seventy-fifth Street and East River; Metropolitan Street Railway Company (Kingsbridge), Two-hundred-and-sixteenth Street and Harlem River; Rapid Transit Subway Company, Fifty-eighth Street and Hudson River; New York Edison Company, Thirty-eighth Street and East River.

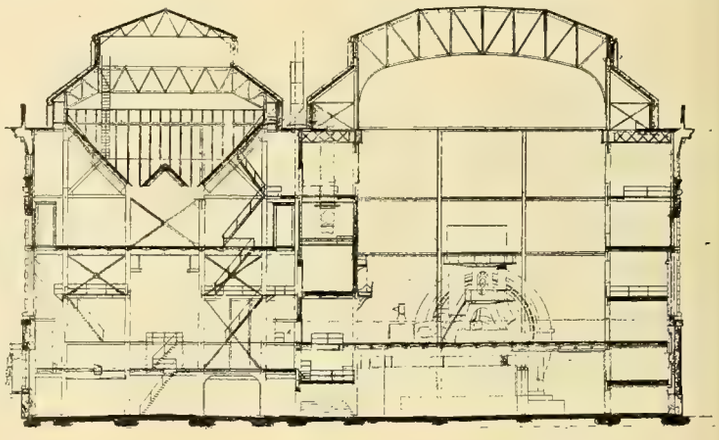
	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
Building.					
Dimensions in ft	200x244 avg.	204x404 avg.	246x160	200x580	272x197
Area in sq. ft	48,800	79,064	39,360	116,000	53,819
Boiler-room Floors.	3	2	2	1	2
Dimensions in ft	225x83	104x408	108x160	81x580	272x79
Area each floor in sq. ft	21,165	42,500	17,280	46,980	21,663
Total area boiler rooms	63,495	85,000	34,560	46,980	43,326
Operating Room.					
Dimensions in ft	110x222	93x399	131x160	119x580	272x118
Area in sq. ft	24,420	35,340	20,960	69,020	32,155
General Equipment Data.					
Total rated boiler H. P	25,520	33,280	15,360	39,000	36,400
Total rated eng. H. P	49,500	64,000	36,000	80,000	83,200
Total max. eng. H. P	66,000	100,000	50,000	125,000	128,000
Total rated generator K. W. capacity	38,500	40,000	28,000	50,000	56,000
Total max. generator K. W. capacity	51,700	60,000		75,000	80,000
Sq. ft. per eng. H. P. normal	.98	1.23	1.09	1.45	.64
Sq. ft. per eng. H. P. max.	.74	.82	.79	.93	.42
Sq. ft. per gen. K. W. cap'y normal	1.27	2.06	1 40	2.32	96
Sq. ft. per gen. K. W. cap'y max	.94	1.38		1 54	.67
Cranes.					
Capacity main hoist	1-30 ton.	1-50 ton	1-50 ton	1-50 ton	1-50 ton
				1-25 ton	1-25 ton
Capacity whip hoist			1-15 ton	1-10 ton	2-5 ton
				1-5 ton	
Span	112'	80'	130	71' 4"	98'
Height eng. fl. to crane rail	49'	69'	56'	65'	62'



METROPOLITAN NINETY SIXTH STREET STATION.

	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
Stacks.					
Number	1	4	2	5	4
Material	Brick	Custodis. Radial brick 8½" to 32" thick.	Brick 100' Steel 100'	Custodis. Radial brick	Steel. ⅝"-44' ½"-44' ⅜"-44'
Lining	Brick	Firebrick in 10' sections, on corbeled shelves.	Steel section lined.	Lined to just above flue opening.	8" firebrick height, red brick balance. In 24 sections, resting on angle irons, 4" air space.
Height above lower grates	353	278'	160'	225'	196'
Internal diameter	22'	17'	14'	15'	17'
Area each stack, sq. ft	380	227	154	176	227
Total area, all stacks, sq. ft.	380	908	308	880	908
Area $\sqrt{H}$. (height above lower grates)	7,140	15,136	4,312	13,200	12,840
Ratio, grate surface to stack area	12.3	8.1	11.2	?	7.3
Coal-handling Apparatus.					
Hoisting bucket, capacity	1½ tons	1½ tons			1½ tons
Motive power	Steam	500 v. D. C. motor		Electric	Electric (Steam Temporary)
Conveyor, capacity per hour	180 tons	125 tons		125 tons	150 tons
Motive power	Steam	D. C. motor			240 v. D. C. motor.
Capacity, bunker (tons)	9,000	15,000	6,000	15,000	10,000
Boilers.					
Type	B & W	B & W	B & W	B & W	B & W
Number	87	64	30	60	56
Boiler tiers	3	2	2	1	2
	1st & 2d floor	3d floor			
Rated H. P. each	265	350	520	520	650	650
Rated H. P. agg. Basis 10 sq. ft. per H. P.	25,520		33,280	15,300	39,000	36,400
Working pressure	150		160	160	175	175
Ratio, boiler to Eng. H. P. (nor. rating)	0.51		0.51	0.426	0.49	0.44
Tubes, high	9	12	12	12	14	14
Tubes, wide	14	14	21	21	21	21
Tubes, total number	126	168	252	252	294	294
Tubes, diameter	4"	4"	4"	4"	4"	4
Heating surface each, sq. ft.	2,650	3,500	5,200	5,200	6,500	6,500
Heating surface aggregate, sq. ft.	255,200		335,570	153,600	390,000	364,000
Drums, number	2	2	3	3	3	3
Drums, diameter	42"	42"	42	42"	42"	42"
						1st fl. 2d fl.
Stokers	Roney		Roney	Roney	Not ordered	Roney Hand
Grate area	52	57	115	115	?	115 88
Grate area, total	3,016	1,653 4,669	7,360	3,450	?	3,220 2,464 5,684
Ratio, heating to grate surface	51	61 4	15.2	15.2	?	56.5 71

	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
Building.					
Heating surface per rated eng. H. P.	3.82	3.32	3.12	4.87	4.37
Grate surface per rated boiler H. P	0.196 0.163	0.221	0.221	?	0.18 0.13
Boiler H. P. per sq. ft. grate	5.45	5.68	4.65	?	5.4 7.4
Forced Draught.					
Blowers	None	16	4		16
Motive power		A C Motors 380 v. Ind.	Steam		Upper tier 260 v D. C. motors; lower tier steam engines
Cubic feet air per min, each		57,000			58,000
Ash pit pressure		1.7"	3"		2"
Feed Water Supply.					
Storage tanks		4-6,000 gal. each		8	4-25,000 gal. each
Boiler Feed Pumps.					
Number	3	8	3	10	6
Type	Duplex	Sing. act. triplex	Duplex 10" cyl.	Vert. comp. dup.	Duplex 9" cyl.
Motive power	Steam	500 v. D. C. motor.	Steam 12" & 17"x15"	Steam	Steam 10" & 18"x18"
Feed Water Heaters.					
Economizers.					
Number	None	16	8	20	None as yet
Total heating surface		98,304	57,600	124,800	
Primary heaters.					
Number	11	None	2	None	16
Total heating surface	18,700		2,360		
Secondary heaters.					
Number	3	None	2		8
Total heating surface	5,100		2,480	5,000	10,664
Engines.					
Number	11	8	8	10	16
Height, floor to top of cylinder	34' 9"	38' 4"	35'	35'	37' 3"
Floor space	28'x42'	2,000 sq. ft.	28'x38'	40'x37' 6", 1,500 sq. ft.	41'x23', 943 sq. ft.
Type	Vert. cross comp.	Double comp 2 hor. cyl. 2 vert. cyl.	Vert. cross comp.	Double comp 2 hor. cyl. 2 vert. cyl.	3 cyl. vert. comp.
H. P. each, nominal	4,500	8,000	4,500	8,000	5,200
H. P. each, maximum	6,000	12,500	6,250	12,500	8,000
H. P. total nominal	49,500	64,000	36,000	80,000	83,200
H. P. total maximum	66,000	100,000	50,000	125,000	128,000
Cylinders	46"-86"	(2) 44"-(2) 88"	46"-86"	(2) 42"-(2) 86"	43½"-(2)75½"
Stroke	60"	60"	60"	60"	60"
Piston speed, ft per min	750	750	750	750	750
Crank angles	90°	135°	90°	135°	101°-126°-133°
Steam press	160	160	150	175-200	175
Valves	Corliss	Corliss	Corliss	Poppet high, Corliss low	Poppet high, Corliss low
Cylinder ratio	3.5:1	4:1	3.5:1	4.2:1	6.02:1
Reheating surface, sq. ft		1,544	1,590	1,544	1,137
Cranks	2	2	2	2	3
Piston rods, diameter	9"-10"	8"	9"-10"	8' H. P., 10" L. P.	9"

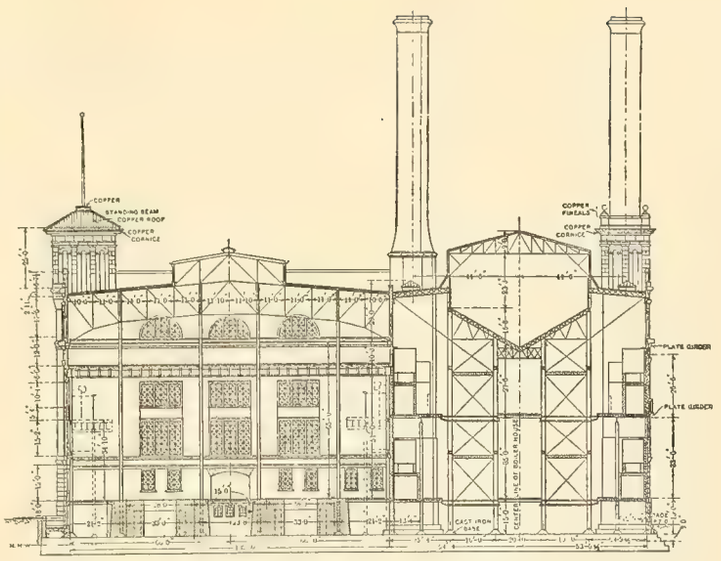


POWER STATION OF RAPID TRANSIT SUBWAY COMPANY.

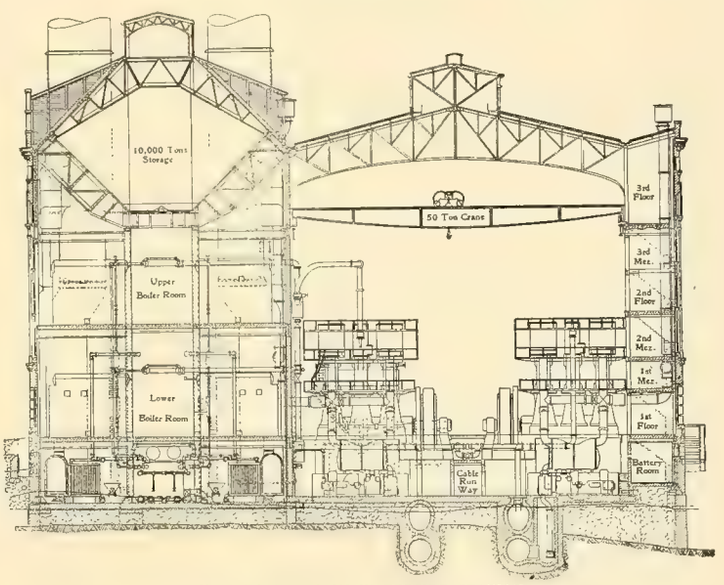
	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
Connecting rods, length in feet	12' 6"	13' 6"	12' 6"	13 6"	13' 9"
Length referred to crank	5	5.4	5	5.4	5 5
Crank pins	14x14	18x18	14x14	20x18	Center 22x14, overhung 16x14
Wrist pins	14x14	12x12	14x14	12x12	14x14
Shaft—length	27 4"	25' 3"	27'	25' 3"	35'
Shaft—maximum diameter	37"	37"	39"	37"	29⅜"
Shaft—diameter hole	16"	16"	16"	16"	10"
Bearings	34"x60"	34"x60"	34"x60"	34"x60'	26"x60"
Total weight on bearings	500,000 lb.	439.000 lb.	507,000 lb.	439.000 lb.	488,755 lb.
Flywheel—diameter	28'	none	28'	none	23'
Flywheel—weight, tons	100	none	100	none	72
Weight of alt. field, tons	65	116		116	65
Condensers.					
Number	11	8	4	10	16
Kind	Surface	Jet.	Jet.	Barometric tube (Jet.)	Surface
Cooling surface, each, sq. ft.	8,000				9,200
Cooling surface, aggregate, sq. ft	88,000				147,200
Cooling surface per normal H. P	1.77				1.77
Generators.					
Number	11	8	8	10	16
Phase	3	3	3	3	3
K. W. capacity, rated each	3,500	5,000	3,500	5,000	3,500
K. W. capacity, overload	4,700	7,500		7,500	5,000
Amp. per phase, rated	307	263	307	263	307
Amp. per phase, overload	425	394		394	450
Armature connected	Y	Y	Y	Y	Y
Volts	6,600	11,000	6,600	11,000	6,600
Speed	75	75	75	75	75
Poles	40	40	40	40	40
Diameter revolving field	16'8"	32'		32'	16'8"
Weight revolving field, lb	130,000	370,000	150,000	370,000	130,000
Weight of armature	130,000	520,000	158,500	520,000	125,000
Circumferential speed per minute	3,927	7,540		7,540	3,927
Diameter frame	21'6"	43'	25'9"	43'	22'2"
Total weight, lb	260,000	890,000		890,000	255,000
Frame divided into segments	2	6	2	7	2
Inherent regulation	5%	6%		6%	8%
Guar. efficiency, ¼ load	90.8%	90%			91%
Guar. efficiency, ½ load	94.8%	94.5%			95%
Guar. efficiency, ¾ load	96.2%	95.5%			96%
Guar. efficiency, full load	96.7%	96.5%			97%
Guar. efficiency, 1¼ load	97%	97%			97%
Actual efficiency, ¼ load		93.15%			93.2%
Actual efficiency, ½ load		96.20%			95.5%
Actual efficiency, ¾ load		97.29%			96.5%
Actual efficiency, full load		97.75%			97%
Actual efficiency, 1¼ load		97.98%			97.2%
Guar. temp. rise, full load, 24 hours		35° C.			30° C.
Guar. temp. rise, 1¼ load, 24 hours		45° C.			
Guar. temp. rise, 1¼ load, 3 hours					50° C.

Building.	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
Guar. temp. rise, 1¼ load, 2 hours		55° C.			
Insulation test field coils, 1 minute		2,500 V.		2,500 V.	2,500 V.
Insulation test armature coils		25,000 V. 30 M.		25,000 V. 30 M.	15,000 V. 30 M. 25,000 V. 1 M.
Armature winding	Form wound	Built up, or bar type	Built up, or bar type	Built up, or bar type	Form wound
Field Excitation.					
Number exciters	6	4	5	5	4
Driven by	3 tan. comp. eng. 3-350 v. ind. motors.	Tan. comp. engines.	Cross comp. ver. engines	2 vert comp. 3 A. C. motors	225 H. P. 6,600 v. ind. motor
Capacity exciter generator at volts	150 K. W. 125	250 K. W. 250	160 K. W. 125	250 K. W. 250	150 K. W. 300
Speed		220 rpm.	250	Motor dr. 500 rpm., eng. dr. 150 rpm.	500 rpm.
Capacity exciter storage battery, all fields	None	None	None	None	1 hour
Amperes per fie'd normal load	300	225		225	120
Volts across field terminals	100	200		200	176
Switchboards.					
Type	Panels and bench boards	Panels and bench boards		Panels and bench boards	Individual panels and switch pds.
Galleries	4	3		2	5
Approximate floor space, sq. ft	6,400	12,000			10,000
Number generators	11	8		10	16
Total normal K. W. cap.	38 500	40,000		50,000	56,000
Number feeders, present		34		36	28
Number feeders, ultimate	80	48		64	40
Busses	1 main set div. into 4 sections and 20 feeder busses, each group busses	2 main sets and 8 sets feeder group busses, each gen-rator or feeder group con. to both main busses.		2 main sets and 8 sets feeder group busses, each generator or feeder group con. to both main busses.	2 sets. Each generator or feeder group both sets
Generator switch arrangement	2 oil switches in series	1 main and 2 selector oil switches.		1 main and 2 selector oil switches	1 main and 2 selector oil switches
Feeder switch arrangement	1 oil switch for each group, 1 switch on each of 4 feeders	2 oil selector switches for each group, 1 oil switch on each of 6 feeders		2 oil selector switches for each group, 1 oil switch on each 6 feeder feeders	Knife select- or and 2 oil switches in series on each
Type oil switches	Electro-pneumatic.	Electric motor		Electric	Electric motor, also solenoid
Generator Equipment.					
Rheostat control	Motor	Motor		Motor	Hand
Ammeters	3	3		1	2
Ind. wattmeter	1	1		1	1
Voltmeter	1	1		1	1
Rec. wattmeter	1	1		1	1
Power factor indicator		1		1	1
Field ammeter	1	1		1	1
Overload relay on signal	1	1		1	1
Reverse relay on signals	2	1			
Feeder Equipment.					
Ammeters	1	3		1	3
Rec. wattmeter	1			1	1
Power factor indicator					1
Time limit relay		1		1	1
Overload relay	1				

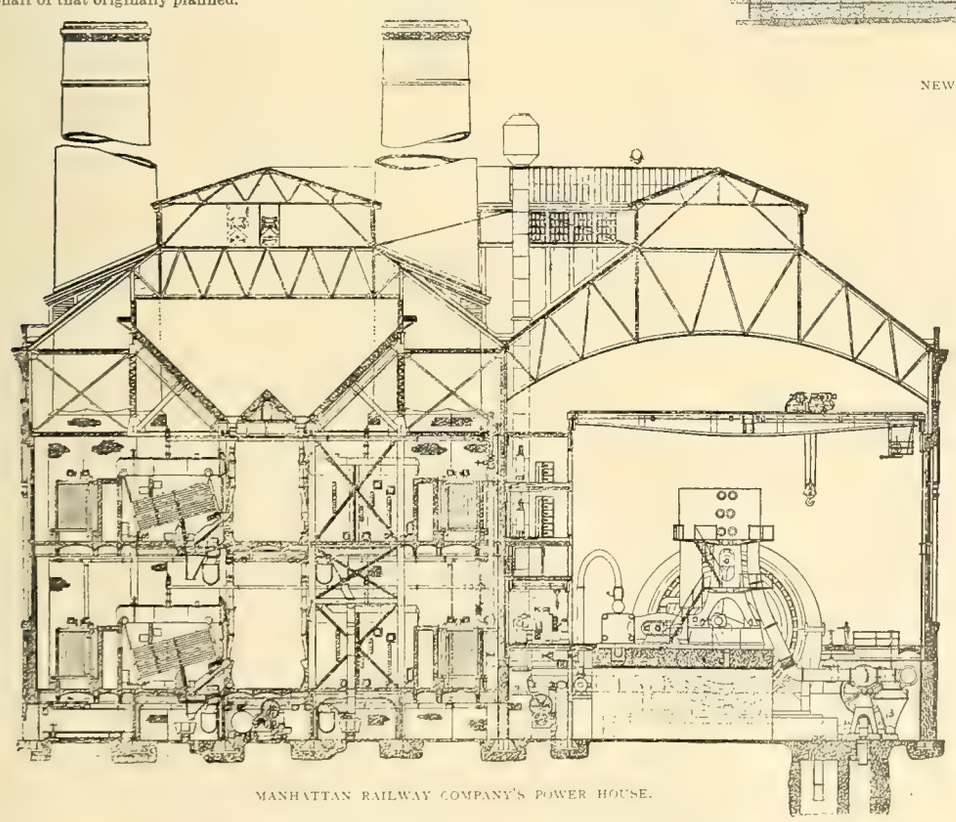
Note—The figures for Kingsbridge relate to the station as now being erected, which is one-half of that originally planned.



METROPOLITAN (KINGSBRIDGE) HARLEM RIVER STATION.



NEW YORK EDISON WATERSIDE STATION.



MANHATTAN RAILWAY COMPANY'S POWER HOUSE.

Satistics of Manufactures in the United States.

In comparison with the figures of the census of 1850, the statistics of manufactures of the United States in 1900, as specified in a recent Census bulletin, show an increase in capital invested approximating 17 fold; in the average number of wage-earners, the increase was about 4½ fold; in amount of wages paid about nine fold, and in gross value of products about 12 fold. The population of the country has in the same period increased 2¼ fold, and the products of agriculture from $1,600,000,000 to $4,739,118,752, or less than two fold. These comparisons are an approximate measure of the relative development of manufactures during the half century just completed.

The value of products of manufacturing and mechanical industries for 1900 was $13,014,287,498, an increase of $3,641,850,215, or 38.9 per cent., over the value shown in 1890, which was $9,372,437,283. The total value of products returned by the census of 1880 was $5,369,579,191, the increase from 1880 to 1890 being $4,002,858,092, or 74.5 per cent. While the increase during the decade ending with 1890 exceeded that for the last decade by $361,007,877, it should be borne in mind that the value of products for 1900 represents a relatively greater volume or quantity of products than is indicated by the value expressed in dollars. The year 1900 alone will be considered in what follows, unless otherwise stated.

Table 4, "Comparative Summary By Specified Industries," contains some interesting data under individual sub-heads, a few of which with the accompanying figures are given below:

Cars, railroad and street, and repairs, not including establishments operated by steam-railroad companies.—Number of establishments, 193 (compared with 166 in 1890); capital, $106,721,188; salaried officials, clerks, etc., number, 1,711; salaries, $1,966,310; average number of wage-earners, 44,063, total wages, $23,342,763; cost of materials used, $70,046,354; value of products, including custom work and repairing, $107,186,359.

Electrical apparatus and supplies.—Number of establishments, 580 (compared with 189 in 1890); capital, $83,130,943; salaried officials, clerks, etc., 4,987, salaries, $4,463,112; average number of wage-earners, 40,890, salaries, $20,190,344; cost of materials used, $48,916,440; value of products including custom work and repairing $91,348,889.

Electrical construction and repairs.—Number of establishments, 1,162; capital, $5,438,087; salaried officials, clerks, etc., number, 799, salaries, $624,965; average number of wage-earners, 5,949, total wages $3,312,126; cost of materials used, $7,673,507; value of products, including custom work and repairing, $15,907,420.

Wire.—Number of establishments, 29 (compared with 24 in 1890 and 40 in 1880); capital, $4,242,173 (compared with $11,607,685 in 1890); salaried officials, clerks, etc., number, 94, salaries, $136,327; agerage number of wage-earners 1,603, total wages, $859,645; cost of materials, $7,014,319; value of products, including custom work and repairing, $9,421,238.

The trolley system of Utica, N. Y., is said to have been put out of business for five hours recently as the result of a bird, a blue heron, alighting on a power wire and touching another wire with its bill, thereby short-circuiting the current, burning out numerous fuses at the power station.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome: and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Interstate Independent Telephone Association. Portraits of Officers 395, 396
Athens County's Record 396
Dayton's Automatic Exchange 396
Rockford Home Telephone System. Illustrated 396, 397
Receiving Device for Wireless-signal Systems. Illustrated .. 397
Long-distance Telephone Connections in New York State ... 397
Municipal Ownership Plan Defeated 397
Selective Telephone Switch for Party Lines. Illustrated 398
Improvement in the Speaking Arc. Illustrated 398, 399
Evansville Telephone Situation 399
Progress of the Work for the St. Louis World's Fair. Illustrated 399
Five New York Power Stations. By W. F. Wells. Illustrated. (Association of Edison Illuminating Companies.) 400, 401
Statistics of Manufactures in the United States 401
Editorial 402
Institute Meetings in Chicago and at the University of Illinois 403
American Society of Mechanical Engineers 403
Central Association of Physics Teachers 403
Electrical Exports for October 403
Chicago Engineers' Club 403
Electric Variable-speed Control. (Papers and discussions before the American Institute of Electrical Engineers.) Part II 404, 405, 406
A Series Parallel System of Speed Control. By George W. Fowler. Illustrated 404
The Storage Battery as a Factor in Speed Control. By H. B. Coho. Illustrated 404, 405
Multiple-unit Voltage Speed Control for Trunk-line Service. By H. Ward Leonard. Illustrated 405
Continuous-current Motors for Machine Tools. By F. O. Blackwell 405, 406
Telephone News from the Northwest 406
Telephone Items from Michigan 406
Ohio Telephone Notes 406
New Telephone Holder. Illustrated 406
Long-distance Telephone Reporting 406
Gravity Hook for Telephones. Illustrated 406
Telephone Men 406
General Telephone News 406
Convention Announcements 406
Central-energy Telephones for Mines and Interurban Railways. Illustrated 407
European and American Trade Competition in Cuba 407
St. Joseph River Power Development 407
Walrath Gas-engine Generating Set. Illustrated 407
Hylo Lamp with Pendant Switch. Illustrated 407
Bad Boiler Explosion 407
Miller Land Anchor. Illustrated 407
Municipal Telephone Experiment at Tunbridge Wells 408
Electric Railways in Maine 408
Storage Battery for Heavy Railroad Work 408
Stewart Magnet-heating Furnace. Illustrated 408
Wireless Telegraphy on Fast Express Train 408, 409
Electric Power Transmission in Northern California 409
Portable Bedroom Light. Illustrated 409
Induction Motors in a Wood-working Establishment 409
Electrical Rhetoric in Nevada 409

DEPARTMENTS.

Correspondence 409, 410, 411
New York Notes 409
New England News 409, 410
Canadian Intelligence 410
Southern Developments 410
Niagara Falls, N. Y. 410
From the Buckeye State 410
Information from Indiana 410, 411
Northwestern Notations 411
Among the Rockies 411
On the Pacific Slope 411
Personal 411, 412
Electric Lighting 412
Electric Railways 412
Societies and Schools 412
Telegraph 412
Publications 412
Space Telegraphy 412
Miscellaneous 412
Trade News 412, 413
Business 413
Illustrated Electrical Patent Record 413, 414

AN ITEM of curious interest to American electrical manufacturers was printed in the Chicago Daily News a few days ago. It was a special cable dispatch dated at Berlin, November 28th, and ran as follows: "It is said that the four great electrical companies of Germany, constituting the Allgemeine, Siemens & Halske, Schuckert and Union, have entered into an agreement systematically to underbid American tenders for electrical contracts, even if it should be necessary to incur loss in the course of this policy. Meanwhile American electricians will bring to the United States samples of every dynamo manufactured in Germany, with a view to standardizing American electrical manufactures in accordance with the technical requirements of the German engineering authorities, which have hitherto been practically prohibitive. This move has not yet come to the knowledge of the Germans." It is hardly credible that the German manufacturers can have entered into the alleged agreement to underbid the Americans at any cost, because such a policy, it is evident, must be ruinously unsuccessful in the long run. However, the German electrical manufacturing concerns have been curiously financed, and possibly they have arrived at some understanding to fight American competition. As to the statement about "standardizing American electrical manufactures in accordance with the technical requirements of the German engineering authorities," what is meant, undoubtedly, is that a more scientific effort is to be made to meet the requirements of the German market. With all due respect to the technical experts of the Fatherland, the "standardizing" of American electrical apparatus will no doubt continue to proceed, as heretofore, on lines studied out and laid down in this country.

IN HIS annual message to Congress, presented this week, President Roosevelt devotes considerable attention to the American Pacific-cable project. His treatment of the subject is especially important, of course, as officially setting forth the government's attitude toward this important work. Summarized, the president's statement of the case is as follows:

During the fall of 1901 a communication was addressed to the secretary of state asking whether permission would be granted by the president to a corporation to lay a cable from a point on the California coast to the Philippine Islands by way of Hawaii. Action on the application was deferred, and Congress likewise adjourned without taking any action. Meanwhile, the Commercial Pacific Cable Company promptly proceeded with preparations for laying its cable. It also made application to the president for access to and use of soundings taken by the U. S. S. Nero, for the purpose of discovering a practicable route for a transpacific cable, the company urging that, with access to these soundings, it could complete its cable much sooner than if it were required to take soundings upon its own account. In consequence of this solicitation of the cable company, certain conditions were formulated by the president and his advisers upon which the executive was willing to allow access to these soundings and to consent to the landing and laying of the cable, subject to any alterations or additions thereto imposed by the Congress. This was deemed proper, especially as it was clear that a cable connection of some kind with China, a foreign country, was a part of the company's plan. This course was, moreover, in accordance with a line of precedents. These conditions prescribed, among other things, a maximum rate for commercial messages and that the company should construct a line from the Philippine Islands to China, there being at present, as is well known, a British line from Manila to Hongkong. The representatives of the cable company kept these conditions long under consideration, continuing, in the meantime, to prepare for laying the cable. They have, however, at length acceded to them, "and," says Mr. Roosevelt, "an all-American line between our Pacific coast and the Chinese Empire, by way of Honolulu and the Philippine Islands, is thus provided for, and is expected within a few months to be ready for business."

Among the stipulations of the president is one reserving the power of Congress to modify or repeal any or all of them. It is not expected, however, that any serious obstacle to the laying of the American cable will be interposed by the legislative department of the government, now that the executive department and the company have reached an agreement. The all-British Pacific cable is now ready for service, and it is a matter for national felicitation that the protracted negotiations delaying the construction of the all-American line are now at an end. Within six or eight months, perhaps, there will be two Pacific cables in operation—one British and government-owned and the other American and private-owned but with proper restrictions as to rates and the contingencies of warfare. Thus, after long maintaining the unenviable reputation of being the only great ocean with inhabited shores to be uncrossed by telegraph wires, the Pacific will secure two cables almost at once. But with the great development of Pacific-bordering countries promised for the present century, and considering the fact that there are a dozen or more transatlantic cables, two lines should be none too many for the business that will be offered in a few years.

Turning to other subjects considered in the message, it will be noted that the president recommends that the tariff on anthracite coal should be removed. This would have no effect at all, he says, save in crises, "but in crises it might be of service to the people." Evidently the coal strike is in mind as one such crisis. Central station will not be materially benefited by free anthracite, but, in the case of another strike, it might, in the slang of the day, "help some."

A glance at public ownership is taken in that part of the message relating to the Government Printing Office. As his utterance is printed in the newspapers, Mr. Roosevelt says: "The excessive cost of government printing is a strong argument against the position of those who are inclined on abstract grounds to advocate the government's doing any work which can with propriety be left in private hands." As it stands, this sentence is not quite clear; we take it, however, that the president's idea is that the excessive cost of government printing furnishes a strong argument for those who oppose the government's doing any work which can with propriety be left in private hands. This is, of course, very true.

A HEARTY welcome awaits the Independent telephone men who will gather in convention in Chicago next week. The visitors are expected to assemble in great number, and suitable preparation has been made for their deliberations and for their entertainment at times when the association is not in session. The programme is a practical one, although it relates almost exclusively to the financial, commercial and legal aspects of the telephone-exchange business, to the exclusion of engineering and construction problems, which is to be regretted. However, the association is young yet—just eight months old, when one stops to think of it—and no doubt it will broaden out and become increasingly useful in all departments of the industry as time goes on. The Independents have been charged with haphazard, rule o' thumb methods in laying out their local exchanges and toll-line systems, and, although this accusation is true only to a limited extent, the new Interstate association should take particular pains to contradict it by providing papers and opportunities for discussing advanced telephone engineering and modern telephone practice. Such pressing questions as patent rights, rates, toll-line interchange and the like should not be neglected, of course, but in a three-day convention time can also be secured for useful technical work. The Independent movement does not lack telephone engineers of the highest class, and there should be no difficulty in securing the hearty co-operation of these men for the strong Interstate association. In point of numbers and enthusiasm the convention promises to be an unqualified success. It is, perhaps, permissible to express the hope that while good-comradeship may abound, the boisterous excess of enthusiasm that characterized the last banquet may not be repeated. Let the young salesman or operator remember, even in his most jovial moments, that the Independents have keen critics, who would not regret the opportunity to point the finger of scorn at "what manner of men these be."

The Western Electrician joins the other electrical interests of Chicago in extending best wishes for the entire success of the first regular annual convention of the Interstate Independent Telephone Association.

Institute Meetings in Chicago and at the University of Illinois.

The first regular meeting of the Chicago members of the American Institute of Electrical Engineers to be held this fall was called to order by R. H. Pierce, local honorary secretary, in the rooms of the Western Society of Engineers on the evening of December 2d. A general call had been issued by Secretary Pierce for this meeting, and the attendance, about 60, was regarded as satisfactory, considering the decidedly inclement weather.

Preceding the general meeting a business meeting of the members was held, at which Mr. Pierce briefly reviewed the past efforts of the Institute to secure meetings in Chicago. The principal difficulties that had tended to prevent successful meetings were that, the meetings being held on the same nights as the New York meetings, the papers, as a rule, were not received in time for general distribution or for discussions to be prepared and that the papers were frequently not on subjects that lead themselves readily to discussion or of sufficient local interest to warrant a general discussion by the Chicago members. These objections had now been met by the management of the Institute, which proposed to have meetings in Chicago and other large cities after the New York meetings, so that benefit might be had of the New York discussions, and also to have papers that were essentially practical and additional papers presented by the local members. B. J. Arnold stated, as a member of the committee on papers, that efforts were being made to get the papers out farther in advance of the meetings than in the past, and thought that that objection would be met.

A committee of seven members was then appointed by the chair to act as a local committee for conducting the affairs of the Institute in this section. Mr. Pierce appointed as chairman of this committee George A. Damon and as the other members James Lyman, P. Junkersfeld, H. H. Wait, A. S. Hibbard, Kempster B. Miller and J. R. Cravath, the members being chosen to represent the different electrical interests in the city as much as possible. Mr. Pierce was made a member ex officio of the committee.

The regular meeting was then called to order by Secretary Pierce, who made a few introductory remarks. The following-named gentlemen presented in abstract the papers on "Electric Variable-speed Control" read at the New York meeting on November 21st, and which are given in the last and present issues of the Western Electrician: Messrs. P. Junkersfeld, H. R. King, George B. Foster, Mr. Gibson, O. E. Osthoff and R. H. Pierce. No additional papers were presented and in the discussion which followed Professor Jackson and Messrs. Arnold, Cutler, King, Foster and Pierce took part.

The effort of the Institute to have branch meetings at the leading technical schools resulted in a meeting at the University of Illinois, Champaign, Ill., on November 25th. The papers presented at the regular October and November New York meetings of the society were read and discussed by students in electrical engineering. At this first Illinois meeting there were present, besides Professor Morgan Brooks and H. C. Marble, members of the Institute, only the men of the senior class, but it is expected that at future meetings, which are to be held monthly, students in mechanical engineering, and also other classes in electrical engineering will be attracted by the topics assigned for discussion.

American Society of Mechanical Engineers.

New York, November 29.—The forty-sixth meeting of the American Society of Mechanical Engineers will commence in this city on next Tuesday and continue through Friday, December 5th. The sessions of Tuesday and Friday will be held in the society rooms at 12 West Thirty-first Street, and those of Wednesday and Thursday at the Sturtevant House, Broadway and Twenty-ninth Street. The president, Edwin H. Reynolds, is ill and will not be present. Visits to the stations of the Interurban Street Railway Company, the Manhattan Elevated and the New York Edison Company have been arranged for, and opportunity will be afforded for visits to other points of interest. A reception of members and guests by the acting president and the president-elect will be held at Sherry's, Forty-fourth Street and Fifth Avenue, on Thursday evening at nine o'clock.

Among the papers to be presented are the following: "A Rational Solution of the Problem of Weights and Measures," by Sidney A. Reeve; "The Metric System," by F. A. Halsey; "Flywheel Capacity for Engine-driven Alternators," by W. I. Schlichter; "Heat Resistance the Reciprocal of Heat Conductivity," by William Kent; "Gift Proposition for Paying Workmen," by Frank Richards; "Rotary Pumps," by J. T. Wilkin; "Filing System for Office Use," by H. M. Lane; "Analysis of Commercial Value of Waterpower," by A. F. Nagle; "Centrifugal Machines," by B. Viola; "Oil-testing Machines and Results," by A. Kingsbury. Topical discussions will be had during the Wednesday evening session upon "Smoke Consumption," "Elastic Resistance," "Oil Burners," "Oil Separation from Steam" and "Oil Tempering of Steel."

Central Association of Physics Teachers.

The first regular meeting of the Central Association of Physics Teachers was held in Chicago, Ill., November 27th to 29th, in the chemistry lecture room of the Lewis Institute of Technology. The association is of recent organization and was organized "to promote efficiency in the teaching of physics." The organization was brought about through a meeting of the physics teachers of about a dozen schools in and around Chicago, held in the spring of the present year, at which a committee was appointed to ascertain the feasibility of such an association among the teachers of physics of the central states. The responses to nearly 500 circulars sent out were so strongly in favor of the move that a meeting was held in Chicago on June 7, 1902, for the purpose of effecting a formal organization. At this meeting, representatives from 25 schools being present, a constitution was adopted and officers chosen for the ensuing year.

Much enthusiasm was exhibited at the June meeting, and it was the firm belief of those present that great good would result from such an organization. Further justification of this belief was furnished by the three-day session just held, as mentioned above, on November 27th, 28th and 29th. This meeting, which was typical of what future ones will be, contained the following features: An address by an advanced teacher and investigator in the field of physics, short papers and discussions on practical experiences in teaching, visits to laboratories and manufacturing plants, and an informal banquet.

The first business of the convention was the meeting on Thursday, November 27th, at the Great Northern Hotel, the headquarters of the association, of the executive committee, which considered applications for membership. The general meeting of the association was called to order at 10 o'clock on Thursday morning in the chemical lecture room of Lewis Institute by President Charles H. Smith. After a few opening remarks, President Smith introduced the speaker of the meeting, Dr. Henry S. Carhart, professor of physics in the University of Michigan. Dr. Carhart's subject was the "Revision of Physical Theory." This interesting paper excited great interest and was discussed at length. At the close of the morning session lunch was served the visitors in the lunch room of the Institute, after which a visit was made to the school's laboratories and shops. At two o'clock the afternoon session was called to order and a short business meeting held, after which a general discussion was entered into upon the following topics:

How much setting up of apparatus should the pupil do?

Should laboratory directions be very explicit as to how the experiments are to be carried out, or should the pupil be left largely to himself as to the mode of performing an experiment?

Leader, director, co-worker, inspector, information bureau, policeman, spectator—which is the teacher's chief function during the laboratory period?

Is it possible to correlate the teaching of physics and mathematics?

At the close of this session the delegates proceeded to inspect the Harrison Street station of the Chicago Edison Company. Leaving this plant, the visitors made a tour through the tunnels of the Illinois Telephone and Telegraph Company. In the evening there was an informal banquet at Kinsley's. Toasts were responded to as follows: "Physics and Invention," Principal J. E. Armstrong, Englewood High School; "The Relations of Physics and Medicine," Dr. Winfield Scott Hall, professor of physiology, Northwestern University Medical School; "Physics and Mathematics," Professor E. H. Moore, professor of mathematics, University of Chicago; "Physics and Engineering," S. G. McMeen, chief engineer, switchboard department, Western Electric Company; "Physics and Visions," Professor A. A. Upham, Wisconsin State Normal School, Whitewater, Wis.; "Physics and Physiography," Professor Rollin D. Salisbury, professor of physiography, University of Chicago; "Physics and Machines," Robert Hall Wiles. Henry W. Price was the toastmaster of the evening, and about 75 persons were present.

On Saturday morning the delegates made a trip to the Illinois Steel Company's works at South Chicago. In the afternoon a visit was made to the Chicago Ship Building Company's shipyards and the works of the American Smelting and Refining Company.

The following-named active members of the association attended the convention:

Harry D. Abells, University of Chicago Academy, Morgan Park, Ill.; Franklin H. Ayres, Central High School, Kansas City, Mo.; C. F. Adams, Central High School, Detroit, Mich.; Fred D. Barber, State Normal University, Normal, Ill.; Frederic L. Bishop, Bradley Polytechnic Institute, Peoria, Ill.; C. M. Bronson, Central High School, Toledo, O.; E. E. Burns, De Kalb High School, DeKalb, Ill.; Katherine B. Camp, Laboratory School, University of Chicago; F. L. Cooper, East Aurora High School, East Aurora, Ill.; A. B. Crowe, Fort Wayne High School, Fort Wayne, Ind.; W. B. Davis, State Normal School, Carbondale, Ill.; J. M. Frost, Hinsdale High School, Hinsdale, Ill.; Henry G. Gale, Chicago, Ill.; F. E. Goodell, North High School, Des Moines, Ia.; Jerome J. Green, Notre Dame, Ind.; Harlan E. Hall, Mansfield, O.; S. F. Hersey, Cedar Falls, Ia.; W. L. Hanson, Monmouth, Ill.; G. M. Hobbs, University of Chicago; H. N. Howland, Chicago; John D. Hullinger, Jr., Calumet High School, Chicago; B. I. Hutchinson, Chicago Manual Training School; Fred J. Jeffrey, Charleston, Ill.; Charles W. Kent, Rock Island, Ill.; J. H. Kimmons, West Aurora, Ill.; Carl Kinsley, University of Chicago; Heman Burr Leonard, Bloomington, Ill.; W. E. Life, Oak Park High School, Oak Park, Ill.; C. E. Linebarger, Lake View High School, Chicago, Ill.; Carleton J. Lynde, University of Chicago; John Le May, Lake High School, Chicago; C. R. Mann, University of Chicago; Charles A. Marple, Louisville Male High School, Louisville, Ky.; M. J. Newell, Evanston High School, Evanston, Ill.; C. E. Osborn, Danville High School, Danville, Ill.; Lewis Omer, Harvey, Ill.; Charles W. D. Parsons, Evanston High School, Evanston, Ill.; A. B. Porter, Evanston, Ill.; Charles A. Proctor, University of Chicago; Gilbert Random, Calumet, Mich.; Walter J. Risley, Joliet, Ill.; F. A. Rogers, Lewis Institute, Chicago, Ill.; J. B. Russell, Wheaton, Ill.; C. E. Spicer, Joliet, Ill.; Maude G. Stewart, Highland Park, Ill.; A. C. Stillhamer, University of Chicago; Arthur A. Upham, Whitewater, Wis.; Reinhard A. Wetzel, Ottumwa, Ia.; Willis E. Tower, Englewood High School, Chicago, Ill.; C. M. Turton, South Chicago High School, South Chicago, Ill.; Fred R. Nichols, English High and Manual Training School, Chicago, Ill., and George B. Masslich, John Marshall High School, Chicago, Ill.

The regular meetings of the association will be held at least twice a year, and at these meetings 10 members will constitute a quorum. The officers of the association are as follows: President, Charles H. Smith, Hyde Park High School, Chicago; first vice-president, Franklin H. Ayres, Central High School, Kansas City, Mo.; second vice-president, C. F. Adams, Central High School, Detroit, Mich.; secretary, C. E. Linebarger, Lake View High School, Chicago; treasurer, E. C. Woodruff, Lyons Township High School, LaGrange, Ill.

Electrical Exports for October.

The electrical exports from the United States for the month of October, 1902, sum up in total value to $1,050,051, as compared with $969,793, for the same month in 1901, and $1,188,591 for September last. The October exports for the present year thus show an increase over those of the same month last year amounting in value to $80,258. On the other hand, the present month did not equal last by $138,540.

"Electrical appliances, including telegraph and telephone instruments," report the following figures: October, 1902, $372,860; October, 1901, $359,933—an increase for the present year of $12,927. Under the head of "electrical machinery" these figures are found: October, 1902, $677,191; October, 1901, $609,860. The increase here amounted to $67,331.

Classified according to destination, the exports of electrical machinery in October, 1902, to some of the principal buyers were as follows: Japan, $190,668; United Kingdom, $181,692; British North America, $76,591; Mexico, $65,980; West Indies and Bermudas, $25,449; British Australasia, $25,030; Africa, $20,517; Brazil, $20,019; Colombia, $7,500; Chinese Empire, $6,605; Philippine Islands, $6,400; Germany, $5,146; Argentina, $3,150; Hongkong, $1,029. Of the above, Japan's shipment jumped from $28,632, in October, 1901, to $190,668, as given above, in the present year. The shipment to the United Kingdom also increased some $27,667 over the shipment for the same month in 1901. Mexico, likewise, falls in line, her shipments showing the following figures: October, 1902, $65,980; October, 1901, $7,622—the increase being $58,358, probably due to an especially large order for a power plant. In the same strain Brazil is not to be overlooked, her figures for the two months showing an increase of $19,753. Africa's shipments also took a jump and show an increase in value amounting to $15,704.

Chicago Engineers' Club.

The Engineers' Club is the name of a new club recently formed in Chicago for purely social purposes. It will have no constitution, by-laws or regular dues, the financial requirements being provided for by a small initiation fee and an occasional assessment. The club will be primarily a luncheon club and suitable quarters are to be secured for the purpose of meeting daily at the luncheon hour. The charter members are Messrs. Andrews Allen, B. J. Arnold, Onward Bates, T. L. Condron, H. N. Elmer, W. N. Finley, H. M. Herr, H. E. Horton, C. W. Hotchkiss, W. M. Hughes, R. W. Hunt, C. F. Loweth, C. W. Melcher, Ralph Modjeski, H. W. Parkhurst, A. V. Powell, Isham Randolph, Louis E. Ritter, G. H. Scribner, E. C. Shankland, T. W. Snow, J. F. Wallace and August Ziesing. Mr. Modjeski was made chairman of the temporary organization, and Messrs. Bates, Modjeski and Ritter were made a committee on permanent organization.

Electric Variable-speed Control.

Part II.

A Series-parallel System of Speed Control.

BY GEO. W. FOWLER.

The system of control of stationary direct-current motors which I shall endeavor to describe to you is commercially known as the "C. & C. series-parallel" system. For some three years the system has been quite extensively and successfully used for driving various kinds of machinery, especially large printing presses. The component parts of the system are a double-commutator type motor, a switchboard, controller, a pair of automatic solenoid switches, and a set of emergency switches. The motor is of the ordinary slow-speed, compound-wound type, with the exception that it has two separate windings and commutators on the one armature body, operating in one magnetic field. The field windings are so arranged that the series turns can be cut out after starting, thus obtaining the advantages derived by using a compound-wound motor at starting, exerting a powerful starting torque with a minimum amount of current; and the constant-speed features of the shunt motor, by cutting out the series, after the motor has reached a certain fixed speed. The armature windings are, of course, thoroughly insulated from each other, and have no connection excepting that obtained through the operation of the controller.

The controller consists of numerous contacts and contact rings mounted upon a slate, the sub-structure carrying the controller arm, which moves over the contacts. For convenience, some external means is generally used to operate the controller, such as a lever, which is frequently used in connection with printing-press work. It is through the movement of this one controlling lever, that all the combinations of windings and connections, with the resultant variations in speed, are obtained.

The contacts of the controller are divided in two separate divisions. To the left the contacts are subdivided into many small ones. To the right there are but few larger ones. Those to the left are in use only when the armature windings are in series, while those to the right are in use only when the windings are in parallel. The two divisions have no connection with each other whatever. For use in graduating the speed, there are two banks of resistance used; one bank in circuit with the armature windings when they are in series and which is connected by the smaller contacts, to the left, and another bank in circuit when the armatures are in parallel, and which is connected to the larger contacts, to the right. The contact rings on the controller are in circuit with the shunt field of the motor and the small round contacts for the purpose of interposing resistance therein for the highest speeds.

With any variable speed-control system wherein a combination of windings or machines are used to obtain the speed variations, it generally becomes necessary at some point in the operation to open the circuit, preparatory to making some rapid change in the combination, in order that the speed changes shall be gradual. When performing this operation it has been, and now is, the custom to use magnetic blow-out coils to prevent excessive flashing of the controller contacts. In the series-parallel system it is necessary to open the circuit when changing from series to parallel, for it is quite obvious that the windings cannot be in series and parallel at the same instant.

In this system of series-parallel control no blow-out coils of any kind are used and the change from series to parallel, or vice versa, is obtained by the use of an automatic solenoid switch. Two solenoids enclosed in a cast-iron case, the object of which is to form a good path for the lines of force, are mounted upon one side of a slate. Through the center of these solenoids is a plunger slotted in the center through which passes a small pin, thereby making a flexible connection between it and the shaft carrying the switch arm on the opposite side of the slate. When energized at the proper time, first one and then the other solenoid operates, throwing the switch arm to the right or left, as the case may be. The connections of the switch jaws on the front of the slate are such that when connection through them is completed by the switch arm, the armature windings on the motor are first in series, and when the arm goes to the other side the windings are in parallel. Therefore, during the time when the switch is operating from series to parallel, the circuit is opened; the action being instantaneous, there is no noticeable change in the speed, neither is there the slightest flashing at the contacts of either controller or switches.

Two of these automatic switches are used with each equipment, one to perform the operation as outlined above, the other to "stop and start" the motor—that is, to open and close the circuit. There is no open point on the controller except between the series and parallel side, and when the lever is thrown to the position which is normally "off," the solenoid switch used for this purpose opens the circuit. Likewise, when the lever is moved "on," the switch closes the circuit. This absolutely prevents the slightest flashing at the controller contacts, when stopping the motor. By the use of the second-mentioned switch, it is also possible to stop the motor from any one of several points, which is required in newspaper printing.

To accomplish this an emergency switch is used. This switch is so connected with the controller (see Fig. 9) that when the plunger is depressed, connection is made through the solenoid which throws the switch "off." In Fig. 9 is represented a diagram of the wiring and connections of a complete series-parallel equipment.

The relative advantages of the series-parallel system over the rheostat control with one commutator is readily apparent by an inspection of Fig. 10, in which the curve shows the comparison between the two systems, when operating a Hoe quadruple press. It will be seen that the current required to exert

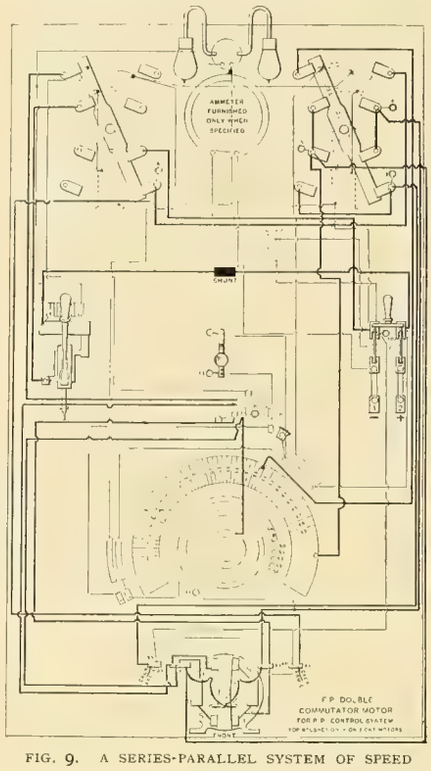


FIG. 9. A SERIES-PARALLEL SYSTEM OF SPEED CONTROL.

the maximum torque when starting the press from rest is somewhat less than the current required for the same operation by a single compound-wound motor with rheostat control. Also the efficiency at all speeds is much better.

While the system was originally designed especially for operating Webb presses, it is equally well adapted to any service requiring heavy starting torque, a wide range of speed variation, ease of manipulation and high efficiency.

A portable motor for use in testing printing presses is shown in Fig. 11. This gives a very good idea of what can be accomplished in this direction. The entire apparatus is mounted on the motor

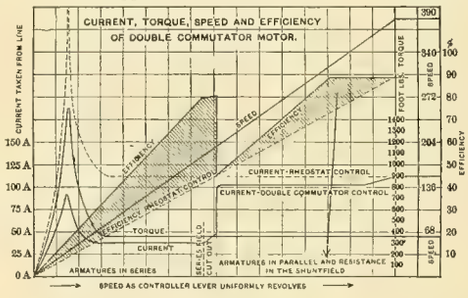


FIG. 10. A SERIES-PARALLEL SYSTEM OF SPEED CONTROL.

frame, and is quite easily moved to various departments.

The Storage Battery as a Factor in Speed Control.

BY H. B. COHO.

It is the purpose in this paper to dwell particularly on a method of using a storage battery, as an auxiliary or independent source of supply, in connection with the operation of printing presses. With printing-press work, the operations of making up and threading in paper require a positive fixed speed of from 12 to 20 revolutions per minute on the main shaft of the press. The methods of obtaining this speed from electric motors, which are common, are to employ either fixed resistances, armatures in multiple and series, or separate sources of supply, such as motor-generators. The motor in the last case is a shunt machine, wound for the line voltage, while the generator is a shunt machine with field separately excited from the line and supplied with a constant voltage. The armature is wound to give a fixed voltage from 12 to 40 volts, depending upon the special requirements.

It is in connection with this last system that the method mentioned in this paper is particularly applicable. Fig. 12 shows the connections to the storage battery and to the motor through the controller. The following data has been obtained in connection with the utilization of this system for the operation of quadruple Hoe printing presses of moderate size. These presses operate at 12 revolutions per minute in making up and threading in, and require for this purpose a current of 150 amperes at 40 volts. The threading-in and making-up process per press lasts at a maximum not more than ten minutes. This process has to be repeated not more than 15 times in 24 hours. From these data it is apparent that a 200-ampere-hour battery on an hour rating will more than fulfill the requirements.

A battery of accumulators to give 40 volts and 200 amperes for one hour will cost not more than $400, which is not a prohibitive figure, especially when considered in connection with the following additional advantages:

(a)—One battery will do for a number of presses, for the reason that all of the presses in any establishment are not simultaneously in operation. (b)—The battery can be on charge at a very low rate at all times when current is flowing on the mains, thus insuring the best possible results from the battery at a minimum cost for current. (c)—The battery having no moving parts, such as bearings and commutators to get out of order, will doubtless appeal to the press operators. (d)—The electro-

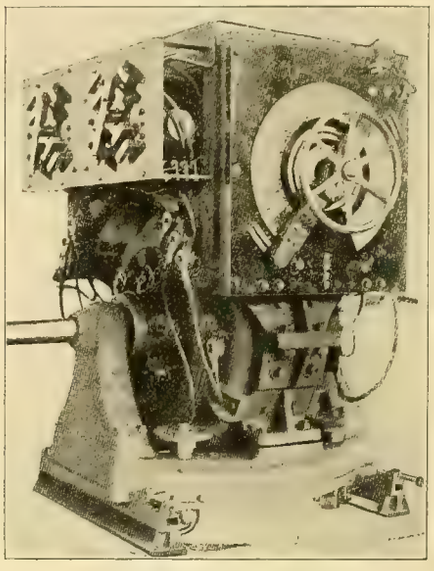


FIG. 11. A SERIES PARALLEL SYSTEM OF SPEED CONTROL.—PORTABLE TEST MOTOR.

motive force of a battery is constant, while that of any other independent source of supply is variable, depending upon the line voltage. Many a press operator has lost his fingers because of sudden variations of voltage supplied to the motor.

The operation of elevator motors by means of a storage battery placed directly across the line, and in connection with a multiple-series controller, offers an excellent means of varying speed. The battery can be figured on a two-hour rate in the severest service, so that the first cost is not excessive, while the saving from repairs to resistance plates and contact pieces is a matter of no small importance in comparing the economic advantages of two systems.

The use of a battery for the multiple-voltage operation of machine tools, presents another phase of the subject. The high first cost of batteries militates against their adoption. In a shop requiring

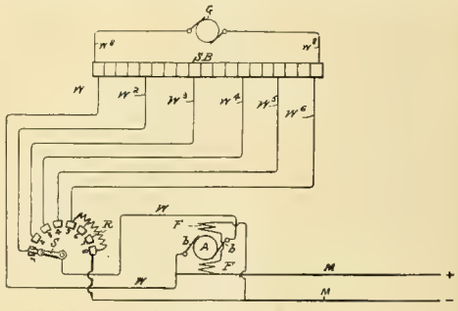


FIG. 12. STORAGE BATTERY AS A FACTOR IN SPEED CONTROL.

about 100 kilowatts average motor load, the battery capacity will have to be calculated on a three-hour rating. The first cost will be about 30 per cent. more than that of equivalent multiple-voltage generators as now employed. That the battery is 30 per cent. more expensive in first cost does not, however, exclude it from competitive consideration, because of the increased efficiency of the cells over that of multiple-voltage generators when operating at varying loads.

As a substitute for storage batteries one can often use so-called counter electromotive force cells. The cost of construction of these cells is much less than

that of equivalent batteries. The cutting down of supply voltage by counter electromotive force is the natural method dictated by economic consideration, while to cut it down by resistance is unnatural.

Referring to the above paragraph, it is probable that careful examination will prove that the latter method of multiple-voltage control, taken in connection with the weakening of the field to give the last 25 per cent. speed variation, will result in the most economical system to install and the lowest first cost for operation.

Multiple-unit Voltage Speed Control for Trunk-line Service.

BY H. WARD LEONARD.

In February, 1894, I read a paper before this Institute describing a system which I considered applicable to the operation of a trunk-line electric railway. The essential features of this system were: First. The generation and transmission of a high-tension single-phase alternating current, the power houses being placed as far apart as the insulation of an alternating-current transmission would permit; second, the entire elimination of sub-stations; third, a transformation of the energy upon the locomotive so as to secure a voltage speed control for the electric motors, thereby obtaining smooth acceleration and efficient control of the locomotive at any desired speed and in either direction.

At that time there were no engineers, so far as I know, who agreed with me that these features were essential for the operation of a trunk-line railway by electric motors. In the recent past, however, many prominent engineers, both abroad and in this country, have declared themselves in favor of these essential features, and I therefore feel warranted in describing an improvement upon the system I originally proposed, by which I can secure the important anl now well-understood advantages of a multiple control of any desired number of locomotive units.

Fig. 13 illustrates diagrammatically one form of my multiple-unit voltage speed control as applied to two locomotive units for trunk-line service. The current is generated in the form of a single-phase alternating current at as high an electromotive force as is practicable to-day, say 20,000 volts. A moving contact leads the single-phase alternating current upon the locomotive. If desired, static transformers can be placed at suitable points along the line of the railway which will reduce the initial electromotive force to any desired lower electromotive force upon the contact conductor.

In many instances it may be desirable to place upon the locomotive a transformer (S^1) for reducing the tension of the alternating current led to the synchronous motor (A^1).

A single-phase synchronous motor on the locomotive receives this alternating current and is driven by it continuously at a practically constant speed; the current after passing through the motor being led to ground through a moving contact. This single-phase motor (A^1) drives continually a small exciter (E^1) and also a large continuous current dynamo (D^1) whose field is separately excited by the exciter (E^1) and has in its field circuit a reversing field rheostat (R^1). The armatures of the propelling motors are connected in multiple directly across the terminals of the armature of the dynamo (D^1). The field magnets of the propelling motors (M^1) are separately and constantly excited by the exciter (E^1).

By manipulating the reversing field rheostat (R^1), the current through the armatures of the motors (M^1) necessary to obtain the required tractive effort, can be obtained at any desired voltage from the lowest voltage to the full-speed voltage, and in either direction. A perfectly smooth and rapid acceleration can thus be obtained with minimum energy from the source of supply. The simultaneous multiple control of the several locomotive units is obtained by means of the four small wires (1), (2), (3), (4), which are lead along the train.

In Fig. 13 the operator is supposed to be upon the locomotive (I). The exciter (E^1), which is producing a constant electromotive force, has its terminals connected to the wires (1) and (2). Across these wires (1) and (2) are connected the field windings of all of the propelling motors on the two locomotives, so that they are all constantly and fully excited.

The wires (3) and (4) are also supplied by a current from the exciter (E^1), but the reversing field rheostat (R^1) is in the path of this current. The fields of the two dynamos (D^1) and (D^2) are connected in multiple across the wires (3) and (4) which extend along the train.

It will be evident that by manipulating the reversing field rheostat (R) the operator can vary simultaneously and similarly the field-exciting currents supplied in (D^1) and (D^2) and that therefore he can cause the voltage of these two dynamos to vary in exact unison from (0) to the maximum voltage in either sense. Thus, the operator can cause the two locomotives to start, accelerate, run at full speed, retard and reverse in perfect unison, always dividing the load perfectly under these various conditions. By placing the controller (R^1) in its open position and going to the other locomotives, the operator can similarly control the two locomotives simultaneously by means of the controller (R^2).

By the use of this system I expect to be able to secure the following advantageous features: First, the haulage over existing roadbeds, grades, bridges, etc., of very much heavier trains than can be hauled by any steam locomotive; second, a material reduction in the cost of maintenance of 10 locomotives as compared with steam locomotives; third, a material saving in the maintenace of the roadbed because of the absence of hammer blow, shouldering, rocking and skidding; fourth, a material increase in the weight of the train which could be hauled around a certain curve by a locomotive having a certain weight on drivers; fifth, a material increase in the load which could be started upon a certain grade by a locomotive having a certain weight on drivers; sixth, a material reduction in the dead load necessarily hauled by a steam locomotive; seventh, a very large increase in the number of trains of given weight and speed which could be operated from a given power house compared with the series parallel or cascade systems; eighth, as each locomotive unit can be equipped with any desired number of driving axles, and any desired number of locomotives can be operated under multiple control, the amount of power which can be applied to a single train and controlled by a single operator is practically unlimited; ninth, 50 per cent. of the energy now wasted on friction brakes can be saved in the form of useful electrical energy restored to the system; tenth, the first cost of equipment will be very much less than that of any system, for equivalent service, which involves the use of sub-stations; eleventh, the cost of haulage per ton mile will be greatly reduced as compared with steam locomotives, especially because of the large increase in the weight of the train which can be hauled; twelfth, difficulties due to electrolysis would be reduced to a minimum.

Continuous-current Motors for Machine Tools.

BY F. O. BLACKWELL.

The application of electric motors to machine tools is a subject requiring a great deal of study in order to obtain the best results, each case having to be treated as an individual. In most shops it might be economical to have the bulk of the machines

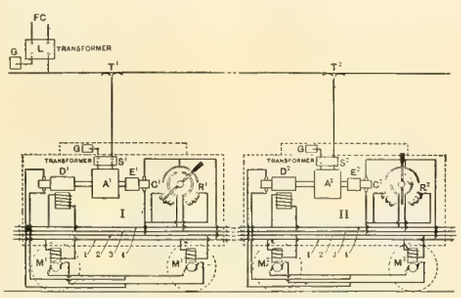


FIG. 13. MULTIPLE UNIT VOLTAGE SPEED CONTROL FOR TRUNK-LINE SERVICE.

driven by individual motors, while in others group driving would be better. Planers, slotters, milling cutters and many other tools need only a slight variation in speed, as the relation between the tool and its work is always the same; variation in speed only being required for different classes of work, that is, for hard or soft metal or for a roughing or a finishing cut. Such work does not require more than a two to one variation, while on the other hand lathes, boring mills and other rotating tools may require an eight or 10 or even 40 to one variation, necessitated by the varying relation between the tool and its work—different diameters of the work.

There are a number of methods in use for attaining variable speed by means of the electric drive, the more common being rheostatic, field and multiple-voltage control.

Rheostatic control is obtained by introducing resistance in series with the armature of an electric motor, the speed being reduced in proportion to the power consumed in the resistance. This method of control is undesirable not only on account of its being very inefficient, but also from the fact that as the load decreases the speed increases. The rheostatic control is, therefore, undesirable and wasteful of power.

By varying the current flowing in the field coils of the motor the strength of the magnetic field is changed and the speed of the motor varied. With any setting of the field, however, the motor will give constant speed under changes of load, and this method therefore avoids the greatest objection of rheostatic control. A motor of ordinary design will not always permit of any considerable weakening of the field without sparking at the commutator, but with a motor having small armature reaction a variation in speed of two to one can readily be obtained, and when delivering a constant horsepower the current will be approximately the same at all speeds because the potential across the armature terminals is always the same. As the field current of a motor is only a small fraction of the total current, the efficiency of this method of control is practically the same at minimum and maximum speeds; it also allows the use of a much smaller controller and renders it possible to get a greater number of running speeds than can be economically arranged for with any other control.

Multiple-voltage control is obtained by having several different line potentials to work from. For instance, with the Edison three-wire system the potential from the neutral to the outside wires is one-half the potential between the outside wires. There are, therefore, two potentials available, and a motor connected between the neutral and one outside wire would run at one-half the speed it would when connected across the outside wires. A four-wire system may also be used in the same manner, giving various combinations of potentials, the minimum of which may be about one-fourth or one-sixth of the maximum potential.

Either of the above methods combined with the field control of the motor makes a very flexible system. For example, a motor having 100 per cent. field control, used on the three-wire system, will give a speed variation of four to one, or a motor having 35 per cent. field control used on a four-wire system with potentials of 60, 80, 110, 140, 190 and 250 volts, will give a speed variation of approximately six to one, or having potentials of 40, 80, 130, 170, 210 and 250 an eight to one speed variation, the gaps in speed between the various potentials being filled in by field control of the motor.

Having at hand an easy method of control, the question arises of how far can we efficiently apply this method to advantage. It has been demonstrated many times that it takes practically a constant horsepower to remove a given amount of metal per minute, irrespective of the rotative speed of the tool. You will therefore see that a motor to be used on the multi-voltage system will have to be sufficiently large to carry its maximum horsepower at the minimum potential, or in other words, at say 40 volts on a 250-volt system the motor will have to be six times too large when working on its maximum potential. For this reason I feel that we must keep the lowest potential employed as high as possible in order that the size and cost of the motor may be within reasonable limits. A potential of 40 or 60 volts requires such large conductors if they are laid out for a small drop that their cost is prohibitive in a plant of any size. If a large drop is used, the motor falls off in speed under load and its speed regulation under changes of load is little better than with the rheostatic control.

With the three-wire system and a 100 per cent. variation in the motor speed by field control we can obtain a four to one total variation which, for general machine-shop work, is sufficient to cover a single operation on a given tool. The total range, however, on a tool can be increased greatly by having a few gear changes. For example, on a back-geared lathe with a gear ratio of four to one a total variation of 16 to one can be obtained. In the same manner on a double-geared lathe a variation of 64 to one might be obtained. By putting a magnetic clutch on this back gear and making the electrical connections in the controller, it is possible to get a 16 to one variation electrically and without increasing the cost of the motor more than would be required for a four-to-one variation.

Where machines must run at various speeds, the usual practice has been to employ step-cone pulleys and changeable gears. The speeds obtained in this way, however, are few in number, and therefore as a wide range of speed is necessary the different speeds must be far apart. If, on the other hand, power is furnished by a variable-speed electric motor with a range sufficient to fill in between the mechanical steps, the tool may be driven always at the highest possible speed and maximum production. This is best illustrated by a test on a 72-inch lathe. A belt-driven lathe required 59 minutes to complete the cut, while the motor-driven lathe did the same work in 31 minutes. The electrically-driven tool, therefore, did the work in 53 per cent. of the time, or, putting it another way, the belt-driven tool required 90 per cent. more time to do the same work.

With electrical control a man can keep his hand on the controller and his eyes on the tool, increasing the speed from time to time. Being limited only by the temperature of the tool, it has been found that much higher cutting speeds are unconsciously attained with a motor-driven tool than would be thought possible were any fixed rule followed. It is, therefore, apparent that this increased production in many cases is so great as to justify fully the installation of an electric system, even if there were no other advantages to be secured.

The cost of motors vary with their size and (for a given horsepower) nearly in proportion to the variation in speed which can be obtained from them. The approximate relative sizes of the motors expressed in the horsepower capacity at which they could be rated at the maximum potential are about twice as large for the three-wire as for the two-wire and for the four-wire four to six times the two-wire.

System.	Speed variation.	Ratio of maximum horsepower.
Two-wire	50-100	100
Three-wire	25-100	200
Four-wire	16-100	400
Four wire	12-100	600

Besides the cost of the motor there is to be considered with the four-wire system the cost of the supply plant; that is, the generator, motor-generators and conductors. The three-wire system is now generally employed for lighting and requires no special appliances. The four-wire system requires a three-commutator motor-generator set which must have sufficient current capacity at the

lowest potential to run all the motors that could ever be in service at one time at their full horsepower at that potential. The motor-generator set and the heavy wiring for the low potentials of the four-wire system will much increase the cost, exclusive of motors as compared with a three-wire system. If the motors are made of sufficient capacity to run the rotary tools at reduced speed and the motor-generator set and distribution cables are made of proper size to take care of the unbalanced load, the four-wire system will altogether cost several times as much as the three-wire system.

In conclusion, I would say that, in my opinion, it will generally be found best to use motors with field control, allowing a total speed variation of two to one with the two-wire system or four to one with the three-wire system, believing that the four-wire system is too expensive for general application if the plants employing it are properly designed and equipped with large enough electrical apparatus.

[*To be concluded.*]

Telephone News from the Northwest.

A company has been formed to build a telephone line from Guckeen to Blue Earth, Minn.

The Little Wolf River Telephone Company is installing a new switchboard for an exchange at North Fond du Lac, Wis.

The Western Electric Telephone Company has been connecting with the local company at Spencer, Iowa. The latter is becoming a competitor for long-distance business, and so the former is making Independent connections in Spencer.

A local telephone company is projected for Chaska, Minn.

The Wisconsin Telephone Company has completed a line from La Crosse to Fountain City, Wis.

The Chippewa Valley Electric Railway Company, operating in Eau Claire and Chippewa Falls, Wis., has ordered materials for the construction of a telephone system and will cover its line, so that a crew can call up the office for orders at any point on the road.

The Twin City Telephone Company held a formal reception to its friends and patrons in the new central-exchange building in St. Paul on November 22d. The company has just installed a new switchboard and threw open the entire building for the inspection of visitors. The building was decorated in the colors of the National Independent Telephone Association, red, white and blue.

The Burlington and Augusta Telephone Company has been incorporated at Burlington, Iowa, and is building a line to Augusta. The capital stock is $5,000.

It is rumored that an Independent telephone company will apply for a competing franchise at Sault Ste. Marie, Mich.

The officials of Massena, Iowa, have notified the Musson Bros. Telephone Company not to stretch any wires nor erect any poles in that city until the company obtains a franchise.

A case has arisen near Lettsville, Iowa, in the transfer of a farm, as to whether the sale of the realty carries with it a rural-telephone line on the farm. The buyer claims that it becomes his, to do as he pleases with. The original builders claim that they own the line, although it was built inside the fence along the public highway.

The E. H. Martin Telephone Company of Webster City, Iowa, has completed what is said to be the longest metallic copper-wire line in Iowa, from Webster City to Des Moines, a distance of 85 miles.

R.

Telephone Items from Michigan.

Sault Ste. Marie, Mich., in the belief that the Michigan Bell Telephone Company is about to raise rates in that city the same as in Detroit and elsewhere in the state, had an ordinance drafted and passed at its first reading, which provides that no telephone company operating in that city may charge in excess of $24 for telephones in business houses nor more than $12 annually for residences. It is further provided that the rates are to be paid quarterly in advance, and that no company shall be required to install a telephone for less than the rental of one quarter of a year. The ordinance is effective January 1st next.

The committee representing the minority interest of the Michigan Telephone Company has issued a circular extending the time for depositing stock until December 10th, after which date only those who have deposited their stock will be protected in any deal with the majority interest.

The ordinance by which the only competitor of the Bell interests is attempting to obtain a foothold in Detroit is being held up by the council for a further consideration of 30 days, and a probable request for a reduction of rate for business use. The rates asked are very nearly as high as those now in effect with the Bell company. One advantage of the new company will be the admission of a number of Independent state lines to a Detroit exchange. An agitation is being made for state legislation which will compel the Michigan Bell Company to connect with Independent lines and allow an interchange of business one with the other.

W.

The poles of the Independent and Rocky Mountain Telephone Companies have all been erected in Emmett, Idaho, and the wires are nearly all strung.

Ohio Telephone Notes.

The United States Telephone Company will pay its July interest about the middle of December, it is stated.

The directors of the Champaign Telephone Company of Rosewood, Champaign County, have elected the following-named officers: President, Murray E. Weimer; vice-president and treasurer, C. H. Espy; secretary and manager, T. J. Heck. All the stock has been taken, and it is said that several improvements will be made on the toll lines which the company owns in Champaign County.

The Stark County Telephone Company of Canton has arranged to make improvements and extensions to its property to the amount of something like $100,000. The rural lines will be developed and exchanges will be built at all the villages in the county.

The Massillon Telephone Company of Massillon is engaged in improving its plant, and in all will spend about $10,000 in the work. The new board of directors recently elected includes President F. S. Dickson of the Federal Telephone Company.

The West Virginia Western Telephone Company of Parkersburg, W. Va., has decided to build a line from Elizabeth to Grantsville. The underground cable in Parkersburg has been completed and it is said the general progress of the work is very satisfactory.

The Weston Home Telephone Company of Weston, which was incorporated a few days ago, has taken over the Farmers' Mutual Telephone Company, which will constitute a basis upon which to build a system. It will have connections with all the other Independent lines in the northern part of the state. The officers chosen are as follows: President, M. Brundage; treasurer, Dr. G. B. Spencer. A secretary and manager will be chosen later on.

The Ottawa County Telephone Company of Elmore has filed notice with the secretary of state of an increase of capital stock from $30,000 to $36,000.

The officers of the Ottawa Telephone Manufacturing Company of Ottawa have filed a report with the court officials to the effect that the assets of the company are $40,196.77 and the liabilities are $38,171.79.

It is said the United States Telephone Company will build a line from Xenia to Yellowsprings and connect up the Xenia exchange with all other points which it reaches.

The Cuyahoga Telephone Company of Cleveland has fitted up a hospital adjoining the exchange for the use of the telephone girls when they become ill from overtaxing their strength or from nervous exhaustion. The company has found that this is necessary, no matter what the hours of work, and it has met the emergency in this way. A trained nurse, Miss Edna L. Tuttle, is in charge of the room, and when necessary she calls in a physician, but she is generally able to handle all cases, unless they are very stubborn.

The Cuyahoga Telephone Company has equipped all its pay-station boxes with burglar alarms, which sound in the room of the janitor and engineer when the money compartment of the box is tampered with. These boxes have been systematically robbed for some time.

O. M. C.

New Telephone Holder.

A telephone holder recently put on the market by the Chicago Typewriter Company of this city is said to be attracting considerable attention among business men on account of its value as a time-saving device. The holder may be fastened to either side of any desk or to any wall or partition, and is intended to hold the telephone set securely in place but to allow it to be extended or closed as necessity requires. The mechanism of the holder

CHICAGO TELEPHONE HOLDER.

is such that the telephone may be pushed around to the side of the desk out of the way, or by the extension of the holder, as shown in the accompanying illustration, it may be brought into position immediately in front of the user. The holder is made of steel, highly nickel-plated, thus making it an ornamental as well as a strong and durable instrument. F. W. Pardee, 119 La Salle Street, Chicago, is the general sales agent for the holder.

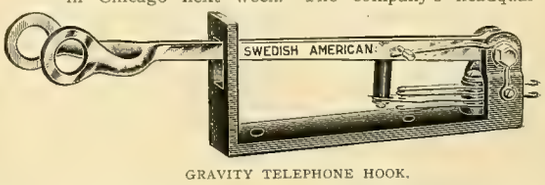
A. V. Acheson, who has just returned from Meridian, Idaho, states that the Rocky Mountain Bell Telephone Company, for whom he is acting, will have completed its new telephone exchange in Meridian within the next 30 days.

Long-distance Telephone Reporting.

An interesting use of the long-distance telephone was made on Thanksgiving Day in Ann Arbor, Mich., on the occasion of the Michigan-Minnesota football game. B. L. Freedy, a representative of the Northwest Telephone Exchange Company at St. Paul, Minn., with Manager Keech of the Ann Arbor exchange of the Michigan Telephone Company, arranged a telephone booth on top of the grand stand. Connection was then obtained with St. Paul, and at the dictation of a St. Paul newspaper man the entire progress of the game was telephoned to St. Paul. Direct connection was maintained for three hours between the two places, which, by the long-distance telephone line, are nearly 700 miles apart. It is said that an attempt at long-distance telephone reporting of this nature had never before been made. In addition to the telephone service and a similar one to Detroit, there were about 20 telegraph operators furnishing the usual telegraphic reports.

Gravity Hook for Telephones.

The cut given below shows a new gravity hook for telephones, in which neither the hook proper nor the frame is in circuit. The contacts are platinum and the springs are spring german silver. The main restoring spring is made of piano wire and its tension can be adjusted instantly without removing the hook or disturbing any of the parts of the mechanism. The Swedish-American Telephone Company of Chicago is the manufacturer of this hook.



GRAVITY TELEPHONE HOOK.

TELEPHONE MEN.

Harry D. Critchfield, general counsel of the Federal Telephone Company of Cleveland, has resigned his position with that company, to become identified with the Automatic Electric Company of Chicago. Mr. Critchfield is a member of the advisory board of the Independent Telephone Association of the United States and is one of the best-known Independent telephone men in the country. W. L. Carey, who has been assistant counsel for some time, will take Mr. Critchfield's place with the Federal.

George N. Daniels, wire chief of the Lehigh Valley system, has resigned, to accept a position as general superintendent of the New York State Telephone Company, with headquarters at Binghamton, N. Y. Mr. Daniels has been with the Lehigh for 10 years and had entire charge of the telegraph and telephone system, under Superintendent Jacobs, between Buffalo and Sayre. The position of wire chief was originated at the last reorganization of the telegraph system. It is understood that the position will now be abolished and the duties devolve upon the superintendent, as before.

GENERAL TELEPHONE NEWS.

The Citizens' Telephone Company of Grand Rapids, Mich., has increased its capital from $1,000,000 to $2,000,000 and its directorate from six to 11 members.

Clermont County, Ohio, is said to have the youngest telephone operator in the state (and possibly in the United States) having full control of an exchange. This is Michie Goodpaster of Edenton, Ohio, a girl only 10 years old, but who is said to be entirely capable. Michie's aunt was first employed by the company as manager of the exchange and the child assisted her at odd times. The aunt became afflicted with typhoid fever and died, and the child succeeded her in the position, which was at first supposed to be temporary but has become permanent.

CONVENTION ANNOUNCEMENTS.

The Lindsley Brothers Company, the well-known producer of cedar poles of Chicago, Menominee and Portland, Ore., will be ably represented at the Interstate Independent telephone convention, to be held in Chicago next week. The company's headquarters will be on the second floor of the Auditorium Hotel where it will be pleased to receive its customers and friends. President George L. Lindsley and Manager J. A. Navarre will personally look after the company's interests.

The Eureka Electric Company of Chicago announces that at its headquarters, in room 656, in the Auditorium, will be found, during the Interstate telephone convention, the latest products manufactured by the company. The exhibit will be in charge of I. J. Kusel, H. J. Kusel, D. L. Canmann, H. Rosenow, C. W. Robbins, Paul Gardner and others, and handsome souvenirs will be distributed. The exhibit will embody special improvements in the products of telephone apparatus.

Central-energy Telephones for Mines and Interurban Railways.

A new mine and railway central-energy telephone set which is especially designed to meet the conditions of bad weather, hard usage and places where high-potential currents abound, is shown, with both outer and inner doors open, in Fig. 1. This outfit is made by the Stromberg-Carlson Telephone Manufacturing Company of Chicago, and Rochester, N. Y. The iron box which protects the telephone proper is said to be weatherproof and absolutely water-tight. The line connections are brought into the box through a double elbow, at the top, as shown, thus eliminating any chance of water coming in contact with any connections in the box.

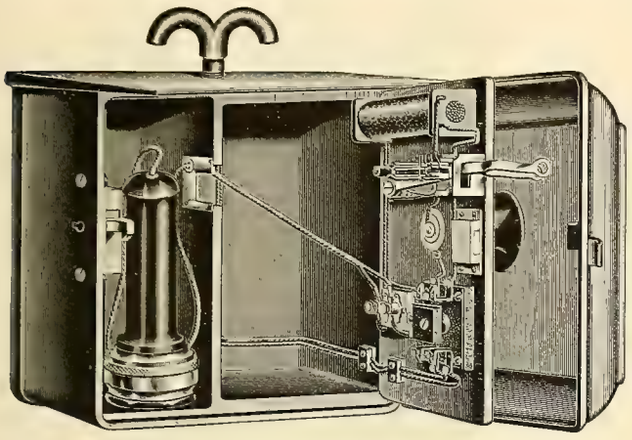


Fig. 1. Telephone Set Open.

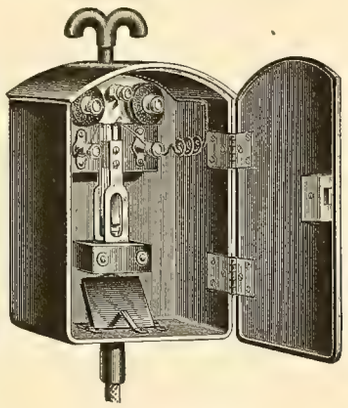


Fig. 2. Cut-in Station.

CENTRAL-ENERGY TELEPHONE FOR MINES AND INTERURBAN RAILWAYS.

The mechanism is completely protected by the inner case, which is locked and only accessible to the person having charge of the maintenance of the system. The various parts of the apparatus are mounted on the inside of the inner case door, and, when it is open, all parts are revealed in a manner that is convenient for inspection, test or repairs. The equipment of a single telephone consists of a long-distance transmitter, a bipolar receiver, platinum-contact hook switch, metallic carbon and fuse lightning-arrester connectors and all necessary parts for the complete operation of a central-energy system. The metal parts are non-corrosive, all the circuits are wired with the best grade of rubber-insulated wire and all parts are interchangeable.

The line cut-out is provided when specified, and is intended as an absolute line disconnector, when the receiver is hung on the switch hook and the outer case door closed; this makes it impossible for any high-potential current arcing to take place in the case when the apparatus is not in use, the carbon and fuse arrester being permanently connected to outgoing lines.

That part of the equipment shown in Fig. 2 is known as the cut-in station and is intended for use in connection with the telephone instruments shown in Fig. 1. This box is weatherproof, provided with hinges and lock and made of heavy cast iron. It is so constructed that it may be used without unlocking. In the lower end of the box an opening is provided with a self-closing trap-door, which may be opened by pressing upward. This equipment consists of a bridging jack, with heavy german-silver reinforced springs and mounted on a heavy hard-rubber base and with heavy sleeve for plug guide, the tension of the springs being sufficiently strong to retain the plug firmly in position and assuring perfect electrical contact. On the bottom of the box there is a Y-shaped guide or groove, which forms a path for plug, to the opening in spring-jack sleeve, thus making it convenient for the user to insert the plug into the jack. The mere insertion of the plug calls headquarters.

This instrument bids fair to become a popular instrument with street-railway people, and it is understood that the company has a number of contracts already executed for this line of apparatus.

European and American Trade Competition in Cuba.

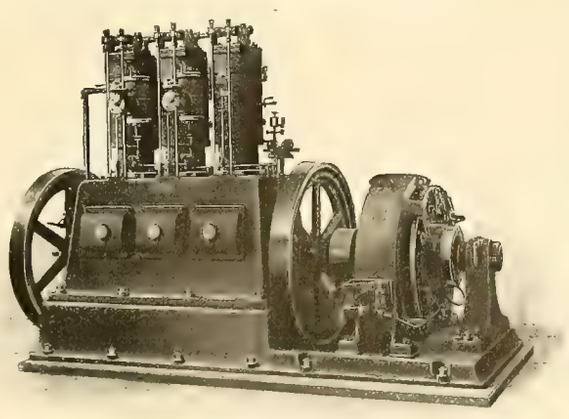
An advance sheet of the consular reports gives the following information, which shows a condition of affairs in Cuba not to be boasted of by the American manufacturer: "Dealers in Cuba in machinery have a decided advantage in placing their orders in Europe instead of in the United States, because in the actual condition and state of affairs they get lower prices, varying from 10 to 30 per cent., according to class of machinery and materials, lower shipping rates, quicker delivery, and terms of payment more advantageous, as European manufacturers are willing to sell their goods on time, while American manufacturers want cash. It is stated that even in case a large reduction of duty, preferential to the United States, should be conceded by Cuba on the articles referred to, the lower prices and freight rates, quicker delivery, and easier terms of payment would fully compensate for the higher customs duties that Cuban dealers would have to pay on the European machinery and materials."

St. Joseph River Power Development.

One of the large engineering enterprises of the decade, surpassed in the Middle West only by the Clergue plant at the "Soo," is the great dam now in the course of construction 20 miles north and above the city of Niles, Mich., at what is known as the Twin Branches, where two small streams empty into the St. Joseph River. An expenditure of at least $1,000,000, and possibly $2,000,000, is being made in the construction of a dam to "harness" the waters of the St. Joseph River. A total of 12,400 horsepower is expected to be developed upon the completion of the dam, which will be electrically transmitted to all the important manufacturing cities of the valley within a radius of 20 miles. This great enterprise has been undertaken by the St. Joseph and Elkhart Power Company, an Indiana corporation, whose plans also provide for another dam at Berrien Springs, Mich., to develop 2,500 horsepower and another of about the same size, midway between Niles and South Bend, Ind., all three to control the water-power of the St. Joseph River. Work was begun in July, 1901, and the contractors employ a force of 300 men. The dam will form a lake covering 1,000 acres of land, having an average width of 840 feet and a length of 10 miles. The company expects to be ready to transmit power by next June.

Walrath Gas-engine Generating Set.

The accompanying illustration shows a direct-connected gas engine and electric generator set put out by the Marinette Iron Works Manufacturing Company of Marinette, Wis. The engine is of the Walrath three-cylinder vertical type, with throttling governor, making it especially well qualified for electric-lighting purposes or any service requiring close regulation of speed. The company has recently installed an engine of this type of 100 horsepower, direct-connected to an 80-kilowatt Western Electric dynamo, in the Hotel Metropole, Michigan Avenue, Chicago. The set is used for lighting purposes, as well as for operating motors for passenger and freight elevators and other service. The engine has now been installed over 30 days, is running every day, and is said to be doing excellent work.



WALRATH GAS-ENGINE GENERATING SET.

The Marinette company has many of these engines installed in this line of work, both belted and direct-connected to dynamos in private as well as municipal lighting plants, all of which are said to be producing as good commercial results as automatic steam engines. Many export orders have also been received. A three-cylinder, 75-horsepower engine, direct-connected to a General Electric generator, has been shipped to Japan and a number of direct-connected plants are now booked for Portugal.

Hylo Lamp with Pendant Switch.

The Phelps Company of Detroit, Mich., has recently put on the market a lamp which it asserts to be suited "to both high and low members of the family." Where an electric lamp is on the ceiling, behind a closed globe or over the dining-room table, it is inconvenient and impossible to take hold of the lamp bulb to lower the light, in the manner which has become familiar with the well-known standard Hylo lamp. The new lamp which the Phelps Company has named the Long-distance Hylo, has a pendand push-button and switch, terminating in snaps like a glove fastener. These are easily attached to the base of the Hylo lamp. Obviously, the cord may be any length and the light controlled at any desired distance. A familiar advantage of this light is in the sick-room, where the cord may be extended to the bed and the invalid can turn on the large or small light without difficulty.

HYLO LAMP WITH PENDANT SWITCH.

Bad Boiler Explosion.

A boiler explosion which occurred recently in the plant of Swift & Co. at the Union Stockyards, Chicago, caused the death of 14 men. The cause of the explosion is yet somewhat of a mystery, and thorough investigations are being made. H. M. Lemon, Chicago manager of the Hartford Steam Boiler Insurance Company, said concerning the accident: "The boiler which exploded at Swift's plant was comparatively new. It had been recently inspected and found in good condition internally and externally. Boilers of superior construction will explode sometimes, even under the best care which can be obtained. It is the unexpected which happens in our experience with steam boilers, and Swift & Co.'s explosion was a disaster entirely unexpected to me, otherwise the insurance would have been canceled."

MILLER LAND ANCHOR.

Miller Land Anchor.

The Miller anchor is a new land anchor that is just being placed upon the market by the Miller Anchor Company of Norwalk, Ohio. The company guarantees this anchor to stand a strain that will break the rods before the anchor can be pulled out of the ground. The anchor is inexpensive, but unusually strong, as it presents more surface to the ground than other anchors. The company's goods will be on exhibition at the Auditorium Hotel, Chicago, during the telephone convention next week.

Municipal Telephone Experiment at Tunbridge Wells.

An interesting example of telephone competition offered by a muncipality against a long-established corporation is afforded in the history of the telephone system installed by the corporation of Tunbridge Wells, England. This town installed a telephone exchange in 1901—the field up to that time having been exclusively covered by the National Telephone Company. As soon as the new system was opened the National company reduced its charge for an unlimited service to £4 per subscriber per annum. The corporation charges were, and still are, £5 17s. 6d. for unlimited service, or an annual rental of £3 10s., plus ½d. for every outward call, or, again, £2 10s. per annum, plus 1d. for every outward call. The present state of affairs is that the corporation has now 853 subscribers, of which about one-half pay the full rate for unlimited service. The National Telephone Company has, by active canvassing and by its reduced charges, succeeded in getting 1,015 subscribers. Of the above, 180 are subscribers to both the telephone systems, so that the total number of telephone users in the town is equal to 1,688. The corporation undertaking, formally inaugurated at the end of July, 1901, has actually been at work some 16 months, and no authoritative statement of its financial position has been issued by the borough accountant. The system extends over 180 square miles of surrounding country, and provides telephonic communication to a large number of outlying villages, which previously were quite isolated from the town.

On November 5th, at a special meeting of the Tunbridge Wells Town Council a draft of a proposed agreement was submitted for the approval of the members. This draft was prepared by the town clerk, W. C. Cripps, on his own initiative, and, after considerable negotiations between him and Mr. Gaine, the general manager of the National Telephone Company. The agreement provides for the complete transfer of the corporation telephone undertaking to the National Telephone Company for the actual cost expended on the same.

The terms of the agreement may be briefly summarized as follows: The company may either repay in a lump sum the whole of the capital spent by the corporation, or may pay the half-yearly installments of the interest and sinking fund as they come due. The company would take over the telephone undertaking from the corporation, and would indemnify them against all claims and liabilities. The rates would be raised to £6 per subscriber for unlimited service, this rate to apply to all now connected to the exchange and to those who apply before March 25th next. The message-rate scales of the corporation would be abolished, and one adopted providing for the annual payment of £3 10s. per annum, plus 1d. for outgoing call, with a minimum charge of £5 per annum. The company would have a free hand in fixing its charges for any subscribers applying after March 31st next. The company would have the use of the corporation exchange for the next two years at the present rental, and would take over the staff of the corporation at their present rates of remuneration. The company would pay the corporation 2s. 6d. per annum for every subscriber on the unlimited service. This payment is spoken of as a wayleave rental. The corporation would agree not to transact telephone business within the licensed area nor to consent to anyone else doing so while the agreement remains in force—i. e., until the expiration of the license in 1925. The corporation shall do its best to obtain the consent of the postmaster-general to the agreement, and that the company is bound to afford a proper, efficient, and continuous telephonic service within the licensed area.

The full agreement was brought before the special meeting of the corporation on November 5th, and was very nearly passed, although it had not even been read by the members. The opposition, however, succeeded in adjourning the matter until November 12th. Meanwhile a series of indignation meetings were held in the town, the general sentiment of the citizens being that the municipal undertaking should be given a further time for development. However, in spite of the many protests, the council met again on November 12th, and after a spirited discussion by a vote of 19 to eight resolved to dispose of its telephone undertaking to the National Telephone Company for £25,000, the amount which has been expended by the municipality on the enterprise.

The principal discussion was over a report signed by the town clerk, borough accountant and telephone manager, to whom it appeared that there were two courses open to the municipality: (1) To accept the offer of the National company, or (2) to endeavor to obtain the sanction of the Local Government Board to a further loan of at least £10,000, explaining the position in which the council is placed, and increasing the rates charged to subscribers—running the risk of a decrease in their number. These gentlemen said: "It is manifestly impossible for the council to continue its undertaking unless it can obtain a fresh loan, as after 1,010 lines have been completed all new subscribers would have to be refused, and no work involving capital expenditure on construction could be undertaken."

Alderman Stone, who acted as intermediary in first bringing together the town clerk and the National company's officers for the purpose of preparing the agreement, at the meeting of November 5th rehearsed the situation in a clear manner. He said that during the last summer various communications had been made to him by members of the council and other ratepayers on telephone matters. He did not wish to say anything against the National company, but it was a fact that they all felt the great advantages of the telephone system, that the charges of the National company were prohibitive, and that the service was bad. The corporation telephone service was therefore started, and they all knew with what eclat it started, and with what success, and at much reduced rates. Directly they started, what did the National company do? They reduced their rate to one-half. Now, everyone with whom he had conversed had said that they did not want two but only one thoroughly good telephone service. The result of the cutting of rates was that neither of the services was being worked at so good a profit as they hoped and as the National company hoped. What, then, was their duty? It seemed to be to find some method by which that cut-throat policy could be ended. Three courses appeared to be open to them: The first was a working arrangement; second, to buy up the National; third, to sell their service to the National. The first course seemed impossible. Then, as to buying out the National. That was a large order. The National was all over the country, while the corporation was confined to its Tunbridge Wells district. It was, therefore, practically impossible that the National should sell to the corporation. Then came the question whether they could sell to the National, and make a good arrangement without loss to the ratepayers. The National would not open the negotiation, and the corporation telephone committee would not go to the National. Somebody, therefore, must act as intermediary. So he undertook the task, along with the town clerk, in seeing what could be done, with the result already stated.

Electric Railways in Maine.

There is apparently a boom in electric-railway building in the state of Maine. It is expected that 200 miles will be constructed within the next year and the electric railways are becoming strong competitors of the steam railroads. The state now contains some 300 miles of electric railways, and many lines are being connected by "links." Governor John F. Hill holds the most electric-railway stock of any person in the state, being principal owner of the Rockland, Thomaston, and Camden company in Knox County, the Augusta, Winthrop and Gardiner company in Kennebec County, and the Portsmouth, Kittery and York company in the extreme southern part of the state. It is expected that the lines of the two first-mentioned companies will be connected next spring by the building of a link 30 miles long. This would bring Rockland and Augusta within 45 miles of each other. The distance by steam railroad is double that. Thomas J. Lynch, F. G. Kinsman, H. G. Staples and C. R. Whitten of Augusta and Fred S. Thorne of Gardiner have formed a company which will build a line on each side of the Kennebec River, between Augusta and Waterville, a distance of 20 miles. Electric railways are also to be built in Aroostook and Hancock Counties, the latter between Ellsworth and Cantine, and the Bangor and Hampden line is to be extended to Winterport and Frankfort. At present there are continuous lines between York and Brunswick, and these will soon be extended to Augusta by the building of a link between Gardiner and Brunswick.

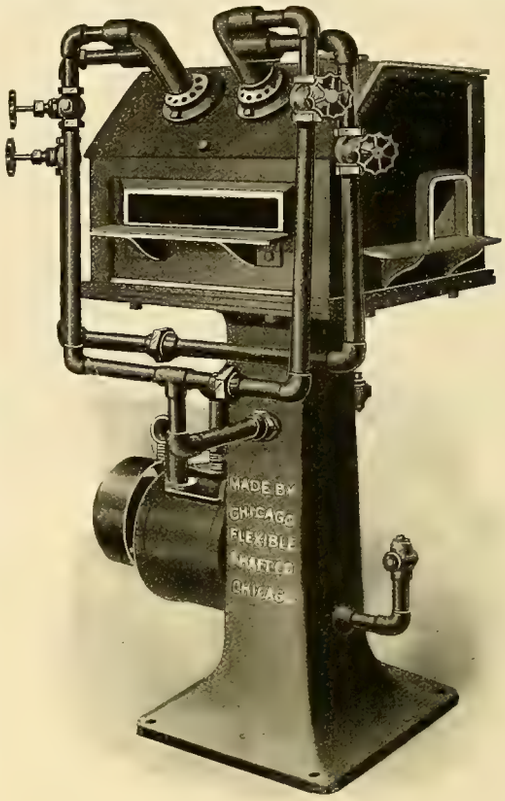
Storage Battery for Heavy Railroad Work.

A contract was recently closed by the Electric Storage Battery Company of Philadelphia with the Baltimore and Ohio Railroad Company for the installation of a second battery of Chloride accumulators, to be operated at the Mt. Royal entrance of the Baltimore and Ohio tunnel, Baltimore, Md. The first battery was installed in November, 1900, in a building which was designed for two batteries, and the second battery is put in as the result of the successful service which has been obtained from the original plant. The railroad company has completed its plans for the electric haulage through the tunnel of both its freight and passenger trains, and for this purpose has contracted for two electric locomotives of approximately double the capacity of the ones now in service. The demand which will be occasioned by this increased service necessitated a corresponding increase in the power equipment, and it was decided that the best way of obtaining this was by the installation of another battery.

Before the first battery was installed, the load required at times the operation of three 500-kilowatt generators. On the installation of the original battery this number of generators was reduced to one, and it is estimated that even with the increased service of the heavier locomotives and the more frequent trips, the larger capacity in battery output will still admit of the entire work being done by the same generator. Three hundred and twenty cells of Chloride accumulators will be operated in parallel with the original battery, giving a total battery output of 2,500 amperes.

Stewart Magnet-heating Furnace.

The accompanying illustration shows an improved form of Stewart gas-blast furnace, designed especially for heating telephone magnets. This new furnace combines on one base a positive pressure blower, air reservoir and heating chamber. The combined outfit takes up very little room, and is so arranged that little heat is wasted, and any heat required can be had by manipulation of the globe valves. The burners are so arranged that the flame is projected diagonally downward against the slab. This arrangement has the advantage of direct and rapid heating, it being possible to heat for hardening as many as 1,000 magnets, large size, 10 by ½ by ¾ inch in 10 hours. The magnets are first placed in the long opening 12 by 2 inches in a layer covering the whole heating chamber. As they are heated they are taken out of the opening. In this way work is kept going all the time, magnets being heated practically as fast as a man can work. The manufacturer of this furnace, the Chicago Flexible Shaft Company of Chicago, claims that with the same amount of gas twice the amount of work can be done with its furnace than with the old-style furnace. It is claimed that one man with this furnace can do more work in one day than can be done in four days with the old-style coal or coke apparatus.



STEWART MAGNET-HEATING FURNACE.

Wireless Telegraphy on Fast Express Train.

Some additional information has been given out by Dr. Howard T. Barnes of McGill University, Montreal, of the experiments in wireless telegraphy recently made in Canada between a fast running Grand Trunk express train and a station. The train was composed of nine cars and arrangements were made so that the communication with the station could be noticed in three of these cars. With comparatively simple laboratory apparatus it was possible to keep the train in touch with the station for from eight to 10 miles. St. Dominique was selected as the transmitting station, where two large metal plate vibrators, 10 by 12 feet, connected with an induction coil of the usual pattern, were situated. On the train itself the waves were received by collecting wires connected to a coherer of nickel and silver powder. The relay operated electric bells in three cars. The collecting wires were run through the guides for the train signal cord, and extended on both sides of the coherer for about one car length.

Professor Barnes says: "To obtain the maximum effect it would have been better to have had a long vertical wire, but since such was impossible, the horizontal wire was used. Although these were placed inside the steel frame cars strong and definite signals were obtained over the distance named. Another difficulty militated against obtaining the maximum sensitiveness, as, owing to the natural vibration of the train resulting from its great speed, it was impossible to have the relay adjusted to its most sensitive point. In spite of these difficulties, the dis-

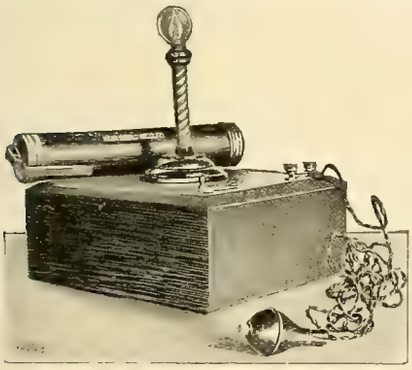
tance to which signals could be sent to the train was eminently satisfactory, and with more refined apparatus greater distances could without doubt be obtained."

Electric Power Transmission in Northern California.

The Northern California Power Company, which furnishes power to a great variety of industries in one of the most prosperous sections of California, has recently installed a 4,000-horsepower generating plant at the Cow Creek station, which is situated in the high Sierras, and is typical of the many transmission plants which have recently been installed in California. The ultimate capacity of the station will be 8,000 horsepower. The company has already installed 3,000 horsepower at another generating station, known as the Battle Creek station, thus making the present total capacity of the company's electrical installation 7,000 horsepower. Among the industries supplied with power by this company are ore smelters, the city waterworks at Red Bluff and Redding, and the operation of large air compressors at the Mt. Copper Company's mine at Iron Mountain. For lighting, current is also furnished to the cities of Redding, Red Bluff and Willows, and the towns of Keswick, Cottonwood, Anderson, Corning and Vina. These towns lie along the Sacramento River and are located in one of the most fertile valleys in California. Irrigation is necessary on most of the land in this valley, and electrically driven centrifugal pumps are employed to raise the water to the irrigating ditches. The apparatus which the Northern California Power Company has recently installed in its Cow Creek station consists of two 1,500-kilowatt, three-phase, Westinghouse alternators, which will be driven by impact waterwheels, supplied with water under a head of approximately 900 feet. The transmission will be at 34,000 volts.

Portable Bedroom Light.

William Roche, 42 Vesey Street, New York, manufacturer of the New Standard dry battery, reports a large and increasing demand for his New Standard home flashlight. He says his dresser or bedroom



PORTABLE BEDROOM LIGHT.

night light, shown in the accompanying cut, is becoming very popular, judging from the sales. This light is fitted with a 3.7-volt lamp, and three Roche Navy square cells. These cells will light the lamp for about 70 hours, using it one-fourth to one-half hour a day. With the ordinary use, of a few minutes at a time, this light, it is said, will last for two years without renewing the battery. In lights of this kind the cells used are 1¼ by three inches, about 2¼ cubic inches, while the Navy square cell measures nearly 30 cubic inches. Mr. Roche has also had very satisfactory sales of his No. 5 Navy Standard cell for telephone work and of his "Autogas" gas-engine cells for automobiles.

Induction Motors in a Wood-working Establishment.

An interesting example of the application of induction motors to the driving of shop machinery is afforded by the plant of William Demuth & Co., Brooklyn, N. Y., manufacturers of tobacco pipes and walking sticks. Power for the factory is furnished by two Westinghouse two-phase, compensated-field alternators, driven by Corliss and Ball & Wood engines, having a close-speed regulation. Excitation is furnished by small multipolar dynamos, driven from the main generator shafts. The main power system operates at 220 volts, and all motors are wound for this pressure. Lighting is also supplied from the two-phase mains, special balancing transformers being introduced between the 220-volt leads for the purpose of furnishing a 110-volt three-wire lighting service and equalizing unbalanced loads upon the lighting system. Motive power in the factory is furnished by 14 Westinghouse type-C induction motors, varying in capacity from five to 20 horsepower. Many of the motors operate in an atmosphere heavily laden with wood dust from the woodworking machinery and are completely covered with this oil-soaked dust, but show no injury therefrom. The motors are belted to short line shafts, which in turn drive various types of belted machinery, including turning and mounting lathes, circular and band saws, buffers, blowers, drill and machine-shop tools. The motors are started at a reduced voltage by means of Westinghouse starting coils, and when near synchronous speed are thrown directly upon the 220-volt system. The power equipment has been in operation for over one year and has been satisfactory in every respect.

Electrical Rhetoric in Nevada.

[From Tonopah (Nevada) Miner.]

We have been trying all week to devise some means to generate enough electricity to energize our motor, but have been unsuccessful. We thought we had solved the problem when we found the following tribute to electricity by Sam Davis in an old scrapbook. It is an extract from a speech made by Sam two or three years ago at a banquet given in Virginia City to celebrate the introduction of electric power on the Comstock. This verbal battery has a sufficient voltage, or whatever the experts call it, to run two motors the size of ours, but its current is alternating or intermittent, while our motor requires a direct and continuous current—such as Sam generated in his conversation dynamo the week we roomed with him at Reno.

"It seems to soar to every height, sound every depth and extend its giant arms throughout illimitable space.

"Born from nothing, it leaps into existence with the full-fledged strength of a giant, dies and is born again, living a thousand lives and dying a thousand deaths in the space of a single pulsating second of time.

"It plants the first blush upon the cheek of dawn; with brush of gold upon the glowing canvas of the west it tells the story of the dying day. At its mere whim and caprice, it causes a thousand pillars of light to leap from the sullen seas that surge about the Pole, and on its shimmering loom it weaves the opalescent tapestries of the aurora to hang against the dark background of the Arctic night.

"It strides the swift courses of the storm which circles round the crest of old Mount Davidson, cleaves the black curtain of the night with scimiters of flame, rouses the lightnings from their coach of clouds and wakes the earthquake.

"It startles nature from her winter sleep, breaks the glittering fetters of the frost, and lifts the shroud of snow from off the landscape. It woos the tender mold and bids the birth of bud and blossom, dowers the flower with perfume, and clothes the land with verdure of the spring.

"Beneath its touch a beetling crag that took Omnipotence a thousand years to build, crumbles into dust and becomes the plaything of the idle winds. It lays its hands upon a populous city, with its teeming, restless multitudes, and where yesterday stood the glittering spires the shining towers and frowning battlements, to-day the cold, grav ocean rolls in undisputed might.

"It brings from every corner of the world the doings of the day, the tales of love and death, of fire and flood, of strife and pestilence, and under 8,000 miles of shivering sea whispers the babble of two hemispheres.

"It lights the lonely garret where wearied workers toil to earn their bread, it sheds rays o'er scenes where feet of feasters tread the halls of revelry.

"It glares in haunts where jeweled fingers lift the cup of pleasure to the mouth of sin, and speeding on its journey, lights the dim cathedral aisle where surpliced priests proclaim the teachings of the Master and golden-throated choirs lift their hosannas to the King of Kings.

"It rides upon the wings of war, where brave men die, and while it treads between contending hosts, exalts the kingly crest and helps an empire plant the flag of conquest.

"It turns the wheels of peace where poor men toil, assists the husbandman to plow, to plant and reap his whispering grain.

"It was the Master's ally at the dawn of time, and when the voice of God cried from the depths of space, 'Let there be light,' it sent the pulse of life along creation's veins, baptized earth's cold brow with floods of fire, and stood the sponsor of the cradled world.

"To-day, the hand of science tethers the turbulent waters of the Truckee, and lifts a force from out the trout pools and whirling eddies to turn the wheels of industry on the Comstock, infuse the old ledge with new life and force it to pour its bounties once more into the lap of the grand old battleborn commonwealth of Nevada."

The regulations established some time since by the Treasury Department providing a rate for allowance of drawback on certain electrical apparatus, made in part from mica, also on mica made into sheets, plates and other forms, have been extended, as far as applicable, to cover exportations of the same class of manufactures by the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa., in the manufacture of which no other than imported unmanufactured or rough-trimmed mica has been used. The manufacturer has submitted a sworn statement of the process of manufacture, which has been placed on file in the office of the collector of customs at New York, together with blue-prints showing location of mica parts in the machines and apparatus, which are for the use of the collector in determining the drawback allowance.

CORRESPONDENCE.

New York Notes.

New York, November 29.—The rumor afloat for some time past concerning the lease of the Manhattan Railway Company by the Interborough Rapid Transit Company has proved to be well founded. A joint meeting of the boards of directors of the companies occurred on Wednesday last and from that meeting an official announcement came to the effect that the Interborough company will lease the Manhattan company on a basis of a seven per cent. dividend guarantee of the latter company's stock by the former. The lease will run for a period of 999 years and goes into effect on April 1, 1903. It covers all franchises and property of the Manhattan Railway Company. The rental from April 1, 1903, to January 1, 1906, will be the net earnings of the Manhattan company not exceeding seven per cent. After January 1, 1906, the rental will be seven per cent. per annum on the stock of the Manhattan Railway Company. This company's stoc kwill be immediately increased to $55,200,000 for the purpose of completing improvements already planned, the present stockholders of the Manhattan to have the privilege of taking the new stock pro rata at par. The Interborough company will pay $10,000 per annum to keep up the organization of the Manhattan company, in addition to the dividend rental, which shall be paid to the stockholders, and the Manhattan stock will be stamped with a contract of the Interborough company to this effect. Another feature of the Manhattan-Interborough deal comes to light in the form of a rumor that the future plans point to a consolidation of all the local traction interests. A combination of the Metropolitan and the Brooklyn Rapid Transit with the Manhattan-Interborough interests is the possibility suggested, and it has been enlarged upon and amplified in the street until some have come to regard it as something bound to occur.

As a result of the bursting of a 30-inch water main at the corner of Broadway and Sixty-ninth Street last Wednesday afternoon, the progress in the Rapid Transit tunnel may be delayed along this point for some time. Thousands of gallons of water poured into the excavation for a space of two hours, and before the Water Department men arrived on the scene it had caused considerable damage. For a distance of nearly three blocks, according to one of the foremen, the concrete covering of the top of the structure has suffered much damage. The water got in under the concrete layer, and raised it so that it may have to be repaired in many spots and perhaps for the whole distance of three blocks.

The state railroad commissioners have granted the application of the Pennsylvania company to construct a tunnel railroad in this city to connect the Pennsylvania and the Long Island Railroads. The plans of the company were exhibited and Vice-president Rea testified for the company. He said that the location chosen for the terminal station, between Seventh and Ninth Avenues and Thirty-third and Thirty-fifth Streets, was regarded as the most suitable for all time. About $7,500,000 had been paid for the property. "It is the plan," he said, "to run all through trains from the West to this terminal station for the unloading of passengers, and then proceed to the yards on Long Island, where the trains will be cleaned and prepared for the return trip. The Pennsylvania and the New York, New Haven and Hartford having acquired the New York Connecting Railway, direct connection with New England by way of Long Island City will be established, and the use of floats for passenger traffic done away with. It is not the intention to employ the terminal for freight service at all." Mr. Rea said the shafts in building the tunnel would be on private property, and the road would maintain all of its present stations on the New Jersey side. Soundings are being taken in the Hunter's Point section of Long Island for what is expected to be the largest electrical power house in the world. The building is to be erected by the Pennsylvania Railroad Company, and it is the reported intention to develop motor power to operate the entire underground system which the company contemplates running under Manhattan in addition to several of the shorter branches on the Long Island Railroad.

President Lederle of the Board of Health said recently that a large number of proprietors of steam plants who have been burning soft coal and have been notified to return to the use of anthracite, have complied. As a result the city atmosphere is again endurable. Small sizes of anthracite coal can be obtained in sufficient quantities to authorize the board to force a compliance with the smoke ordinance. One of the most obstinate offenders has been the Manhattan Railway Company, but that company now agrees to stop burning the soft coal.

The Russell & Stoll Company of New York city was incorporated this week to manufacture electrical fittings. Its capital is $30,000, and the directors are F. J. Russell, Theodore Stoll and A. O. Uhlitz, all of Brooklyn. O.

New England News.

Boston, November 28.—The Boston Elevated Railway Company recently received 4,300 tons of Scotch hard household coal, to be distributed among its employes. The company has also received 4,373 tons of soft coal from Europe.

The Hartford and Middletown Railway Company

is surveying the route for an electric railway between the Wethersfield, Conn., terminus of the Hartford Street Railway Company's system and Cromwell, Conn., where it will connect with the proposed extension of the Middletown Street Railway Company's lines. When these lines are completed, Hartford and Middletown, Conn., will be connected by electric railways which will parallel the steam railroad.

The Union River Light, Gas and Power Company has been organized at Ellsworth, Maine, and will develop the waterpower of Union River for the electric lighting of Ellsworth and other places in Hancock County. The company has an option on the Bar Harbor, Maine, electric plant. The falls in Union River will produce 4,000 horsepower.

The Stuart-Howland Company of Boston, dealer in electrical supplies and specialties, will move from 283 and 285 Devonshire Street to the corner of Winthrop Square and Devonshire Street, about January 1st. The company's new quarters were recently vacated by the Pettingell-Andrews Company.

The D. J. Mahler Company, manufacturer of electrical apparatus, has purchased an estate on Pawtucket Avenue, East Providence, R. I., and will construct a factory there.

The J. W. Bishop Company of Worcester, Mass., has obtained the contract for the proposed municipal lighting plant at Taunton, Mass.

Owing to an accumulation of orders the Massachusetts Fan Company's electric fan factory at Waltham, Mass., is running evenings.

The Edison Electric Illuminating Company of Boston will build a storehouse 1½ stories high, measuring 20 by 80 feet, at the corner of Harrison Avenue and Zeigler Street, Roxbury District.

The Automatic Switch Company, recently organized at Waterbury, Conn., has established a plant in Oakville, Conn. It will manufacture a double-acting electric time switch for regulating lights in store windows.

The West End Street Railway Company held its annual meeting on Tuesday and re-elected its present board of directors, with two exceptions. G. T. W. Braham and William Skinner died during the past year and no successors were elected. The following figures are taken from the balance sheet dated September 30, 1902:

ASSETS.

Road construction	$10,581,396
Equipment	8,080,812
Land and buildings	10,734,952
Cash and accounts receivable	1,231,778
Subway equipment	296,944
	$30,925,882

LIABILITIES.

Common stock	$ 9,085,000
Preferred stock	6,400,000
Bonds	14,666,000
Accounts payable	559,669
Surplus	215,213
	$30,925,882

The contract for the power for the new Beverly, Mass., factory of the United Shoe Machinery Company will be placed within the next few months.

B.

Canadian Intelligence.

Toronto, Ont., November 28.—The annual meeting of the Montreal Street Railway Company passed off very quietly. The report was taken as read and the sum of $100,000 set aside as an insurance fund. The old board of directors was unanimously re-elected as follows: Hon. L. J. Forget, Messrs. James Ross, K. W. Blackwell, F. C. Henshaw and H. Montagu Allen.

Galt manufacturers have organized themselves into an electric power committee for means of securing power from Niagara Falls. An effort will be made to place 50,000 horsepower in the Ontario district, comprising Brantford, Paris, Galt, Preston, Hespeler, Berlin, Guelph, Waterloo, Baden, Ingersoll, New Hamburg, Stratford, London and Woodstock. The approximated rate is placed at $15 a horsepower.

The Barton Township Council has passed a by-law giving the Hamilton and Caledonia Electric Railway Company free right-of-way on the Barton and Glanford roads as far as Ryckman's Corners for 25 years, but after 1928 the company must pay $100 a mile yearly.

Toronto and Pittsburg capitalists propose building a belt electric line through the most fruitful part of the Niagara Peninsula. The route is to be from Homer, six miles from St. Catharines, to Niagara-on-the-Lake, thence along the river road to Queenston, and along the Q. and G. stone road back to Homer. Frank Broderick and Herbert L. Dunn of Toronto and H. L. Christy of Pittsburg are the gentlemen promoting the scheme. They appeared before the Grantham Township Council on Saturday and a by-law was passed giving them the franchise. The work is to be commenced by July 1st next and completed by July 1, 1905.

The Valleyfield Electric Railway Company has applied for incorporative powers to build and operate an electric railway within the limits of the counties of Beauharnois, Huntingdon and Chateauguay, connecting the several municipalities of these counties with the town of Valleyfield and extending to the Canadian Pacific Railway line at the town of Caughnawaga.

The Toronto Suburban Railway Company has notified the council of its intention to extend the Lambton branch of its line across the Humber River at Lambton Mills and Etobicoke Creek at Summerville.

While the city engineer has been busy preparing plans for the entrance of radial railways into Toronto, those who are most likely to secure control of these railways have practically all their plans ready for the entry into the city as soon as the council agrees on the terms. Upon the recommendation of Engineer Rust, W. T. Jennings, ex-city engineer, was appointed advisory engineer on radial railways. Mr. Jennings will be asked to report a comprehensive scheme for radial railways for the city.

The Canadian Northern Railway has entered into an agreement with the Great Northwestern Telegraph Company to transact all commercial business for the Great Northwestern Company in Manitoba.

The Canada Realty and Construction Company has been granted letters patent incorporating James Morrison, Rudolphe Forget, Paul Galibert, William McNally and Joseph Michaud of Montreal, to construct public and private works of every description; to enter into contract with the government of Canada, or any of the provinces thereof, or with any municipal or other corporation, or with any firm or person for the execution of such works as may be undertaken by the company; to own and operate such works during construction, and until such time as the company may decide to dispose of the same, and to acquire franchises, etc.

The Hill Electric Switch Company, with a capital stock of $10,000, has been organized in Montreal.

H.

Southern Developments.

Charlotte, N. C., November 29.—A new ice factory is being built at Orlando, Fla., to be operated by power supplied by the electric-light plant. The Raleigh (N. C.) Ice and Electric Company will also operate its ice plant by electric power generated at Melbourne, where an $80,000 plant has been completed on the Neuse River.

The Lexington and Columbia (S. C.) Railway Company has applied for a franchise in Columbia. The company proposes to connect Columbia and Lexington by trolley.

The roads and bridges committee of Fulton County, Atlanta, Ga., has recommended that the Georgia Railway and Electric Company be allowed to double its tracks for only 1,500 feet on the line to East Point, Ga.

Greensboro, N. C., has granted a franchise to the company which proposes to construct a trolley line to connect High Point with Greensboro and Winston. F. E. Darlington and George Cohen of Philadelphia are interested.

A bill has been jointly introduced in the Legislature of Georgia at Atlanta providing that when a new city or suburban street-railway company is granted a franchise in any town, condemnation proceedings may be instituted if sanctioned by the city or county, when it is necessary for the new company to use the tracks of a previously existing company to give a satisfactory service to the public.

An election will shortly be held in Griffin, Ga., on the question of issuing $100,000 bonds for water, sewerage and light extension.

The Savannah (Ga.) Electric Company proposes to expend $40,000 building an extension of its system at West End. President Geo. J. Baldwin has asked for the necessary franchise.

L.

Niagara Falls, N. Y.

Niagara Falls, November 29.—Application has been made by another syndicate for the right to develop power on the Canadian side at Niagara. The company is as yet unnamed, but among those interested are Frederic Nicholls, managing director of the Canadian General Electric Company, and William Mackenzie, president of the Toronto Railway Company.

A new power development is about to be made in the vicinity of Medina, N. Y., where a large storage reservoir is to be constructed. The principal promoter of this latest power project is A. L. Sweet of Medina. Mr. Sweet now practically controls all of the waterpower of the Medina locality, but with the drainage of the Tonawanda swamps and the gradual diminution of all streams thereabouts, taken in connection with the increased demand for power, a greater storage capacity and a greater head is necessary.

The Ontario Power Transmission Company has been granted franchises in the town of Niagara and village of La Salle, adjoining Niagara Falls. This company has already received a franchise in Niagara Falls. It will receive its power supply from the Ontario Power Company now constructing a plant on the Canadian side at Niagara. It agrees to erect a transformer station in La Salle, and to have 5,000 horsepower ready for supply by September 1, 1906.

The Canadian Niagara Power Company has awarded Escher, Wyss & Co. of Zurich, Switzerland a contract for the making of three 10,000-horsepower turbines, which are to be installed in the new wheel-pit now in course of construction on the Canadian side at Niagara Falls. The wheels will be similar to those installed by the Niagara Falls Power Company in wheel-pit No. 2, and will be delivered the latter part of next year.

D.

From the Buckeye State.

Cleveland, Ohio, November 29.—The Northern Ohio Traction and Light Company of Akron has been incorporated with a nominal capital stock of $10,000, by J. R. Nutt and others. This is the beginning of the reorganization of the Northern Ohio Traction Company, which has been talked of for some time.

The Cincinnati, Georgetown and Portsmouth road will be put in operation as an electric line within a few days. The power house was tested a few days ago and found in splendid condition.

The Pocahontas Water, Light and Power Company of Marlinton, W. Va., has been incorporated with a capital stock of $25,000, to furnish light and power in that and a number of nearby towns. J. W. Price of Marlinton is one of the interested parties.

The Cleveland Gas and Electric Fixture Company of Cleveland has been incorporated in West Virginia with a capital stock of $100,000, and has been authorized to transact business in this state. B. G. Tremaine is president of the company and W. C. Hine, secretary.

O. P. and M. J. Van Swerington of Cleveland have purchased the electric-light plant from the Mount Vernon men, who have owned it for some time.

The Central Heating and Light Company has made application to operate in the village of Ashley.

An improvement association has been organized at Hudson, and among other things contemplated is an electric-light plant.

The Cincinnati Gas and Electric Company has completed its work of wiring the village of Linwood for lights, and the municipal plant which has been operated by the waterworks department since its annexation to Cincinnati, will be shut down.

The Proctor & Gamble Company of Cincinnati has purchased a large tract of land adjoining its plant and will erect a large electric-light and power plant, to supply the entire plant with power and light. This will be one of the largest private plants in the state.

O. M. C.

Information from Indiana.

Indianapolis, December 1.—The incorporation of the Consolidated Traction Company of Indianapolis during the last week is regarded as the first step in a gigantic interurban project. The articles of incorporation say that electric railways will be run through Brownsburg, Lizton, Jamestown, New Ross, Crawfordsville, Dayton, Mulberry, Darlington, Frankfort, Lebanon, Whitestown, Zionsville, New Augusta, Lafayette, Stockwell, Clarkshill, Colfax and Thorntown. The present capital stock is $300,000. Edward Hawkins, president of the company, says "the purpose is to absorb two or three companies already incorporated. The merger has been in contemplation for weeks, but it has taken time to bring all the interests together. By the consolidation we have a line of cities which offer a better field to interurban lines than any other in the state. There will be a meeting of the incorporators this week, when a plan of action will be determined upon and made public." The following-named men are connected with the new company: Edward Hawkins and R. W. McBride, Indianapolis; A. F. Ramsey and A. E. Reynolds, Crawfordsville; W. C. Mitchell and G. P. Haywood, Lafayette, and E. P. Baker, Lebanon.

The filing of acceptance of the interurban franchise granted by the City Councils of Rushville and Morristown to Charles R. Henry during the week is also regarded as favorable to the early building of another extensive traction system. In each case Mr. Henry filed a $5,000 bond to have the road in operation by July 1, 1904, but said it was the purpose to build the line next year. Associated with Mr. Henry in the enterprise are owners of the Indianapolis and Cincinnati street-railway systems, otherwise known as the Widener-Elkins syndicate. The proposition is to build a double-track electric line from Indianapolis to Cincinnati. The ultimate end of the movement is a through system of electric interurban roads between Cincinnati and Chicago, via Indianapolis, Lebanon, Lafayette and intermediate points. The company will organize in a few days and be capitalized at $1,000,000.

The Aurora council has granted a franchise to Swarthout & McMullen for an electric railway in the streets of the town for a period of 25 years. By the terms of the grant, the company will be permitted to haul freight and passengers. The Indiana Southern Railroad will be incorporated to build a line through Aurora, Versailles, Osgood and to Batesville, where it will connect with the Indianapolis and Shelbyville line.

The Anderson City Council has agreed to extend the Union Traction Company's franchise to 50 years, and the company will build its car shops in that city. Accordingly it has appropriated $100,000 for that purpose. The lines direct from Anderson to Daleville, Middleton, Elwood and Franklin will be completed at once. Machinery has been purchased and will at once be installed at the power house, which will increase the present capacity by two-thirds. In further consideration of the extended franchise, it is agreed to make Anderson the central distributing point in its system, and power for the operation of the Indianapolis Northern Company will be supplied from Anderson. The improvements and extensions will cost fully a million dollars, and it is proposed to have all the work done within a year. The company has also allayed all fears of the general offices being moved to Indianapolis by leasing the entire

sixth floor—51 rooms—of the new Union Block for general office purposes.

The Indianapolis, Lebanon and Frankfort Traction Company, which is well along with the construction of its line, is to be reincorporated this week as the Indianapolis and Northwestern Traction Company with a capitalization of $3,000,000.

Judge Shively of Wabash has decided in favor of the Wabash and Logansport company and against the Fort Wayne, Logansport and Lafayette Traction Company in a contention for the right to use the Wabash and Erie Canal towpath through Wabash County. The judge said the Fort Wayne company failed to convince him that it was not a paper company merely. An appeal will be taken.

The interurban lines centering in Indianapolis are not only cutting into the steam-road passenger business, but they are interfering materially with the freight and parcel business. Milk trains are now run regularly, and milk stations are being established all along the line.

Mayor Schrader of New Albany has vetoed an ordinance, passed by eight members of the City Council, last week, granting the New Albany, Paoli and French Lick Valley Traction Company a franchise to build an electric line within the city limits.

The Indiana Supreme Court has declared void a deed of sale by the East Chicago Town Corporation to the Lake County Water and Light Company, and holds that the Common Council of a city cannot sell or transfer property held by it for public use or governmental purposes, without special authority from the Legislature. Waterworks and electric-light systems are within the class of property held in trust for the inhabitants and cannot be sold without legislative authority.

Congressman Hemenway of the Evansville district will endeavor to secure a congressional appropriation to erect several dams in the Ohio River, to afford navigation during summer months, and more especially to develop power to generate electricity for the whole of Southern Indiana.

A local company has been formed at Bluffton to erect an electric-lighting plant to cost $15,000.

F.

Northwestern Notations.

Minneapolis, Minn., November 29.—Complaint is made by the residents of Helena, Mont., over the street-car service, and the council has been petitioned to compel the company to live up to its franchise.

U. P. Hord of Aurora, Ill., and F. G. Keator of Chicago have made a proposition to the city of Mankato, Minn., to construct an electric interurban line to Kasota and St. Peter, Minn., with the possibility of continuing on to St. Paul.

The City Council of Austin, Minn., made a uniform rate on electric-light service, without regard to the amount used. Now some of the larger users are dropping electricity for other means of lighting, claiming that the rate is too high. A sliding scale of rates, with concessions for the heavy users, is talked of.

The remainder of the right-of-way has been secured for the projected electric railway from Marquette and Negaunee, Mich., and construction is to be begun in the spring. The project is financed by Toledo and Cleveland capitalists.

The General Electric Company of Duluth, Minn., has just installed a large engine at the power house, to furnish power for the city's lighting system. The new engine more than doubles the capacity of the plant. The engine has a capacity of 2,000 horsepower and is the largest at the head of the lakes.

Arrangements are being made for the purchase of a new outfit complete for the electric-light plant of Breckenridge, Minn., including an engine and dynamo. The business of the plant has grown to such an extent that a great enlargement is absolutely necessary.

The council of Langdon, N. D., contemplates purchasing the electric-light plant there. The company's franchise expires very shortly.

A new light and power company is in process of organization in Sault Ste. Marie, Mich. The company will secure its power from the Michigan Lake Superior Power Company.

The municipal electric-light plant of Negaunee, Mich., showed a profit of $286.55 for October. The receipts were $812.26 and the disbursements $525.71.

The city of Black River Falls, Wis., has bought the electric-light plant from R. G. Mason & Son for a consideration of $3,600.

It is reported that Jay P. Graves has bought the electric-railway line in Spokane, Wash., on Washington Street, known as the Spokane and Montrose Street Railroad. It is understood the line is soon to be extended to Moran Prairie.

An electric car line is being surveyed for in Waterville, Wash., and to the Columbia River.

It is understood the projected electric railway from Shanano to Green Bay, Wis., has franchises for nearly the entire distance between those cities.

E. S. Harrison of Winnipeg, Man., has secured a franchise for an electric-light plant at Minnedosa, Man.

Detroit, Minn., will vote on purchasing the electric-light plant of the Detroit Light and Land Company. This village has had more or less trouble over its lighting contracts, having bonded to put in a municipal plant, only to have it decided that the election was illegal, and then granting a franchise to a competing company, and the newcomer concluding not to enter the field.

James Barta has been granted a franchise at Ord, Neb., for an electric-lighting plant.

The Twin City Rapid Transit Company is in much better shape to handle its business in Minneapolis and St. Paul this winter than last season. The waterpower is considerably larger than a year ago and the company has an addition of 3,000 horsepower from storage batteries installed since last year and has steam plants furnishing about the same power which are now being installed in each city. The additional power will be about 8,000 horsepower, and is expected to be ample for all requirements.

The East Wisconsin Traction Company has been incorporated to build an electric line from Green Bay, Wis., through De Pere, Two Rivers and Manitowoc. The capital stock is $50,000.

Muscatine, Iowa, may yet install a municipal electric-light plant. For a year the city has been striving to secure cheaper lighting. Last winter the People's Lighting Company was granted a franchise, the company agreeing to furnish lights for $64 per annum for service until one o'clock and $74 for all night. The old company was getting $90 and $100 and its contract expired October 6th. When the new company failed to have a plant in operation at that time, it was learned that the new company had sold its franchise to the old company. The council now threatens to fix prices, and if the company does not agree to them, will submit a proposition for a municipal plant to the voters.

The local street-railway company of Keokuk, Iowa, is considering a project to extend an interurban line to Warsaw, Ill.

The City Council of Mankato, Minn., has granted a franchise for a city and interurban electric-railway company to U. P. Hord of Aurora, Ill., and F. G. Keator of Chicago. They propose a line to Kasota and St. Peter, Minn., and ultimately to the Twin Cities. No business is asked.

The City Council of Mankato, Minn., has substituted gasoline lighting for electric on the streets because of dissatisfaction with the services and prices of the electric company.

A change of time on the railroad running from Oshkosh to Omro, Wis., has driven a great deal of passenger traffic to the new electric interurban line lately completed between these cities.

McNeill Bros of Oskaloosa, Iowa, operating an electric-lighting plant there, have transferred their interests in the Oskaloosa Light, Heat and Power Company to the new company.

R.

Among the Rockies.

Salt Lake City, Utah, November 28.—A power plant on the Bear River in southern Utah is the latest project of the Utah Sugar Company, and the directors are busy planning for this important piece of work. The cost of the plant will approximate $150,000. The power will be used for the new sugar river factory in the Bear River country, and also to furnish electric light for the factory and for other institutions in that part of the state, so the enterprise will not only be self-supporting but a source of revenue to the company. The site is considered the best in the whole state for power.

The franchise of the Consolidated Railway and Power Company of Salt Lake City, Utah, to extend its line from Murray, which is located 15 miles from Salt Lake City, to Sandy, and from State Street, in Salt Lake, to the Highland Boy smelter and the United States and Bingham Gold and Copper Company's smelter, was granted the 20th by the Board of County Commissioners. Permission was also granted by the board to the Salt Lake and Suburban railway to lay tracks on Fifteenth Street and State Street, the latter to connect with its Winchester road.

The Big Buffalo Mining Company of Lewiston, Idaho, which has, for the last year, been engaged in mining at Buffalo Hump, Idaho, is about to put up a big electric power plant on the properties on Sheep Creek.

The large electric-light plant at the Chloride mines, near Baker City, Ore., was destroyed by fire recently, the loss being $5,000. The plant will be rebuilt immediately.

Mr. Stewart, manager of the Rocky Mountain Bell Telephone Company at Eureka, has just resigned his position to accept a better one with the Telluride Power Company at Provo.

The street-car fender ordinance was passed at a recent Salt Lake Council meeting to read: "The company has until April 1st to equip its cars with fenders, and the penalty for neglect in providing same to be from $10 to $150 in each case."

New York and Pennsylvania capitalists will at once build a 200-ton concentrating mill, together with a 500-horsepower electric light and power plant, at the Argentine District, Summit County, Colorado. The plants will be built at Argentine, across the range, 12 miles from Georgetown. J. T. Keil of Pittsburg, Pa., E. E. Smathers of New York and several other wealthy eastern capitalists are back of the enterprises. The power plant will supply power and light for mines in the locality. Five hundred horsepower can be obtained from the two streams, which the site of the plant covers, with water at its present low level, and the acreage extends on both sides of the forks of the creeks.

The newly completed electric works at Tonopah, Nev., are now in excellent working order, and power units sufficient for all electric and reduction work are being rapidly installed. It is estimated that fully $100,000 will be expended in completing the installation of the immense plant.

An application has been made by Jay P. Graves of Spokane, Wash., for a franchise covering all the principal streets and avenues not yet equipped with street-car service, and he will, if franchise is granted, lay tracks immediately on these new lines and add the new equipment to his recent purchase of the Spokane and Montrose street-railway system.

The Cody (Wyo.) Electric Light Company's outfit arrived last week and will be installed immediately. The work is being done under the management of O. J. Midthun of Cody.

The Eureka Mining Company is installing an electric smelter near its mine at the north end of Seven Devils County, Idaho, a short distance from Lewiston, Idaho.

The Elmore (Idaho) Power Company has just presented its prospectus to the public and states therein that its property comprises 1,400 acres of land with a right to add 4,000 acres; a power plant in process of erection on Snake River, this county; franchises for lighting the town of Mountain Home, and contracts for furnishing electrical power in Elmore and vicinity.

G.

On the Pacific Slope.

San Francisco, Cal., November 27.—The electrical machinery is now being placed in the new power house of the United Gas and Electric Company at San Jose, Cal. A 400-kilowatt, three-phase generator, direct-connected to an engine, is ready for operation in case of a temporary interruption of the transmission service from the Standard Electric Company's system. A 300-kilowatt, three-phase generator is in transit from the East, and a 1,000-kilowatt generator has been ordered for delivery in nine months. The large generator will be direct-connected to an engine of Corliss type. All of the electrical apparatus is of the General Electric Company's manufacture.

Advices from Orting, Wash., state that Stone & Webster of Boston have been awarded a contract by the Pierce County Improvement Company for furnishing equipment for generating 25,000 horsepower.

Judge Campbell of San Bernardino County, Cal., has contracted with the city of Riverside, Cal., to construct a pressure pipe for 600 inches of water to bring water from Lytle Creek to the city power station, where he will put in a plant for generating electricity to the amount of 500 horsepower. A power line will be constructed to carry the power to the Riverside sub-station, where it will be delivered at a voltage of not less than 10,500 or more than 11,000. The price of electricity delivered is to be $72 per horsepower per annum, steady flow.

Under the name of the Edison Electric Company a number of electrical companies of Los Angeles, Cal., have been merged. The new incorporation includes the old Edison Electric Company, the Redlands Electric Light and Power Company, the Santa Ana Gas and Electric Company, and the subsidiary companies of the Edison Electric Company. The new company has a number of projects already well under way. These include the construction of a 20,000-horsepower plant on Kern River, a 3,000-horsepower plant on Mill Creek, and a 3,000-horsepower steam plant in Los Angeles. Arrangements have been made to issue bonds to the amount of $10,000,000 for further improvements. Of these, one lot of $1,500,000 has been delivered to N. W. Harris & Co., E. H. Rollins & Sons and Perry, Coffin & Burr.

A.

PERSONAL.

At a recent meeting of the New York Electrical Society the following-named members were elected: W. A. Belden, Thompson D. Harbinson, J. O. Sinkinson, M. B. Foster, Leon E. Schmielsewski, W. C. Andrews, Charles R. Pratt, Harold Melbin, E. B. Conrad and A. Frederick Collins.

Edwin Reynolds, who for many years has been general superintendent of the Edward P. Allis Company and lately chief engineer of the Allis-Chalmers Company, Milwaukee, Wis., has been made the consulting engineer of the entire concern. Irving H. Reynolds, general superintendent, is advanced to the position of chief engineer. The position of general superintendent remains vacant for the present.

Announcement is made of the marriage of Miss Marie Chisolm Gregg, daughter of Mr. and Mrs. Joseph Gregg, 5108 Hibbard Avenue, Chicago, to Mr. Armin Oscar Kuehmsted, also of this city, on November 26th. Mr. Kuehmsted is well known to the electrical fraternity through his connection as senior member and president of the Gregory Electric Company. Many friends unite in extending congratulations. Mr. and Mrs. Kuehmsted will reside at 4909 Madison Avenue, Chicago.

At a recent meeting of the American Institute of Electrical Engineers the following-named gentlemen were elected associate members: Cooper Anderson, Telluride, Colo.; Grafton Wall Appler, Pittsburg, Pa.; Frederick Darlington, Great Barrington, Mass.; William Warren Deane, Chicago, Ill.; John F. Easterbrook, Pittsburg, Pa.; Frank Malcolm Farmer, Brooklyn, N. Y.; Clinton Jerome Hixson, Berlin, Germany; Ray Herbert Manson, Chicago, Ill.; Sidney B. Martin, Pittsburg, Pa.; Frederick William

Newell, Yonkers, N. Y.; Randolph Halliday Nexsen, New York city; Jay H. Perkins, Youngstown, Ohio; Bert Ernest Semple, Chicago, Ill.; Frank Lord Sessions, Columbus, Ohio; Sidney Roby Sheldon, Moscow, Idaho; Arthur Harlan Stephens, Electra, Cal.; Harry Stoddard Williston, Philadelphia, Pa.

Joseph E. Montague of Chicago has accepted an offer to become manager of the local lighting and power plant at Niagara Falls, N. Y., and he will leave about the middle of this month to enter upon the duties of his new position. Mr. Montague has been identified for a number of years with the Chicago Edison Company, and during this time he has made hosts of business and personal friends, who extend to him their most hearty wishes for unlimited success in his new undertaking.

F. A. McKenzie, in a recent issue of the London Mail, sketches George Westinghouse in an entertaining manner as a typical American. He sums up the secret of Mr. Westinghouse's success in the following words: "Foresight, anticipation of the world's future needs, bold and costly experiments, trained technical skill, the abundant use of labor-saving appliances, and an elaborate system of organized intelligence." Of his electrical work, he says: "He looks forward to a coming time when the enormous generating stations necessary to-day shall be curiosities of a past age, and when all the power and light necessary for a city shall be turned out in a small hall."

ELECTRIC LIGHTING.

The Cooper-Hewitt Electric Company of New York city has been incorporated in New York state, the incorporation papers stating that its object is to manufacture electric lamps. The capital of the company is $2,000,000 and the following-named gentlemen are the incorporators and directors: C. B. Hill, J. F. Symes, G. H. Stockbridge, C. H. O'Connor and L. J. Hunt of New York city. This company will engage undoubtedly in the manufacture of the Cooper-Hewitt mercury-vapor lamp.

ELECTRIC RAILWAYS.

A short-circuit on the motor car of a train on the Northwestern elevated road in Chicago on the evening of December 2d blew out a fuse and formed an arc, igniting the woodwork of the car and partially destroying the latter. The circuit-breaker in the power house was also thrown out and the system was tied up for about half an hour. The motorman was quite severely burned, but the passengers walked to the nearest station in safety.

Dynamo and switchboard tenders employed by the Chicago City Railway Company want a reduction in the hours of labor and an increase in wages. The question has been placed in the hands of the executive committee of the Chicago Federation of Labor and that body will confer with General Manager McCulloch and attempt to secure concessions. Dynamo tenders at present receive $2.50 a day and switchboard tenders $2.25 a day for 12 hours' work. They want an eight-hour day, $2.25 a day for dynamo tenders and $2 for the switchboard men.

The Illinois Supreme Court recently rendered a decision against the Chicago Union Traction Company to the effect that the above company must carry a passenger anywhere inside the city limits for a single fare of five cents. This means that the company must issue transfers allowing a passenger to go from one of its lines to any other intersecting line of the company and to ride to the city limits for the one fare. The transfer decision, it is said, has precipitated so serious a crisis in the company's affairs that, at a directors' meeting recently, plans were considered for a complete financial reorganization of the company. The case has been appealed to the United States Supreme Court.

High-speed electric-railway experiments on the military line between Marienfeld and Zossen have been concluded for this year. On the last day the electric locomotive had a whole passenger train, consisting of 11 coaches, and weighing altogether 154,000 kilograms, attached to it, in order to test its starting capacity. The result is said to have been most satisfactory. A further trial was made with the special express-train cars of the two leading electrical companies in Berlin. Three of these cars, weighing altogether 98,870 kilograms, were attached to the electric locomotive, and a speed was attained of about 125 kilometers an hour.

The statement of the Northwestern Elevated Railroad Company of Chicago to the Illinois State Railroad Commission for the statistical year ended June 30, 1902, shows a gain of 15 per cent. in gross business and 6½ per cent. in net earnings over the preceding year. There was a reduction of proportion of operating expenses from 32.96 to 28.22 per cent. Fixed charges were increased 36 per cent., of which taxes amounted to $139,469. There was a reduction of $79,416 in rentals, due to the absorption of the Union Loop. During the year $365,000 was expended for permanent betterments, including $187,000 for new cars and $91,000 for power-house extension. The accumulation of earnings since the road was opened to June 30, 1902, has amounted to $417,113, all of which has gone back into the property.

SOCIETIES AND SCHOOLS.

It is unofficially announced that British engineers intend to accept the invitation of the American Institute of Electrical Engineers and send delegates to the International Congress to be held in America in 1904. The British engineers are in favor of holding the congress at Montreal instead of at St. Louis, Mo., as it is at present proposed.

The report that the Armour Institute of Technology was to become a part of the University of Chicago has been emphatically denied by J. Ogden Armour, who says that the Institute will remain independent. President Harper of the university states that steps will soon be taken to establish a technical school in connection with the university.

TELEGRAPH.

A bill has been introduced in the Senate of Virginia to allow telegraph companies to construct their lines along any railroad chartered in Virginia, without having to secure the consent of the railroad, thus placing the railroad lands on the same footing as private lands for the purposes indicated.

The United Pneumatic Fire Alarm Telegraph Company has asked the Chicago City Council for a 20-year franchise. It is now operating a mercurial system in the city without a franchise. City Electrician Ellicott threatened to cut the wires if a franchise was not obtained. The measure was referred by the council at a recent meeting to the committee on gas, oil and electric lights.

The time limit placed by the Pennsylvania Railroad Company for the removal by the Western Union Telegraph Company of its poles and wires from the railroad lines expired December 1st, but the telegraph company has not been forced to comply with the order. By an agreement between the two companies the poles are to remain until the dispute is settled by the courts.

The western division of the Postal Telegraph-cable Company, which embraces all the territory of the middle West, is being subjected to a thorough inspection. That part of the company's line between Detroit, Mich., and Chicago is receiving especial attention on account of the heavy business over it. It is said that the company will spend in the neighborhood of $50,000 between Detroit and Chicago alone.

The Western Union Telegraph Company recently lost a suit in the federal court in Fort Dodge, Iowa, that will probably result in instructions being issued to its employes to refuse to accept telegrams by telephone. A Britt (Iowa) bank last spring cashed a draft for $8,872 on telegraphic instructions from the bank in Dennison, Iowa, on which it was drawn. It was proved that the telegram was telephoned to the Western Union without the authority of the Dennison bank.

PUBLICATIONS.

A 252-page catalogue of "All Things Electrical" is distributed to the trade by the Electrical Material Company of Baltimore, Md. As its title implies, the catalogue lists a great variety of electrical supplies, machinery and tools, including sockets, switches, instruments, insulators, fixtures, lamps, wire, bells, telephones, batteries, toys, fans, generators, transformers, etc.

A handy and useful catalogue of engineering specialties, including valves, steam and hydraulic pipe fittings, wire, babbitt, etc., has been issued by the Eastwood Wire Manufacturing Company of Belleville, N. J. Several pages are given up to rules and numerical tables, including a convenient discount table, and at the back of the book are an index and blank pages for a cost ledger.

Volume II. of Transactions of the American Electrochemical Society has been issued in book form by the society. It contains the proceedings of the second meeting held at Niagara Falls on September 15th to 18th last, the full list of 21 papers and discussions, alphabetical and geographical catalogues of the members and an index of subjects and authors. The book contains 274 pages and is substantially bound in cloth.

C. O. Mailloux of New York city has published in neat pamphlet form his elaborate and comprehensive paper entitled "Notes on the Plotting of Speed-time Curves" which he presented at the Great Barrington convention of the American Institute of Electrical Engineers, on June 19th last. Following the paper is the general discussion of railway papers and topics which was held at the convention. The matter is reprinted from the Transactions of the association and covers 110 pages, besides a large number of diagrams and charts.

Technical Library No. 6, issued by Joseph T. Ryerson & Son of Chicago, is a catalogue in handy pocket form devoted to pneumatic tools which the firm handles. Drills, flue rollers, reamers, tappers, hammers, riveters, hoists and other pneumatic accessories are described, and considerable interesting technical data of a theoretical and practical nature are given that bear on the use of pneumatic tools and compressed air. The catalogue has attractive colored cover designs. In commemoration of the sixtieth birthday of the firm an anniversary number of Ryerson's Monthly Journal and Stock List is issued. It contains much interesting historical matter, which is well illustrated by portraits and factory views.

SPACE TELEGRAPHY.

The Italian Minister of Telegraphs Galimberti has decided to establish a space-telegraph line between Genoa and Buenos Ayres, according to an off-handed newspaper report.

It is said that Marconi plans to be able within a few years to send space-telegraphy messages completely around the earth by means of a number of new stations to be built in Asia, Africa and Europe, as well as in Canada and the United States. Marconi at present says that, by his system, he can send 40 words a minute across the Atlantic and hopes to increase this number to 75. The latest scheme evolved by Marconi is to span the Pacific.

The Muirhead system of space telegraphy was recently tested successfully on board the Vedamore, an Atlantic liner belonging to the Johnston company. It is reported that messages were received and exchanged over distances at sea up to 300 miles and received up to 1,000 miles, the ship's apparatus not being powerful enough to transmit at that distance. These messages were exchanged between a land station at Holyhead and the vessel at sea. The Morse alphabet is used in the Muirhead system.

MISCELLANEOUS.

The Interstate Development Company of Williamsport, Pa., has been incorporated with a capital of $200,000 to acquire telegraph and telephone lines.

Perpetual injunctions have been issued and served upon the Genesee Electric Company for infringement of the Rochester socket and receptacle patents owned by the General Electric Company.

In the matter of an appeal on motion brought by Ira S. and Edwin Callender from a decision of the primary examiner of the United States Patent Office denying interference proceedings as against the application of David E. Coulson for a patent for a time cut-off for electric circuits, it has been decided by Commissioner Allen that the examiner was right in deciding that Coulson's application was not abandoned, and his decision has been affirmed.

Among the recent electrical patents issued by the Patent Office, was one to Thomas A. Edison on a process for coating phonograph records. The process of operation consists (according to one of the claims) in "maintaining the record in an exhausted chamber in proximity to a metallic electrode" and "in establishing a silent or brush electrical discharge between the electrode and a second electrode placed on the other side of the record, whereby the latter will receive a metallic deposit, then in electroplating on the metallic deposit, and finally in removing the original record from the matrix so secured."

A dispatch from Berlin, Germany, states that the manufacturers of machinery for compressing coal waste and lignite into the fuel called "briquettes," of which enormous quantities are used in Germany, have organized a syndicate for promoting the export of this machinery to the United States, and have sent an engineer to America to make estimates of the cost of plants and to describe the process of manufacture. The syndicate is importing samples of American coal waste and lignite in order to analyze them and test the machines with them. At the time of the recent coal strike in the United States briquette dealers in Berlin arranged to send 10,000 tons to New York, but before cargo space could be engaged the strike was ended.

TRADE NEWS.

New factory buildings of the Lunkenheimer Company of Cincinnati, Ohio, were formally opened recently. Power is supplied by induction motors and the illumination is furnished by Nernst lamps.

The contract for the electric conduit, wiring and switchboard work on the new Chicago federal building has been awarded to the Arthur Frantzen Company of this city, on the recommendation of Pierce, Richardson & Neiler, the experts to whom the bids were submitted. The contract for the boilers and heating apparatus has similarly been let to Thomas & Smith of Chicago.

Judge Lacombe of the United States Circuit Court for the Southern District of New York has handed down a decision upholding certain claims of patents Nos. 414,757 and 414,758, granted to Philip Diehl, Nos. 465,360 and 465,361, granted to Philip Diehl and Edwin H. Bennett, Jr., and No. 585,250, granted to Edwin H. Bennett, Jr. These patents cover electric fans and combined fans and electroliers, and belong to the Diehl Manufacturing Company of Elizabethport, N. J. The Dayton Fan and Motor Company and Lowe & Leveridge are permanently enjoined from using or selling electric fan-motors infringing upon these patents.

President Charles Alexander of the Mechanical Boiler Cleaner Company of Boston, Mass., was a visitor last week at the Chicago office of his company. This branch of the company's business is

proving most successful in charge of W. R. Mason as western manager. Mr. Alexander is one of Providence's most enterprising business men, and is prominent in Republican political circles. He is noted, too, as an exponent of Rhode Island's hospitality, as evidenced in the Alexander clambakes. It is a fact worthy of mention also that as a scientific grower of clams Mr. Alexander has been made the subject of a government report.

The Standard Underground Cable Company has about completed the erection of what is said to be the largest and most modern plant in this country for rolling copper rods, drawing all sizes and shapes of bare wire, and insulating weatherproof wires and cables. This plant is an addition to the company's large underground-cable factory and rubber-insulated wire and cable factory at Perth Amboy, N. J. The rod mill was started successfully on November 25th and the wire mill on December 1st. The company is now prepared to furnish bare rods and wire in any quantities, the capacity of the rod mill being 3,000,000 pounds per month and the wire mill, 2,000,000 pounds single turn. The weatherproof factory will be in full operation by February 1, 1903, with a capacity of 500,000 pounds of wire and cables per month, working single turn. The sales-department staff has been largely added to, on account of this new departure and the general increase in business. The general sales department, with headquarters in Pittsburg, together with the branch-office managers at New York, Philadelphia and Chicago, remains the same. A. B. Saurman, who has represented the company in Boston for the last few years, goes to San Francisco, where he is associated with C. F. Sloane, the Pacific Coast sales agent of the company. Mr. Saurman will devote his attention exclusively to the interests of the company on the coast. The Boston office is now in charge of Frank Clark Cosby, formerly the company's representative in St. Louis, and afterward connected with the sales department of the Westinghouse Electric and Manufacturing Company in New York city. The New York office force is augmented by the presence of H. P. Kimball, formerly with the Williamsport Electric Company. R. M. Hirst, for several years connected with the Philadelphia office, will devote most of his time to the trade in the territory covered by the Philadelphia office. The Pittsburg office will have two men constantly on the road, A. A. Anderson, who has been with that office for several years, and Mr. McBride, formerly with the Pittsburg Reduction Company. J. R. Wiley, at the Chicago office, will be assisted by E. J. Pietzcker, formerly with the American Steel and Wire Company.

BUSINESS.

"This is the season for sign lamps and lamps for decorations," says the Electric Appliance Company of Chicago, which recommends the Packard sign lamps. The company is prepared to make quick shipments.

H. T. Johnson of the Manhattan Electrical Supply Company, New York, was a visitor last week at the company's western branch office. The Manhattan company's western house, under the management of F. M. Pierce, has proved a great success and Mr. Johnson states that the eastern headquarters are doing better than ever before.

The Standard Pole and Tie Company of 44 Broad Street, New York city, announces that the work on its new crossarm mill at Brooksville, Fla., is progressing rapidly. The plant consists of a sawmill, a crossarm mill, and two complete sets of crossarm machinery and a large storehouse and paint shed, aside from the office and the blacksmith shop. This mill is situated in the center of a 6,000-acre tract of Florida heart pine, and with these facilities the company expects to be able to turn out the best crossarms on the market at the rate of two carloads a day. The company is contemplating the installation of an electric-light plant to light its plant and also the town of Brooksville. This will enable it to work both day and night on rush orders. The last year has been a very successful year for the company, it having sold over 45,000 of its southern cedar or juniper poles and 208 carloads of crossarms.

The Standard Vitrified Conduit Company, 39-41 Cortlandt Street, New York city, has about completed its factories at South River, N. J., which, it claims, are the largest factories in the world that are devoted entirely to the manufacture of a complete line of multiple and single-duct conduit. The company is making large deliveries to the Bell Telephone Company, throughout the country, likewise to Independent companies. Its multiple-duct conduit is made with a solid steel-key connection, used only in the outer walls of the conduit, which renders great economy and rapid construction. The factories are so located that the company can ship for domestic and export use at a very low freight rate by water or rail, and generally is in a position to serve the trade with prompt deliveries and at favorable prices. The company says it is perfectly independent in the trade and is not affiliated in any way with any combination.

The Sprague Electric Company of New York city is receiving many orders for its direct-current apparatus, and reports among recent sales the following: Twenty 200-kilowatt turbine generators, three 75-kilowatt generators and four 20-kilowatt generators to the De Laval Steam Turbine Company, Trenton, N. J.; one 200-kilowatt engine-type generator to the Otis Elevator Company, Yonkers; one 200-kilowatt belted-type generator to W. D. Ewart, Chicago; one 50-kilowatt belted-type generator to the American Express Company, Chicago; eight eight-kilowatt generators, six five-horsepower and four one-horsepower motors to the Fisher Motor Vehicle Company, Hoboken, N. J.; one 40-horsepower belted-type motor to Miehle Printing Press Manufacturing Company, Chicago; two electric hoists to the Phœnix Iron Works, Phœnixville, Pa.; one electric hoist to American Car and Foundry Company, Berwick, Pa.; two electric hoists to Michigan Alkali Company, Wyandotte, Mich.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, November 25, 1902.

714,127. Electrical Measuring Instrument. Claude W. Atkinson, Cardiff, England. Application filed May 23, 1902.

The instrument has a float constructed as a whole so that its coefficient of expansion under heat is equal to the coefficient of expansion of the liquid in which the float is supported, in combination with a receptacle for containing the liquid.

714,154. System of Electrical Distribution. Albert G. Davis, Washington, D. C., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 25, 1897.

One claim reads: In combination, a source of single-phase electromotive force, a plurality of primary windings connected in series with each other and with the source, the windings being so mounted that they are rigidly maintained in fixed angular relation to one another, a secondary member capable of rotation relatively to the windings, and connections leading from the windings to translating devices. (See cut.)

714,155. System of Electrical Distribution. Albert G. Davis, Washington, D. C., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 25, 1897.

Combined with an alternating-current system are a number of branch circuits upon which are primarily impressed electromotive forces of the same phase, and an electro-dynamic phase modifier connected to the branch circuits, and arranged to advance the current in one of the branch circuits, and to retard the current in the other of the branch circuits.

714,156. Phase Modifier and System of Electrical Distribution. Albert G. Davis, Washington, D. C., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 28, 1897.

A phase-modifying device comprises a plurality of magnetic structures, one or more of the structures carrying weighted windings and constituting an inducing member and other of the structures carrying secondary windings, and an induced member in inductive relation to all of the magnetic structures and capable of rotation with respect to the same.

714,157. Regenerative System. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 29, 1902.

In the system are a moving body, a motor or motors operatively connected to the moving body, means for connecting the motor or motors to act as generators, and a translating device located at a fixed point capable of transforming the gradually diminishing electromotive force produced by the motors acting as generators into a practically constant electromotive force.

714,158. Oil Guard for Commutators. William F. Dawson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 23, 1902.

An annular oil guard is attached to the commutator support and extends radially outward to a plane of revolution beyond the commutator.

714,173. Railway Signal. John A. Guinn, Perry, Iowa, assignor to the Railway Automatic Time and Danger Signal Company, Des Moines, Iowa. Application filed March 31, 1902.

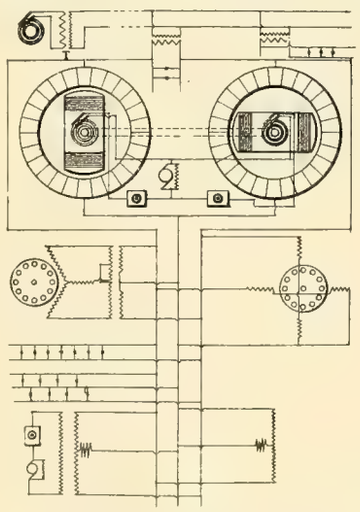
Parts of the system are a post, a time-index normally extending from the post and connected with mechanism operated by a passing train so as to be raised, a pivoted signal arm raised by contact with an arm on the index, and a latch engaging directly with the heel of the signal arm keeping the same in elevated position.

714,181. Tripping Electric Switches or Circuit-breakers. John D. Hilliard, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 13, 1901.

Combined with an alternating-current circuit, or a local circuit supplied thereby, are a contact device normally short-circuiting a magnet coil in the local circuit, and means for opening the short circuit upon determinate line conditions in the alternating circuit.

714,189. Traveling Contact for Railway Telephones, Telegraphs, or the Like. Alva D. Jones, Louisville, Ky., assignor of forty-seven one-hundredths to John C. Strother and Oscar Fenley, Louisville, Ky. Application filed April 4, 1902.

The device comprises an absorbent pad adapted to make sliding contact with a line conductor, a supply pipe for maintaining the pad in a moistened condition, and an intermediate receptacle containing soluble chemicals.



NO. 714,154.—DISTRIBUTION SYSTEM.

714,196. Regenerative System. Martin T. A. Kubierschky, Berlin, Germany. Application filed October 18, 1901.

A braking system for electric railways is described in which there are a subdivided source of electromotive force, one or more motors, a controlling switch for connecting the motor or motors in successively varying relations to the source, a motive device for operating the switch, and electrically operated means for controlling the operation of the motive device.

714,201. Storage Battery. Stanislaw Laszczynski, Berlin, Germany, assignor to Titus von Michalowski, Berlin, Germany. Application filed February 23, 1901.

The battery has a negative electrode of nickel oxide, a sponge zinc plate as positive electrode and as electrolyte a solution of potassium or sodium aluminates, which are able to conduct the current, but not to dissolve the sponge-zinc electrodes after discharging.

714,210. Motor Regulation. Robert T. Lozier, New York, N. Y. Application filed April 2, 1900.

Combined with a common supply circuit, a main motor, a dynamo and means for driving the dynamo from the supply circuit, are means for connecting the dynamo with the working motor, means for varying the strength of the field of the dynamo, a resistance in series with the armature of the motor, and a switch connected to the supply circuit and adapted to make contact first with the means for varying the field of the dynamo, and then with the resistance in series with the armature of the motor.

714,226. Coil for Arc Lamps. William H. Northall, Elwood, Ind. Application filed May 1, 1902.

The wire winding is insulated by a wrapping of asbestos twine composed of fibrous asbestos and a small proportion of tough long fibre.

714,232. Transformer, Inductor, etc. Franz Pichler, Weiz, near Graz, Austria-Hungary. Application filed October 23, 1901.

In the transformer are combined a core, a coil surrounding the same, and heat-radiating plates inserted between the turns of the coil, and surrounding the core, the plates being radially slotted whereby to prevent the circulation of eddy currents.

714,233. Sign Illuminated by Electric Current. Emile Plançon, Lingèvres, France. Application filed April 11, 1902.

A groove forming the sign is cut into a glass plate and there is a lining for the groove of suitable material colored differently from the glass plate. Small rectangular metal plates are arranged in the groove from one end to the other, the edges of the plates being somewhat distant from each other. Electric conducting wires connect with the ends of the grooves forming the sign.

714,246. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring and the American Wireless Telephone and Telegraph Company, Philadelphia, Pa. Application filed October 25, 1901.

In the system are a transmitter, which comprises a generator of fluctuating potentials and connections from the means to separated earth plates through a current or kinetic-energy restraining means.

714,267. Trolley-pole Harp. John H. Walker, Lexington, Ky. Application filed January 14, 1902.

The harp has diverging spring arms.

714,268. Contact for Trolley Harps. John H. Walker, Lexington, Ky. Application filed February 12, 1902.

Bearings are attached to the prongs of the harp and a pin or journal is secured to the trolley wheel and projects beyond the sides of the hub of the wheel.

714,277. Composite Carbon Electrode for Arc Lamps. André Blondel, Paris, France. Application filed April 8, 1902.

The electrode consists of a body of carbon combined with light-producing salts and a substantially thin coating of non-scorifiable carbon inclosing the body.

714,290 and 714,291. Electrical Receptacle. Philip H. Fielding, New York, N. Y. Application filed January 18, 1902, and February 20, 1902.

Electrical appliances adapted to be connected with line wires are described.

714,292. Lamp Socket. Philip H. Fielding, New York, N. Y. Application filed February 20, 1902.

An incandescent lamp socket is described.

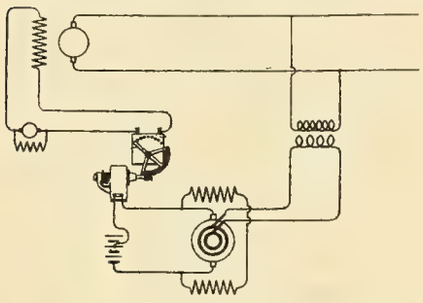
714,351. Induction-motor Starting Device. Arthur H. Abell, Schenectady, N. Y., assignor to the

General Electric Company, Schenectady, N. Y. Application filed April 19, 1902.

Combined with an alternating-current induction motor are a switch for opening and closing the circuit between the motor and a suitable source of supply, a resistance-controlling or other regulating device for controlling the flow of current in the motor circuit at starting, and operating mechanism constructed and arranged first to close the switch, then to operate the regulating device, and thereafter to open the switch by a continued movement of the operating mechanism in the same direction.

714,355. Protective System. Albert H. Armstrong, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 30, 1901.

Overhead lines extending from a source of current are combined with an auxiliary conductor or conductors located so as to intercept the fall of one of the overhead lines and means controlled by the engagement of the overhead line and the auxiliary conductor or conductors for open-circuiting the overhead line.



NO. 714,360.—DISTRIBUTION SYSTEM.

714,360. System of Electric Distribution. Harold W. Buck, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 4, 1899.

Combined with the dynamo-electric machine are mains leading therefrom, a rotary converter fed from the mains, a source of constant electromotive force placed in series in the direct-current mains of the rotary converter, and normally balancing the electromotive force impressed thereon by the rotary converter, and means controlled by current in the direct-current mains for varying the field of the dynamo-electric machine. (See cut.)

714,366. Train-signal System. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 10, 1902.

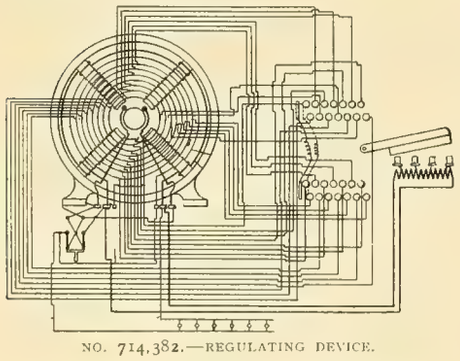
In the system are an indicating device, a conducting system to which the indicating device is connected, a plurality of circuit-controlling devices connected in series in the conducting system, and means for rendering certain of the circuit-controlling devices inoperative to open the circuit to which they are connected.

714,373. Electrical Dental Furnace. Ashley M. Hewett and John C. Smith, Chicago, Ill. Application filed February 17, 1902.

In the furnace are an exterior muffle open at both ends, an interior muffle adapted to be inserted into the exterior muffle, and a resistance coil surrounding the inner member adapted to be connected in an electric circuit.

714,382. Regulating Device for Dynamo-electric Machines. Christian W. Kragh, Madison, Wis., assignor to the Northern Electrical Manufacturing Company, Madison, Wis. Application filed September 9, 1899.

Combined with a dynamo-electric machine are a regulating device comprising a coil of wire of sufficiently high resistance to act as a controlling resistance and wound upon the field magnet of the machine in an opposite direction to the exciting field-magnet coil, and means for cutting this resistance wire into the circuit so that it simultaneously acts in two ways to reduce the effect of the exciting field-magnet coil, first, by decreasing the current flowing therethrough due to the resistance interposed, and, second, by decreasing the magnetic effect of the exciting coil. (See cut.)



NO. 714,382.—REGULATING DEVICE.

714,395. Starting Rotary Converters. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 7, 1899.

In the system of electrical distribution described are combined a number of rotary converters, means for coupling them into operative relation to alternating or direct-current circuits, a direct-current generator for starting the rotary converters into operation upon the direct-current side, and an induction motor driven by the alternating-current source for operating the auxiliary generator.

714,400. Electrolytic Cell. Maurice C. Rypinski, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 25, 1900.

The cell provided with electrodes, one at least of which is of aluminum, and an electrolyte consisting of a solution of a salt of an organic acid.

714,411. Controlling Alternating-current Motors. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 7, 1899.

Combined with an induction motor are means for dissimultaneously varying the resistance of the circuits of the inducing and induced windings respectively.

714,412. Induction Motor. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 22, 1900.

714,436. High-potential Switch. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 20, 1901.

The switch has a number of fixed terminals mounted side by side, the joint between each lead and its terminal being housed by a rigid insulating bushing and having a sealing joint therein of moisture-proof material for the joint, whereby all metal parts are surrounded by a high-insulating dielectric.

714,446. Protector for Third Rails of Electric Railways. Howard Brooks, Wheaton, Ill., assignor of two-thirds to George W. Brown and John C. Mastick, Wheaton, Ill. Application filed June 23, 1902.

The protector combines a detachable sectional upper division or half consisting of an overhanging rim, a main body and a depending rim with a lateral flange and made of non-conductive material, a detachable sectional lower division or half consisting of a front ridge or rib, a main body and an upwardly extending rim with a lateral flange and made of non-conductive material, and tie bolts passing through the lateral flanges of the upper and lower divisions or halves of the guard or protector.

714,452. Polarized Electromagnet. Luigi Cerebotani, Munich, Germany. Application filed April 25, 1902.

The device comprises a permanent horseshoe magnet, an electromagnetic pair, the cores of which correspond to the poles of the permanent magnet, a horseshoe electromagnet, the coils of both electromagnetic pairs being wound in series, and a double-armed pivotal lever armature for electromagnetic pairs.

714,497. Railway Electric Motor-cooling System. Cyprien O. Mailloux and William C. Gotshall, New York, N. Y. Application filed August 26, 1902.

Combined with an electric-railway motor are a source of compressed air or gas upon the car or train of cars propelled by the motor, and means for releasing and discharging the air into or upon the motor to keep the temperature of the same down by the refrigerating or cooling effect due to expansion of the air.

714,498. Railway Electric Motor-cooling System. Cyprien O. Mailloux and William C. Gotshall, New York, N. Y. Application filed September 13, 1902.

One claim reads: The combination with an electric-car motor, of means for cooling the same, and means responsive to changes of temperature condition in the motor for controlling the action of the cooling means. (See cut.)

714,506. Trolley. James Morgan, Ellwood City, Pa. Application filed August 28, 1902.

An attachment for trolley heads comprises a supplemental harp; guard plates pivotally mounted thereon, guard rollers carried by the plates, and rollers pivotally mounted on the outer face of the plates.

714,540. Telephone Switch. John A. Warrick, Sheldon, Ill. Application filed November 5, 1901.

See page 398.

714,577. Telegraphic or Telautographic Apparatus. Ernst K. Gruhn, Dresden, Germany, assignor to Kopier Telegraph Gesellschaft mit Beschränkter Haftung, Dresden, Germany. Application filed April 16, 1901.

In the apparatus embodying circuits, a stylus and means for varying the current through the circuits in accordance with the component movements of the stylus, are combined a device for deflecting a ray of light, and means for oscillating the deflecting device in different planes controlled by the variation of current in the circuits, whereby the movements of the stylus in any direction are made manifest by the rays of deflected light.

714,589. Trolley Wheel. Jerome B. Lockerby, Ithaca, N. Y. Application filed January 27, 1902.

A wheel with guide arms is described.

714,590. Battery Depolarizer. Charles E. Lockwood and William C. Banks, New York, N. Y. Application filed September 5, 1900.

A depolarizer for a primary battery is composed of a copper plating deposited upon the surfaces of finely divided iron particles and oxidized thereon.

714,593. Electric Switch. Norman Marshall, Newton, Mass., assignor to the Marshall-Sanders Company, Boston, Mass. Application filed November 2, 1901.

The knife switch described has an insulating base provided with an aligning groove, and contacts having bases having converging sides fitting within the groove, and cooperating with the sides of the groove to bring the contacts into alignment as the bases are drawn down into the groove.

714,600. Outlet Box. Ernest W. Müller, Brooklyn, N. Y., assignor to Hubert Krantz, Brooklyn, N. Y. Application filed March 12, 1902.

The electrical outlet box described is adapted to be fitted into a ceiling and carries on its lower face an insulated suspension hook for an arc-lamp or the like.

714,607. Electric Cut-out. Henry N. Potter, Pittsburg, Pa., assignor to George Westinghouse, Pittsburg, Pa. Application filed March 27, 1901.

In an electromagnetic cut-out are a movable element having an adjustable natural period, and so disposed that the force of restraint and the pull of the magnet are at an angle of less than 90 degrees with relation to each other.

714,608. Trolley Guard. Charles O. Prince, Canton, Ohio, assignor of one-half to George M. Hedrick, Canton, Ohio. Application filed September 2, 1902.

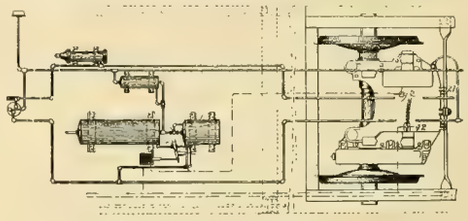
Combined with a trolley pole are a cross-bar on the pole near its upper end, arms pivoted at the ends of the bar, and springs acting to hold the arms upward.

714,617. Controlling Alternating-current Motors. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed June 7, 1899. Divided and this application filed April 11, 1902.

The method of stopping an induction motor consists in inserting a resistance in circuit with the windings of the induced member, open-circuiting the windings, inserting a resistance in circuit with the inducing windings, and then open-circuiting the inducing windings.

714,630. Apparatus for Simultaneously Transmitting a Number of Telegraphic Messages Over a Single Wire. Josef Ziegler, Vienna, Austria-Hungary. Application filed May 29, 1900.

In the system of multiplex telegraphy described are combined a number of orbitally movable electric contact devices in fixed relation to one another, a number of stationary electric contact devices, distributed entirely around the orbit of the movable contact devices, and arranged to engage the movable contact devices of a number of circuits connected to the respective movable and stationary contact devices and arranged to be closed thereby, instruments included in the circuits, means for energizing the circuits, and means for moving the movable contact devices. (See cut.)



NO. 714,498.—RAILWAY MOTOR-COOLING SYSTEM.

714,637. Method of Increasing the Number of Phases of Electric Currents. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed June 25, 1897. Divided and this application filed April 6, 1902.

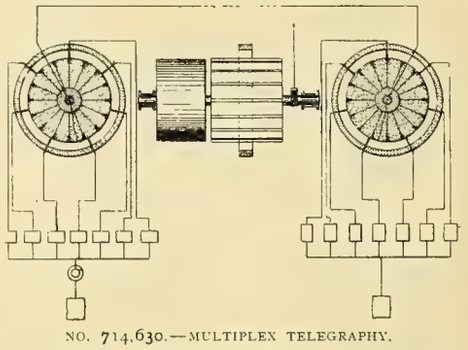
The method of increasing the number of phases of an electric current from a source of alternating electromotive force consists in opposing an electromotive force from the source by the resultant electromotive forces of a plurality of sources, and rigidly maintaining fixed the relative phase relations of the component electromotive forces going to make up the resultant.

714,638. Method of Increasing the Number of Phases of Currents in the Alternating Systems. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed June 25, 1897. Divided and this application filed April 18, 1902.

The method of producing multiphase current from single-phase current consists in passing the single-phase current through a divided circuit, and impressing an electro-dynamic counter electromotive force upon each branch of the circuit in such a manner as to vary the phase relations of the currents therein.

714,639. Method of Producing Multiphase Currents from Single-phase Currents. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed September 28, 1897. Divided and this application filed April 25, 1902.

The method of supplying multiphase translating devices from a single-phase source consists in generating by means of an alternating current a magnetic field in an inducing member, causing thereby relative rotation between the inducing member and a suitable induced member, generating thereby a plurality of dephased currents in secondary windings fixed with relation to the inducing member, and feeding the currents to the translating devices.



NO. 714,630.—MULTIPLEX TELEGRAPHY.

714,648. Wireless Telegraphy. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Gustave P. Gehring, Philadelphia, Pa. Application filed May 13, 1901.

A receiving apparatus for wireless telegraphy comprises air and ground plates, a series of wave-responsive devices in circuit therewith, metallic rings surrounding the wave-responsive devices, means for attracting the rings to cause them to restore the wave-responsive devices, and a phonic wheel for making successive circuits for energizing the means to cause the wave-responsive devices to be decohered one at a time in succession.

714,649. Ore-conveying Surface for Electrical Separators. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Texas. Original application filed February 3, 1902. Divided and this application filed July 1, 1902.

In the device described are an ore-conveying surface comprising an insulated body having a conducting face upon one surface thereof, and means for electrically charging the conducting face.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, DECEMBER 13, 1902. No. 24

An Interesting Swiss Light, Railway and Power Plant.

The Vereinigten Schweizerbahnen, through numerous local railways, has given good service to the many villages in the Rhine Valley, but was not considered sufficient for the growing traffic between Altstätten, Heerbrugg and Berneck, Switzerland, and the construction of an electric railway between these localities was thought needful to serve the many small places along the line.

As a good waterpower was to be had near Altstätten, it was decided to take advantage of this for a power plant for supplying current for the electric road as well as supplying lights for the streets and private use. It was also considered advisable to install steam engines in connection with the hydraulic plant, to supply a surplus of power for use on market days, when the traffic was extremely heavy. The installation of the power stations and railway equipment was entrusted to the Maschinenfabrik Oerlikon of Oerlikon, near Zurich, Switzerland.

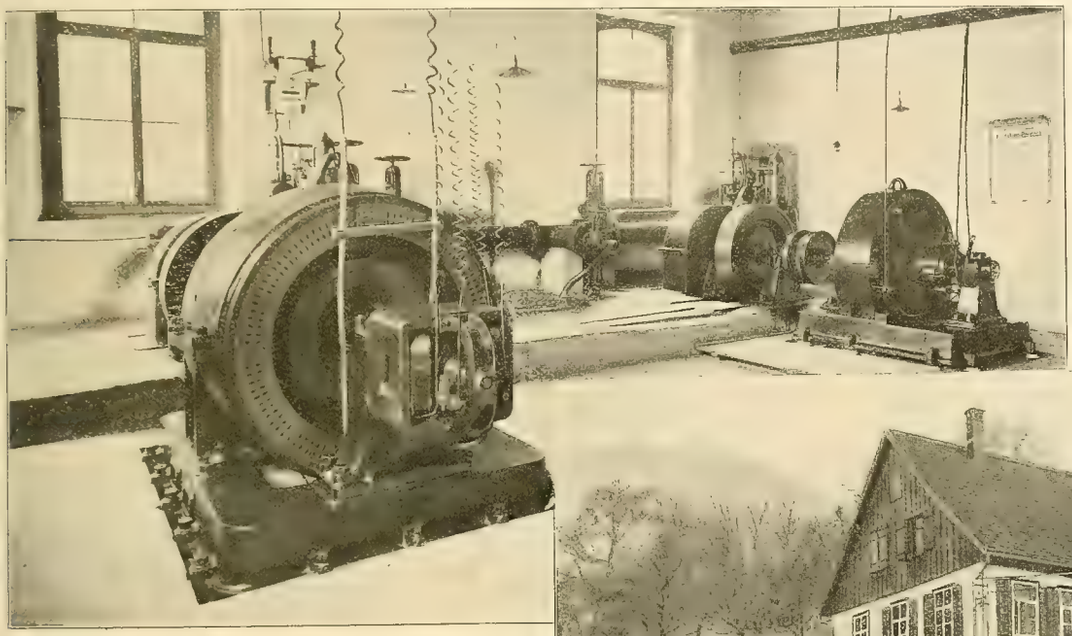


Fig. 1. Interior of Power Station at Weidest.

Fig. 2. Weidest Power Station.

The Alstätten-Berneck electric railway starts at the Berneck City Hall and ends at the Altstätten railroad station, a distance of 11.6 kilometers, following the state road. The maximum grade is at Berneck, where, for a distance of about 55 meters, the grade is said to be 52 per cent., while the average grade is 13.75 per cent. and the minimum curve radius is 25 meters. The tracks are separated by one meter, and all of the signals are automatic in action. The rails are of Hartwig section, with a width at base of 109 millimeters and a height of 135 millimeters, the weight being 24.5 kilograms per meter.

The rails rest on a stone bed 200 millimeters wide and 180 millimeters deep, over which there is a gravel bed 65 millimeters thick. The current is supplied from a trolley line connected with feeders from the overhead power-transmission line. The line voltage used is 600 volts, and the rails are bonded with copper wire, six millimeters in diameter.

The trolley wires consist of copper conductors eight millimeters in diameter, carried on insulators with iron mast arms and wooden poles. The overhead line is separated into two parts, supplied with current from the Schönthal switchboard direct. The part of the line on the Berneck side may be operated from either the Weidest power station or from the Schönthal plant.

There are in operation on this line a number of motor cars, which seat 24 persons. There are smoking compartments in each car, and each is lighted and heated by electricity. The motors are of 18-horsepower capacity, and the total weight of the car is 6,500 kilograms. A postal car is provided for carrying the mail to the various places along the line.

The machine shop and repair works are equipped with electrically operated lathes, planers, and boring machines, driven by direct current from the transmission line. There are from 16 to 21 trips made each day in each direction, between 6 a. m. and 9 p. m., and the speed is from 12 kilometers to 13.6 kilometers per hour.

The line between Altstätten and Berneck is divided into eight sections, ranging from 1,250 meters to 2,500 meters in length, and the rate of fare between the villages is 15 centimes (three cents) and for each additional section five centimes (one cent). The line passes through Marbach, Rebstein, Balgach, Bad and Heerbrugg.

The total number of passengers carried per year is about half a million, the cars traveling a total of 151,435 kilometers. The total income was 77,720 francs, or 51.3 francs per car-kilometer, while the expenses were 57,377 francs, or 37.88 francs per car-kilometer.

The two central power stations which supply the necessary current for the railways and lighting of villages are located at Weidest and Schönthal, and both are equipped with alternating and direct-current apparatus. The Schönthal station is a reserve-power house, which is used when the hydraulic power of the Weidest station is insufficient. When the traffic is heavy between Altstätten and Berneck on market days the following combinations may be used:

First—The Weidest station may supply current for the railway alone, the direct-current generator working in parallel with the Schönthal storage-battery plant, the alternator supplying the necessary village lighting current when the consumption is normal.

Second—If the current supplied by the alternator of the Weidest station is not sufficient for lighting during heavy load, the reserve alternator at the Schönthal station can be run in parallel on the Weidest alternator line. The second alternator may be operated by the steam engine or driven by the direct-current motor from the railway line supplying still more alternating-current lighting energy.

Third—If, for any reason, the alternating or direct-current generator at the Weidest station is out of order, it can be replaced by the corresponding machine at the Schönthal power house.

Fourth—When required, the direct-current generator of the Schönthal station can be operated by the alternator, which may act as a synchronous motor, the necessary alternating current for the motor being supplied by the Weidest station. The alternating-current generator which is to act as a synchronous motor must, however, first be started by the direct-current machine from the accumulator charge until up to synchronism, when it will operate well as a motor, the direct-current machine supplying current for the railway line.

Fifth—The two direct-current machines in both stations may be operated in parallel with the storage battery on the railway system during heavy traffic, the lighting current required being light.

The capacity of the storage-battery plant which is used as a railway regulator at Schönthal, is 60 ampere-hours, 270 cells being employed. The normal output is 60 amperes, but 120 amperes or 180 amperes may be used for short periods. The generators supply a steady output, corresponding to the average load, and the batteries take care of the peak of the load in starting cars and on heavy grades, receiving current back from the line when loads are light.

The transmission line from the Weidest station to the Schönthal power house is 1,500 meters long and consists of two conductors of five millimeters in diameter for the alternating current and two conductors eight millimeters in diameter for the direct current. The poles are placed 50 meters apart.

The waterpower for operating the turbines at the Weidest power plant is obtained from the Brendenbache and the Ebenackerquelle, two streams whose sources are in the mountains, at the foot of which lies the village of Altstätten. The waters from the Brendenbache are collected in a reservoir of 1,000 cubic meters capacity, and are carried by a pipe 250 millimeters in diameter and 1,700 meters long to the power house, where they operate a high-pressure turbine, directly coupled to the direct-current railway generator (Fig. 1). This turbine is of 70-horsepower capacity and operates under a pressure of 15 atmospheres, the fall being 150 meters and the water discharge 55 liters per second.

The water from the Ebenackerquelle is collected

in another reservoir 400 meters from the power plant. This reservoir has a capacity of 250 cubic meters, and the water is conveyed through an iron pipe 300 millimeters in diameter to a turbine in the power plant which is directly connected to an alternating-current generator (Fig. 1). This turbine was constructed by Esher, Wyss & Co. of Zurich, and has a capacity of 100 horsepower, the head being 100 meters and the water discharge 70 liters per second. Both of these turbines operate at a speed of 600 revolutions per minute.

On account of the desirability of using the water over again by works below the power station, the water from the tailrace of the turbines is collected in a large reservoir below, which has a capacity of 1,400 cubic meters.

The Weidest power station (Fig. 2) is located 1,500 meters from Altstätten. The first floor of the building is used for the turbines and generators and controlling apparatus, and the upper portion is arranged for living rooms of the engineers in charge. The 100-horsepower turbine, as mentioned above, drives an alternator of the Oerlikon type, at a speed of 600 revolutions per minute. This is a single-phase machine with a primary of 2,100 volts and a secondary distribution with three conductors of 240 volts. The alternator has a capacity of 66 to 72 kilowatts and a frequency of 50 cycles per second. The primary of these alternators, as well as the secondary windings, are stationary, the machine being of the inductor type. The exciter is directly connected to the alternator and has a capacity of three kilowatts and is a bipolar, continuous-current Oerlikon dynamo.

The compound-wound direct-current generator for supplying the current for the electric railway has a capacity of 47 kilowatts and supplies a current of 600 volts' pressure, the speed of the machine being 600 revolutions per minute. The switchboard is 1.35 meters wide and 2.5 meters high and consists of two panels for the generators and exciters, mounted with the necessary switches, cut-outs, measuring instruments and rheostats. The lighting of the Weidest station may be supplied from the alternating-current high-tension-current circuit from a static transformer, the current being generated either in this station or at the Schönthal power house.

The Schönthal power plant is 1,400 meters from the Weidest station, and the two generators are operated by the reserve engine and boiler plant and are belt-driven. The engine develops 50 horsepower and operates at a speed of 120 revolutions per minute. The high-pressure cylinder of the engine is 370 millimeters in diameter and the length of stroke is 360 millimeters.

The alternating and direct-current generators are installed with the shafts of each coinciding so that they may be easily coupled together, and either may be used as a motor to drive the other, or either or both may be driven from the steam engines. The lighting alternator has a capacity of 32.4 kilowatts and operates at a speed of 750 revolutions per minute, generating a single-phase current of 50 cycles per second at a pressure of 2,500 volts. Each generator has three bearings and a tight and loose pulley. The exciter of this alternator is also directly coupled to the same shaft outside the main bearing. The direct-current generator installed in this plant is compound-wound, and has a capacity of 33 kilowatts.

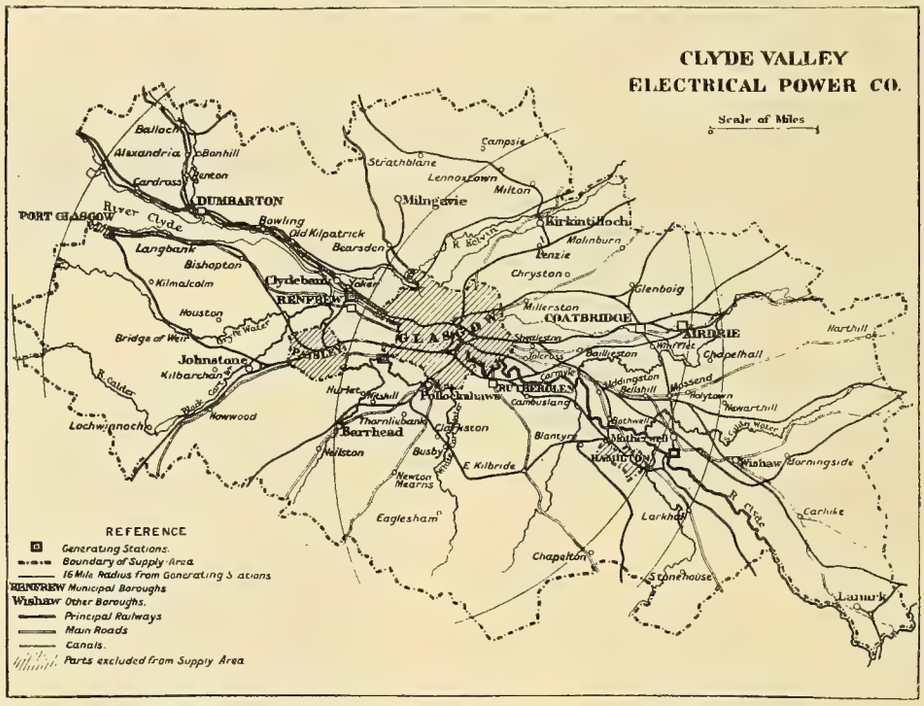
The switchboard is of white marble and is equipped with the necessary direct and alternating-current measuring instruments, switches and controlling apparatus on their respective panels. There is also a voltmeter for the Weidest current, as well as synchronizing lamps and transformer, to aid in coupling the Weidest and Schönthal alternators in parallel. On the direct-current switchboard there are ammeters, voltmeters and regulating resistances with the necessary switches for operating the machine as a motor or generator. The direct-current machine, in being used as a dynamo and driven by the steam engine of the alternator as a synchronous motor, supplies a 500-volt current to the railway circuit and operates in parallel with the storage battery as a regulator. The direct-current machine when operating as a motor takes current from the traction line and operates the alternator as a generator for supplying single-phase current for supplying lights at night when the railway service is not heavy.

The low-tension lighting circuits are operated at 120 volts, the primary lines being operated at 2,100 volts, single-phase, the current being supplied from Weidest station during light load, the Schönthal reserve station coming into use on full-load hours. Three transformers are of 55 kilowatts capacity, two of 20 kilowatts, and one of 15 kilowatts. The three-wire distribution is used for the low-tension secondary system, the total number of lamps being 1,200. The lighting rates range from eight francs to 48 francs per year for private consumers for five-candlepower to 32-candlepower lamps. The rate for power is 34 centimes (seven cents) per kilowatt-hour.

Large Power Distribution Scheme for Scotland.

The British Parliament has recently sanctioned a bill, which gives authority for an extensive power-distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill and shown on the accompanying map, includes that part of the Clyde Valley extending about 10 miles on each side of the river and about 20 miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manfacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant.

This is the busiest part of industrial Scotland, and contains about 1,200 works, many of which are large iron and steel works, coal mines, shipbuilding yards and chemical works. Some of these works will alone require more power than many of the local municipalities now provide for lighting purposes, and it was easily shown that it would be inadvisable for the separate boroughs to attempt to supply an amount of power involving so large an expenditure of capital.



LARGE POWER DISTRIBUTION SCHEME FOR SCOTLAND.—MAP OF DISTRICT SUPPLIED.

The three generating stations are to be built at Motherwell, Yoker and Crookston. The Motherwell station is located in the neighborhood of a large number of manufacturing works and in the center of an extensive coal field and can be connected with the adjoining line of the Caledonia railway. It is also in close proximity to the River Clyde, from which water for steam and condensing purposes can be obtained.

The Yoker station is also situated on the Clyde, near the line of the Lanarkshire and Dumbartonshire railway, and is in close proximity to a large number of shipbuilding yards, works and docks. Authority has been obtained to lay cables across the Clyde from Yoker to Renfrew, which will enable the works at Renfrew, and other works on the south side of the river, to be supplied from this station.

The third generating station will be situated near Crookston, on the Glasgow and Southwestern railway canal line; but, owing to the arrangement allowing the company to cross the river, it will not be necessary to construct this station immediately.

The works from which the most urgent demands for power have been received are situated in the areas immediately surrounding the first two sites, and it is intended, therefore, to proceed with these stations first and to install in each a plant of about 4,500-kilowatt capacity. They will be so designed that they can be enlarged from time to time as the demand requires. A radius of 14 miles from these stations covers practically the whole district in which the company will be allowed to distribute its power, but a large proportion of the works are located within a radius of six or seven miles of the stations. When the stations are in operation, they will probably be coupled together electrically, enabling them to share the loads and average up their power factors or to supplement or aid each other in any emergency. The capacities of the respective stations will ultimately be about 10,000 kilowatts each at Motherwell and Yoker, and 5,000 at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 710 square miles covered by the scheme, only 13 are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition, and it is thought that many of the remainder petitioned in favor of the rival Caledonian scheme, which was turned down.

The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high-voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric and Manufacturing Company. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Robert Robertson has recently spent a considerable period in the United States investigating systems and methods of power transmission and distribution, particularly in the large cities and in such localities as Niagara, Snoqualmie Falls, Wash., Canyon Ferry, Mont., and other places.

Copper Mining in Upper Michigan.

At a regular meeting of the Western Society of Engineres in Chicago on December 3d J. F. Jackson read a paper on "Copper Mining in Upper Michigan." The paper dealt with the general features of the mining problem and also went into some detail on the geological features of the country, showing what great engineering ability is required, and what excessively heavy machinery is called into service. Mr. Jackson illustrated his talk fully by the use of very interesting and instructive lantern slides and showed some maps of the mining territory in upper Michigan, by the aid of which he was able to bring more forcibly to the attention of his listeners the actual processes employed in copper mining and the great depth to which the mines are worked. He also explained the peculiarity of the trend of the copper lode in the peninsular, stating that it inclined from the horizontal by an angle varying from 30 to 70 degrees, depending upon the locality; but in all cases seeming to dip as the lake is approached, so as to pass underneath it and appear on the other side with about the same general trend.

About 50 members and visitors attended the meeting and all seemed very much interested in Mr. Jackson's talk. A discussion of a very general nature followed the reading of the paper and specimens of copper ore were distributed for inspection. Mr. Jackson very kindly allowed the members to take these specimens away with them.

The North Chicago Village Board has granted a perpetual franchise to the Chicago and Milwaukee Electric Railroad Company, so it can connect its new branch to Libertyville, now partly built, with its main line at that point, instead of at Lake Bluff, as was previously planned. The branch will connect with the Chicago, Milwaukee and St. Paul railroad at Rondout, and later with the Wisconsin Central railroad, when built farther west.

Electrical Features of the Aurora, Elgin and Chicago Railway.[1]

By Howard Brooks.

An electric railway built entirely upon private right-of-way, with easy grades and curves, steel and concrete bridges, strong and durable as the best steam railways demand, is something the electrical man has been looking forward to for years past, and to be asked for a maximum speed of 70 miles per hour would seem to be the height of ambition. However, this is no longer dreamed of, but is the matter-of-fact, every-day performance on the Aurora, Elgin and Chicago railroad. The road will have, when completed, about 80 miles of main line, of which 21 miles are double track. The distance from Chicago (Fifty-second Avenue and Harrison Street) to Aurora is 33.3 miles, and the line from Wheaton to Elgin is 16.5 miles. This part of the line is unfinished. A branch running from the Aurora line to Batavia is six miles long.

The railway serves a population of about 80,000 outside of Chicago. The same interests own the Elgin, Aurora and Southern Traction Company, with 70 miles of track; 37 miles of this line connects Carpentersville, Elgin, Batavia, Aurora and Yorkville. The remainder consists of street lines in Aurora and Elgin.

The width of the right-of-way is mainly 60 and 100 feet. On the single-track portions of the line the cuts are excavated to a width sufficient for a double track. The maximum grade is 1.8 per cent. for a mile in length, entering Aurora and Batavia, but on the rest of the system the aim has been to limit all grades to one per cent. The ordinary curves connecting tangents are of 10° and 20°, and the maximum on high-speed portions of the line is 40°.

The width of the roadbed is 16 feet for single track and 28 feet for double track. The track is laid with 80-pound rails of the A. S. C. E. section, 60 feet long. They are laid with staggered joints and spliced with angle bars held by four one-inch bolts. On double tracks the tracks are 13 feet center to center, and are connected by cross-overs at intervals of three or four miles. The ties are spaced two feet center to center, with nine inches of gravel ballast underneath. The switches are all of the standard steam-road pattern.

All highway grade crossings are planked and fitted with cattle-guards of vitrified-clay blocks. There are three street-railway crossings and only four steam-railroad grade crossings. Three railroad crossings are protected by interlocking plants. There are three steel plate-girder bridges, carrying the line over steam railroads and 12 bridges carry the line over streets and roads. There are, also, four bridges carrying highways over the line. All piers and abutments are of concrete. There are four arch bridges and a number of culverts and cattle-passes of like material.

The Chicago terminal is a transfer station for connections with the Garfield Park line of the Metropolitan West Side Elevated Railway. The cars run between two platforms, on the outside of which is the terminal loop of the elevated railway, which is reached by an incline from the elevated station at Forty-eighth Street. At Elgin and Batavia the line runs on its own right-of-way up the river bank to a terminal station in the center of the town. At Aurora the cars run for about one-half mile along Broadway Street. Through the country open platforms at road crossings serve as stopping places. Three of the six sub-station buildings have waiting rooms and platforms for passengers.

A half-hourly service is maintained in both directions. At present the time allowed for the run between Aurora and Chicago, or Elgin and Chicago is one hour 15 minutes, but this will be reduced in the future. A car recently made the trip from Aurora to Chicago (33.3 miles) in 38 minutes, making six stops. Of course, an acceleration at the rate of two miles per hour per second may have something to do with this performance. The traffic is handled by the telephone train-dispatching system, the head dispatcher being located at Wheaton.

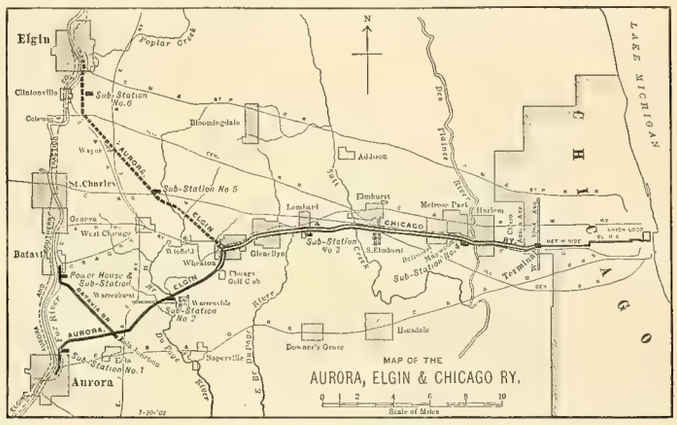
The main repair shops and car shed are being built at Wheaton, and are of fireproof construction throughout. The machine shop is spanned by an electric traveling crane, and is equipped with a boring mill, a wheel press, and all other tools found in a first-class repair shop. The pit tracks have a pit two feet deep outside the track rail, to permit getting at the outside of the trucks more easily, and enables one to work at the third-rail shoes, journal boxes, etc., at a proper height for ease and comfort.

1. Paper read before the Chicago Electrical Association on November 21, 1902. Mr. Brooks is assistant electrical engineer of the Aurora, Elgin and Chicago Railway Company.

Motor-car Equipment.

The equipment of the motor cars consists of 125-horsepower, G. E.-66 motors. The General Electric Company's type-M train-controlled system with small master controller on each platform, operating magnetic "contractors" under each motor car, is used. One and two-car trains will have every axle motor-driven. Three-car trains will have one car without motor.

The cars upon which these motors are placed were built by the Niles Car and Manufacturing Company. The cars are 47 feet six inches over bumpers and 39 feet four inches over bodies. This length was selected to allow the cars to pass around the sharp curves of the Union Loop in Chicago. The cars seat 56 people. There is no waste room either on the platforms or inside the car. The heating is by Consolidated electric heaters, placed along the side of the car. Van Dorn draw-bars are used, thus permitting coupling with the Metropolitan cars. The trucks are Peckham's M. C. B. 30, which follow the general lines of a M. C. B. truck, but have diamond frames and combined spiral springs and elliptic springs under the bolsters. In addition to the regular equalizer springs, which support the frame, there are spiral springs between the frame and each journal box, which take a small part of the weight and are intended to prevent the tilting of the frame. Compressed-air track sanders are mounted on the truck. The Christensen straight air brakes with independent motor-driven compressor and automatic motor regulator are employed. The car wheels are 36 inches in diameter, and have a standard M. C. B. tread and flange. The axles are 6½ inches in diameter. The weight of these cars is 74,325 pounds. The motors alone weigh 17,120. The gear ratio is 1.61 to 1. Owing to shortage of cars, many of them make over 500 miles per day.



Third-rail Details.

The third-rail insulators were furnished by the Ohio Brass Company. The first of these were wooden blocks set on a cast-iron base, the top of the block having a cast cap with lugs projecting upward to hold the rail in line. In using an insulator with wood in its construction, ashes must not be used for ballast, as on one of our sidetracks the wood part of the insulators burned up during a recent rain and dropped the rail on the ties. This burning was due to the acid from the cinders, although the wood blocks were boiled in paraffin and practically new. We also have had trouble in other places on the main line where much sand was in the gravel ballast. The sand splashes up on the wood and starts a leak which ends with the destruction of the insulator.

The remainder of the insulators are a special design of Mr. Gonzenbach, made by the same company. This new design of third-rail insulator consists of a cast-iron base, over which fits a thin cap of Dirigo insulating material. On top of this is placed the cast-iron cap, upon which rests the third rail. The insulating material is not joined to the cast-iron fittings in any way, and the rail simply rests on the top of the cap, as the weight of the rail is sufficient to hold the three parts of the insulator together. It will be noted that the insulating portion of the Gonzenbach type is at the top. This removes the insulating material from the ground so far that the splash of rain does not reach it, so that if only a common insulating medium was used it would be very much better than any wood-block type that could be devised.

It will be noted that instead of omitting the third rail at the beginning of a cross-over, to prevent catching of the contact shoes on cars which are passing through the cross-over, where the shoe comes in line with the main track, the third rail has been bent downward, so as to clear the contact shoes. This does away with underground connections, which would otherwise be necessary. For connecting across road crossings and other interruptions in the third rail, a lead-covered cable, 1,500,000 circular mils cross-section on the main line and 1,000,000 circular mils on the Batavia branch, is placed in the ground, a board being used for the protection of the cable.

A cast-iron tip is put on the third rail where it is interrupted, which furnishes an incline for the contact shoe of the car. These tips are 28 inches long, and in addition to the incline they afford, the third rail is dropped 1 1-2 inches in 33 feet approaching the tip. Ordinarily the third-rail shoes come in contact with the third rail on the incline of the rail and not on the cast-iron tip, the tip being used to keep the shoes from catching the end of rail in event of their getting too low or out of adjustment. At full speed the shoes are torn off if the rail is three-eighths of an inch too high, i. e., if shoes are three-eighths of an inch lower than the top of the cast-iron tip the blow tears off the shoe.

The bonding of the track rails is accomplished with two United States bonds, American Steel and Wire Company's make, at each joint. These bonds are 12 inches long with one-inch terminals and have each a cross-section of 300,000 circular mils. Each third-rail joint is bonded with two Protective Rail Bond Company's bonds of 500,000 circular mils. Tracks are cross-bonded 10 times every mile with bonds of 300,000 circular mils.

It is very necessary to protect the ends of the conductor and lead covering of the cable, which is used for connecting across the break in the third rail at highway crossings and special work. If this is not done, moisture soon works in between the lead covering of the cable and the conductor. This trouble has been overcome by a special terminal designed by Mr. Gonzenbach, which serves the double purpose of forming a connector and protecting the cable insulation at the end of the cable. Electrical connection to the third rail is made by three flexible bonds, 24 inches long, soldered into the cap of the Gonzenbach terminal and bonded to the rail by a hydraulic compressor, a cap screw being used to attach this cap or top to the main part of the cable, so that it may be detached in a few seconds.

The third rail between any two sub-stations constitutes a continuous section fed by the sub-stations at each end. On the line, all the third-rail sections on the entire system are connected together through the medium of the sub-station bus-bars and feeder panels, so that there is opportunity for the sub-stations to divide the load among each other as far as the conductivity of the third rail will permit, and in case of an excessive load upon one section the sub-station nearest is not required to carry the whole load. On the double-track part of the road the third rails on the two parallel tracks are not connected together, but form two separate sections through the medium of the sub-station feeder panels and bus-bars, just as are any other sections, but we contemplate tying the two third rails together through a circuit-breaker located half way between the sub-stations, so that we will have the benefit of the two conductors in case of a blockade on one track. The use of a circuit-breaker would be necessary to avoid trouble on both third rails, as would happen in event of a short-circuit on one.

We are trying to devise some means of overcom-

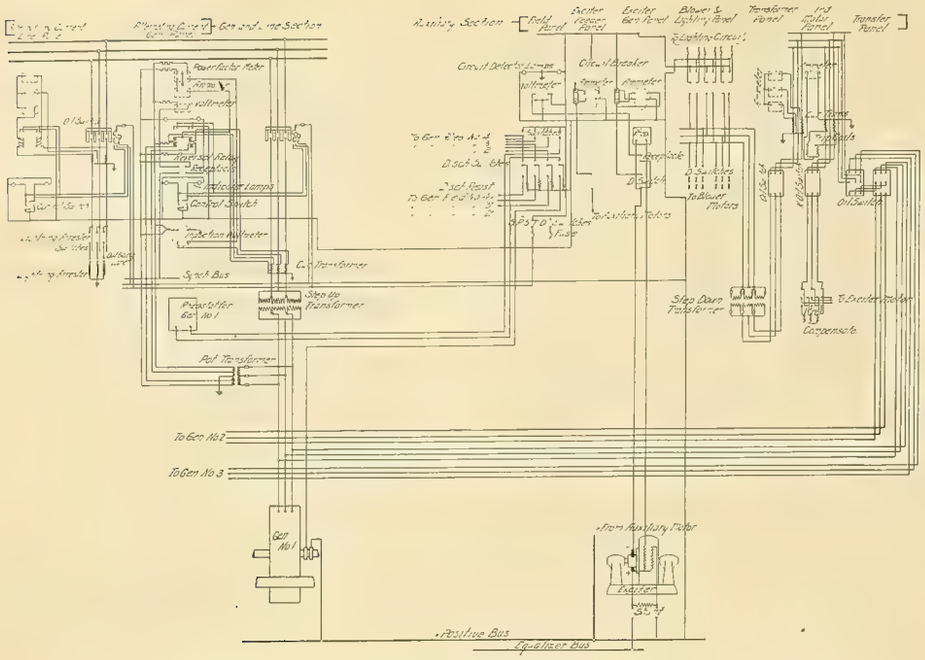
Power House at Batavia, Ill.

Three-car Train, Showing Third Rail.

Concrete Bridge.

Steel-girder Bridge.

AURORA, ELGIN AND CHICAGO ELECTRIC RAILWAY.



ELECTRICAL FEATURES OF THE AURORA, ELGIN AND CHICAGO RAILWAY.—POWER STATION WIRING.

ing the breaks in the third rail at road crossings, and are trying an overhead bow trolley at these points, but it seems as though the long contact shoe underneath the car if so arranged as to make contact with magnetic contact plates or buttons similar to the Baltimore and Ohio Railway tunnel locomotives of Baltimore, will be the most promising manner of overcoming this difficulty. The main objection to the overhead trolley is that it disfigures the right-of-way with so many poles, etc. So far as power on the car is concerned, there is no need of current at these points, as the car will coast a mile on level track, but owing to air-brake rigging and controller parts under the cars, there is not much room for an independent source of light in the cars, such as storage batteries or acetylene-gas tanks.

Transmission and Distribution.

The road is laid out for six sub-stations. The transmission is by 26,000-volt, three-phase alternating current. The high-tension lines are carried on cross-arms, with insulators 30 inches between centers on the cross-arms, and the cross-arms are 24 inches apart. The telephone lines are on cross-arms seven feet below the lower transmission cross-arms. There are two telephone circuits, one for general business and the other for dispatching. The telephone lines are transposed every fourth pole and the high-tension lines every mile. The telephone wires are transposed by tying both to a single wide petticoat transposition insulator every fourth pole.

The erection of 650 30-foot, 4,250 40-foot, and 150 50-foot poles under the conditions we had to contend with was not an easy task. The greater part of the poles were hauled from the nearest railway stations by wagon, and as the right-of-way was minus bridges and only partially graded, three or four 40-foot poles made a big load for one team.

The holes for 40-foot poles were put down six feet, and many were blasted with dynamite, a two-inch hole being bored six feet deep and a stick of 40 per cent. Ætna tamped in the bottom. Then the hole would be half filled and another stick put on top of this and tamped, both being set off with a magneto generator. This made the hole the same diameter all the way up, and as the sod is cut the size of the hole intended, there was no tearing up of ground.

No direct-current overhead feeders are needed, as the third rail has sufficient capacity to conduct all the current from the sub-stations to the trains. The overhead pole line has only to carry two telephone circuits, and the 26,000-volt, three-phase, high-tension feeders which supply the sub-stations. The high-tension feeders are of standard aluminum cable equivalent to No. 00 and No. 2 copper wire. The poles carrying these lines are 40 feet long, placed 80 feet apart.

The system of high-tension distribution is arranged to secure freedom from interruptions of service due to short-circuits or breakages on any one transmission line. Three high-tension feeder lines leave the power house at Batavia. A line of No. 00 runs directly across the country to sub-station No. 1, near Aurora. Another high-tension pole line with No. 0000 follows the line of railroad, supplying sub-stations Nos. 2 and 3, and extending to Maywood. The line from No. 3 to 4 is No. 00. The third line, of No. 0000, from the power house is built directly across the country to sub-station No. 5 on the Elgin branch, and along the right-of-way from this sub-station to Wheaton, at which point it joins the pole line from the Aurora branch, and the two three-phase circuits run on the same poles to sub-station No. 3, with one circuit from there to No. 4. Sub-station No. 6 is supplied by a line of No. 00, running from sub-station No. 5.

Power Station.

This is one of the first high-tension, alternating-current distribution plants to go into operation in which all the switching is done on the high-voltage side of step-up and step-down transformers. Each generator in the power house has its own bank of three transformers and each rotary converter in the sub-stations has its bank of three transformers. In each case the transformers are considered as a unit with the generator or converter. Each generator is connected with its bank of transformers directly without any switches or circuit-breakers. In other words, each generator and its transformers constitute practically a 26,000-volt unit.

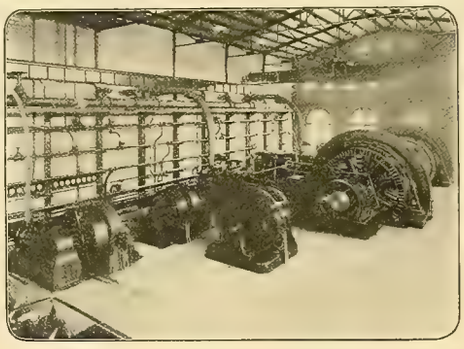
Each leg of the switch is an oil cylinder in a separate brick compartment, a motor on each switch keeping a large spring under tension, which throws the switch open or shut. After each operation of the switch the motor puts the spring under tension again. This always leaves the switch in condition to be opened or closed once, should all other power fail. The motor is operated by direct current from the exciter panel and is entirely automatic in its action. The trip of the switch is also worked by direct current from a small switch on the generator panel. It can also be worked by hand at the switch proper. Indicating lamps on the generating panel show green when the switch is open and red when closed.

Taking up the circuits in their logical order, on the accompanying station wiring diagram, the main current from the generator (2,300-volt, three-phase) is taken directly to the low-tension terminals of its three delta-connected transformers, taps being taken off between the generator and transformers for a potential transformer which supplies switchboard instruments of the generator panel. Current for all auxiliaries is taken off the generator leads between the generator and sten-up transformer. These leads are taken to the switchboard gallery through lead cable drawn through tile conduits to the transformer panel of the auxiliary switchboard, and as the present capacity of the station is four 1,500-kilowatt machines, there are four cables of three-strand conductors each, which lead to double-throw oil switches on the first left-hand or transfer panel. This panel is also fitted with a wattmeter reading the total alternating-current power required for the motor-generator exciter.

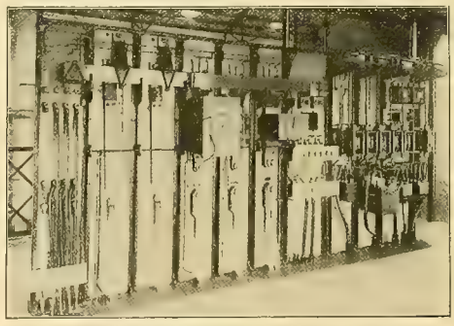
The second panel contains a 2,300-volt, 110-ampere, alternating-current circuit-breaker and switch combined and also an ammeter. The third panel is fitted with a single-throw oil switch and an ammeter for each phase. This panel controls the blower motors, lighting, etc. The fourth panel is fitted with a direct-current wattmeter of 2,500 amperes at 125 volts, two triple-pole, single-throw blower-motor switches and three double-pole general lighting switches. The fifth panel is fitted with a 2,400-ampere motor-generator switch, field rheostat, voltmeter plug and 0 to 5,000 ammeter.

The sixth and seventh panels are each fitted with one 1,280-ampere switch, field rheostat, voltmeter plug and 0 to 2,500 ammeter. These two panels are for the two steam-driven exciters, and at shutting-down time the steam exciters are thrown in parallel with the motor-generator and voltage is so adjusted as to take the load off the motor-generator. This permits shutting down without a moment's darkness in the station, or having to start any auxiliary motors that would have dropped out otherwise.

The eighth and ninth panels are each

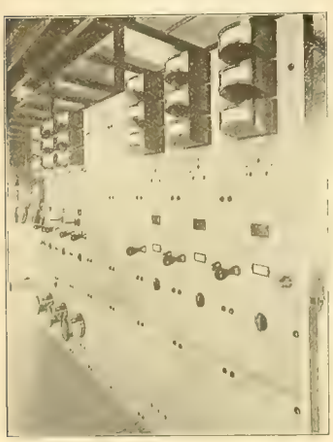


General View of Engine Room in Power House.



Rear of Exciter Switchboard in Power House.

ELECTRICAL FEATURES OF THE AURORA, ELGIN AND CHICAGO RAILWAY.



High-tension Switchboard at Power House.

High tension Wiring Under a Transformer.

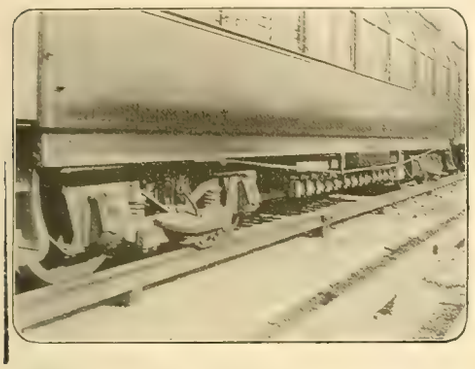
Gallery for High-tension Wires.

Distributing Frames at Power House.

ELECTRICAL FEATURES OF THE AURORA, ELGIN AND CHICAGO RAILWAY.

fitted with one 800-ampere, single-pole, single-throw switch, 1,500-ampere ammeter and 1,200-ampere circuit-breaker for supplying the auxiliary motors on the pumps, elevators, etc. The whole station equipment is in two halves, independent of each other, so that in event of trouble on one end of the station the other end is free. This arrangement is carried out in all steam and water piping also. The tenth panel is equipped with one field break-up switch and one field discharge switch of 250-ampere capacity for each of the four generators, and an astatic voltmeter reading to 175 volts.

At first thought, it would seem that in using a motor-generator for exciting the main generators one would get extreme variations in voltage, due to the fact that load on the generators would cause a

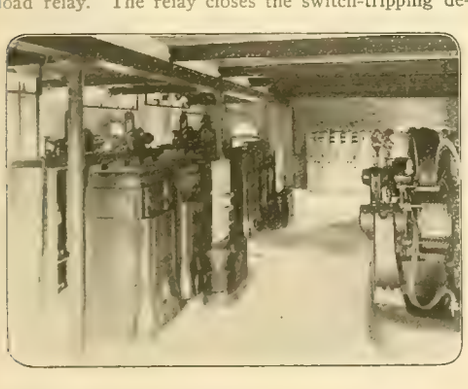


AURORA, ELGIN AND CHICAGO RAILWAY.—DETAIL OF SIDE OF CAR.

drop of voltage due to the variations of engine speed in addition to the regular drop in generator voltage due to the full or extreme overload, which in turn would cause a drop in voltage of motor-generator exciter. However, with load varying from 500 to 2,000 kilowatts on a 1,500-kilowatt machine in 80 seconds, the direct-current voltage at the sub-stations does not vary more than 10 per cent. The motor-generator is of 300-kilowatt capacity, or large enough for exciting all generators and supplying current for all auxiliary motors, lamps, etc.

The main-generator current, after passing through its three step-up transformers and being raised to 26,000 volts, passes through current transformers, which are for operating the ammeter, power-factor indicator, induction wattmeter and reversal relay on the generator panel. After passing the current transformers the leads are taken to the motor-operated oil switch, from which they pass to the alternating-current, 26,000-volt bus-bars in the bus-bar compartment. The reversal relay is a combination of current and potential coils, so arranged as to trip the generator switch should current start to flow from the line toward the generators, as would be the case in event of one of the rotary converters being run as a generator from the third-rail current. Direct current from the exciter circuit is brought to the generator panel for controlling the main switches, which are located some distance from the switchboard. The generator and feeder panels have no high-tension wires upon them whatever.

Each feeder passes first through a motor-operated oil switch, similar to those in the generator circuits. It then passes a current transformer, which operates a power-factor meter, ammeter, and the overload relay. The relay closes the switch-tripping de-



AURORA, ELGIN AND CHICAGO RAILWAY.—INTERIOR OF SUB-STATION.

vice, when current flowing exceeds the amount for which the relay is set. The main-feeder switches can also be operated by a hand-control switch, as well as automatically by overload. The 26,000-volt wiring in both power station and sub-stations is carried in brick flues, which isolates each circuit from adjacent circuits.

Sub-stations.

The regular sub-station equipment for all the sub-stations comprises two 1,500-kilowatt rotary converters with a bank of three transformes each. The sub-stations have air-tight bus-wire compartments, in which air is kept under pressure by the blower for cooling the transformer and the reactive coils. The top of the coil and transformer cases have openings by which the amount of air passing may be regulated.

At the Warrenville, Lombard and Ingalton sub-stations there is another panel devoted to the outgoing line to the next station. The principal object of this is to make it possible to cut off the line beyond in case of short-circuit or line trouble. After passing the lightning arresters, the incoming line goes through the current transformers which supply current for an indicating ammeter, and the current coil of a reversal relay. This reversal relay is the same as that on the power-house generator panels and will act to open the oil switch on the incoming feeder in case the sub-station attempts to give current to line instead of receiving it. After passing the current transformers the incoming line is taken to the three-pole motor-operated oil switch. The switch is also controlled by a hand switch on the feeder panel. From the oil switch the incoming feeder goes directly to the bus-bars. The panel for the outgoing line and controlling apparatus connected therewith are similar to the incoming, except that the motor-operated oil switch is controlled by an overload relay instead of a reversal relay, and there is an ammeter in each leg of the circuit. The potential transformer for the reversal relay on the incoming panel is connected directly to the alternating-current bus-bars. Current for the operation of the motor-operated switches is supplied by a small storage battery located in the cabinet in the sub-station.

Each rotary converter has its bank of three transformers controlled by a motor-operated oil switch. The alternating-current panel is to all intents and purposes a high-tension panel, although there are no high-tension wires upon it. After passing the main switch the high-tension lines go through current transformers for the switchboard instruments. The converter panel contains a power-factor meter, ammeter, voltmeter, overload relay and controlling switch. The machines may be started on direct current from the third rail or by alternating current, and can be started alternating current from rest and put into service in 30 seconds. When starting on alternating current the three-pole, double-throw switch located on top of the reactive coil is first thrown up, giving only half voltage until considerable speed has been attained, when this switch is thrown down and the rotary given full alternating-

AURORA, ELGIN AND CHICAGO RAILWAY.—TYPICAL SUB-STATION.

current pressure through the reactive coil. Since a synchronous motor produces a leading current, and as the series winding would tend to increase the leading current, the reactive coil is so wound as to balance this effect at all loads, thus keeping the power factor at unity, or, in other words, the increase of leading current due to the increase of excitation of rotaries made necessary as the output increases, is met by the increased lagging effect of the coils due to the increase of current flowing through it.

Power-station Equipment.

The current for operating the entire line is generated at the one power house near Batavia, Ill., on the banks of the Fox River. This will also supply current for the line from Elgin to Aurora and for the local cars in these cities. This traffic tends to equalize the load on the station. The power house is 202 by 160 feet in size, of steel-frame construction, with brick exterior and limestone trimmings. Alfred Box & Co. of Philadelphia, Pa., furnished the 50-ton electric traveling crane.

There are two cross-compound condensing Corliss engines of 2,200 horsepower, made by the C. & G. Cooper Company, Mount Vernon, Ohio. The cylinders are 32 by 64 inches, with a common stroke of 60 inches. These engines run at 75 revolutions per minute. On the shaft of each engine is mounted a revolving-field, General Electric, three-phase, 1,500-kilowatt generator and a 20-foot, 80-ton flywheel. A third engine will soon be erected and space is provided for a fourth unit. There are also two horizontal 200-horsepower engines of the Phœnix Iron Works manufacture, direct-connected to 160-kilowatt General Electric exciters.

The boilers are supplied by the Edge Moor Iron Works Company of Wilmington, Del. These boilers are of the water-tube type, of 500 horsepower each and carry a pressure of 180 pounds. The chimney is of brick and stone, 240 feet high, and has an 11-foot flue.

American Institute of Electrical Engineers.

The next regular meeting of the American Institute of Electrical Engineers in New York will be held on December 19th at 12 West Thirty-first Street. The general subject for the evening will be "Braking and Traction Brakes," and papers will by presented by J. D. Keiley and R. A. Parke.

WORLD'S FAIR NOTES.

Over 10,000 persons visit the World's Fair grounds every Sunday, weather permitting, and in a short time excursion trains will pour many times that number into the city. The Electricity and Varied Industries Buildings are the centers of attraction, and the rapidity of progress on the Machinery Building is a source of wonder to those who keep in touch with World's Fair matters.

Prof. W. E. Goldsborough, chief of the department of electricity, while in Cleveland recently, spoke before a joint meeting of the Electrical Club, Chemical Club, Architects' Club and Civil Engineers' Club of that city, on the Louisiana Purchase Exposition. At the close of the address an informal discussion took place, and many questions were asked, showing the great interest taken in the coming exposition. While in Cleveland Chief Goldsborough secured five large exhibits for his department.

In all probability a mining exhibit will be installed on a large scale, and will form one of the features of the exposition. The natural hills in the exposition tract afford every opportunity for a display of this kind, and there is every reason to believe that the project will be carried out. As outlined, there will be several shafts and tunnels, and these will be equipped with the latest appliances —hoisting engines, cages, cars, tramways, stamps, etc., in actual operation. Mining companies will furnish ores, and the various steps in the extraction of the metals will be shown.

The Electricity Building is rapidly approaching completion, although it will probably be some time in January before it will be finished in every detail. The roof trusses are all in place, and a portion of the roofing is in place. The interior is nearly complete, and the finishing touches, such as window, door and skylight sash are being put on. The towers are entirely covered with staff, as are the cornices, etc., and the exterior walls are now receiving the white covering. The court has been in a nearly finished condition for some time, and needs little but the sculptural and horticultural effects to transform it into an inviting spot.

At a meeting on Friday of last week the Grounds and Building Committee rejected all bids submitted for the erection of the Transportation Building, as all were in excess of the appropriation. The bids ranged from $744,428 to $883,240. Minor changes will be made in the plans of the building and new bids ordered. Only three days will be allowed for estimates on the new plans. The Transportation Building will be the largest in the main group, the dimensions being 525 feet by 1,300 feet. There will be over four miles of standard track in addition to 270,000 feet of exhibit area. F.

Chicago Electrical Association.

The regular meeting of the Chicago Electrical Association was held in its rooms on the evening of December 5th. In the absence of President Woodworth and Vice-president Wiler, Harold Almert filled the chair, and after the regular preliminary business, introduced the essayist of the evening, Captain DeKhotinsky, formerly managing director of incandescent-lamp factories at Paris, Rotterdam, Gelnhausen and also at Marlboro, Mass. Captain DeKhotinsky's paper was on "The Early Development of European Incandescent Lamps," and was read by Albert Scheible.

Quite a few samples of the early types of European incandescent lamps were exhibited and were peculiarly interesting in that some of them, in filament construction, are very similar to types recently brought out. The average lamp of the early European day burned on a voltage of 60 to 70 volts and consumed from 20 to 25 amperes. Such a lamp in Paris would sell to the retailer for five francs, or practically one dollar. Considerable discussion followed the reading of the paper. Captain DeKhotinsky stated the interesting fact that in the early development of the incandescent lamp, Europe worked from the start for a lamp which would use a carbon filament, while the inventors and scientists of the United States attempted the development of the metallic-filament lamp, though the Americans finally brought out the successful carbon-filament lamp. The discussion tended toward a general talk on filaments and their manufacture. Albert Scheible, H. G. Dimick, W. R. Hale and others participated.

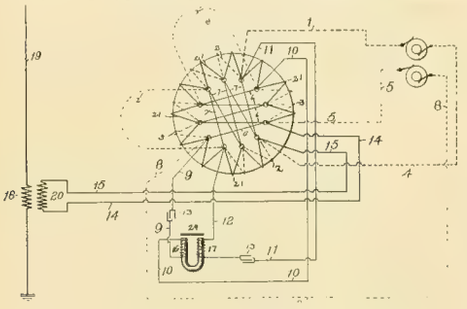
At the close of the discussion J. R. Cravath, for the nominating committee, submitted the names of the gentlemen to be voted on for officers of the association during the ensuing year, this meeting being the time for the regular annual election of officers. The committee's report was adopted, resulting in the election of the following-named officers: President, P. B. Woodworth; vice-president, P. Junkersfeld; secretary, W. B. Hale; treasurer, H. G. Dimick; auditor, DeW. C. Tanner; directors, W. J. Warder, Jr., C. W. Whitney and Albert Scheible.

The next regular meeting of the association will be held on January 19, 1903. At this meeting H. M. Brinkerhoff, general manager of the Metropolitan West Side Elevated Railway Company, will present a paper on "The Third-rail System for Electrical Railways."

Fessenden Electromagnetic Receiver.

Reginald A. Fessenden of Manteo, N. C., has invented and patented a current-operated receiver for electromagnetic waves which is a part of his space-telegraphy system. The invention has for its object the production of a constantly rotating magnetic field and the changing of direction of the field without changing the amount of the magnetic lines—i. e., without producing a magnetizing or demagnetizing effect. The invention is shown diagrammatically in the accompanying drawing.

"In the practice of my invention," says Mr. Fessenden, "I employ a magnetic circuit which may be closed, as shown, and may be formed of soft iron, although other magnetic material (as hard iron or nickel) may be employed. The metal forming the magnetic circuit may be kept under mechanical strain, as by clamping the periphery and forcing the middle portion of the disk outwardly, or vice versa, thereby producing an increased magnetic instability. The magnetic field is produced by a two, three, or polyphase generator of suitable construc-



FESSENDEN ELECTROMAGNETIC RECEIVER.

tion. In the arrangement shown one of the windings (2) forms part of the circuit (1) (4), so connected to the generator that a current of one phase is produced therein, while the other winding (3) is included in the circuit (5) (8), in which a current of a different phase is generated. The windings (6) and (7) form parts of circuits (9) (10) and (11) (12), respectively, which also include an electromagnetic indicator (29), as a telephone, galvanometer, siphon-recorder, etc. It is preferred that the circuits (9) (10) and (11) (12) should each include a separate independent coil or winding (16) (17), although both circuits may be connected in series with a single coil, so as to operate analogously to the case of a drum-wound alternating-current armature. It is preferred to arrange condensers (13), of small capacity, in the indicating circuits (9) (10) and (11) (12) to cut out currents due to the rotation of the magnetic field, but permit the passage of currents caused by the sudden change of direction of the field by currents produced by electromagnetic waves.

"The winding (21) is included in a circuit (14) (15), which also includes the secondary (20) of a transformer, the primary (18) of the transformer being connected in series with the receiving conductor (19). The circuit including the secondary of the transformer is preferably tuned to the period of the electromagnetic waves, preferably by proportioning the secondary circuit.

"The field caused by the two or more phase currents from the generator revolves constantly and uniformly, the currents being produced in such manner that they shall have, as nearly as may be convenient, a sine form, and thereby cause the field to revolve without abrupt changes in direction and to be maintained at uniform strength.

"On the passage of a rapidly alternating current caused by the electromagnetic waves through the circuit (14) (15), the lag of the direction of the magnetic lines behind the magnetic field is reduced suddenly—i. e., the lag of the direction of the magnetic induction of the magnetic flux or the direction of the magnetomotive force is suddenly reduced. It is assumed that this is due to the rapidly alternating currents produced by the electromagnetic waves, causing rapid vibrations of the magnetic molecular chains, thus causing the molecular magnets to adjust themselves better to the direction of the rotating magnetic force, and therefore not to lag behind so great a distance. This sudden shifting in direction of the magnetic flux would not cause any voltage in a circuit which entirely enclosed the magnetic flux; but in the present case the relative positions of the magnetic flux and the circuits (9) (10) and (11) (12) are continually changing, and any change in direction of the magnetic flux will produce a voltage in one or both of the circuits, though the total amount of the magnetic flux remains unchanged.

"The positions of the circuits are to some extent interchangeable. For example, the circuits (9) (10) and (11) (12) may be used instead of the circuits (1) (4) and (5) (8) to produce the rotating field, and vice versa. Also any of these circuits may be connected in operative relation to the receiving conductor and used to produce the magnetic variations, and thus the electromagnetic vibrations may be superimposed on any of the circuits while operating normally for its primary purpose. It is characteristic of this form of magnetic receiver that the magnetic flux is not changed as to amount, but only as to direction. In this it is differentiated from other forms of magnetic receivers, such as those used heretofore, in which the amount of the magnetic flux is changed, but not its direction.

"In the form of receiver described a slowly rotating magnetic field produces a slowly rotating magnetic flux. Field and flux are constant in amount; but the flux normally lags behind the field. On the receipt of signal waves and the passage of currents thereby produced through the receiving coils the amount of this lag is reduced, without, however, changing the amount of said field or said flux, and said variation in lag between the direction of the flux and the field generates a voltage which is used to produce an indication."

American Society of Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers was held in New York city on December 2d, 3d and 4th. On account of the illness of the president, Edwin H. Reynolds, there was no presidential address, and in its place was substituted a paper on "A Rational Solution of the Problem of Weights and Measures," by Sidney A. Reeve, professor of mechanical engineering in Worcester Polytechnic Institute. Professor Reeve expressed the opinion "that the metric system is not naturally and inherently adapted to industrial needs, and that to commit ourselves finally to its universal, compulsory adoption would be a mistake of immeasurable magnitude." After discussing some of the inconveniences of the metric system, he proposed a new duodecimal system, which introduces new signs and names.

The system consists of taking as a standard the English yard and treating that exactly as the meter is treated in the metric system, except that the divisions are on the duodecimal system to suit the duodecimal numbers, instead of the decimal system to suit the decimal numbers. This results in small units of length which are exactly equal to those now in use in the machine shops; also in a unit of volume corresponding to the meter, which is practically equal to the existing pint. This new pint, which is a cube measuring three inches on each edge, when filled with distilled water weighs within 2½ per cent. of the present standard pound.

The duodecimal system, as proposed by Professor Reeve, necessitates the introduction of two new numbers. They are inserted by him between the nine and the 10. The first is a peculiar-looking combination of the figure 1 and the 0, and is called the dek; the second is like an inverted 3, and is called an eln. Thus, when the decimal 10 is reached it signifies a dozen. Professor Reeve has compiled some interesting new names for his duodecimal numbers, such as "dozone" (thirteen), "fitze" (five dozen), "twodz-nine" (two dozen and nine), etc. This, of course, brings in the use of the dek and eln, and he has "dedz" (dek, dozen), etc.

This paper was discussed at some length by the members of the society, and, in fact, the consideration of the metric system occupied a large share of the attention of the entire convention. An interesting feature was the presentation of papers on opposing sides of the question by F. A. Halsey and F. J. Miller, both of the editorial staff of the American Machinist. Congressman James H. Southard of Ohio, chairman of the House Committee on Coinage, Weights and Measures, and Prof. S. W. Stratton, director of the Bureau of Standards, championed the cause of the metric-system bill now before Congress.

The annual report of the council of the association showed a total membership of 2,349, and recommended certain economies for reducing the expenses of the society. At a business session James M. Dodge, president of the Link Belt Engineering Company and the Dodge Coal Storage Company of Philadelphia, was elected president of the society.

National Bureau of Standards.

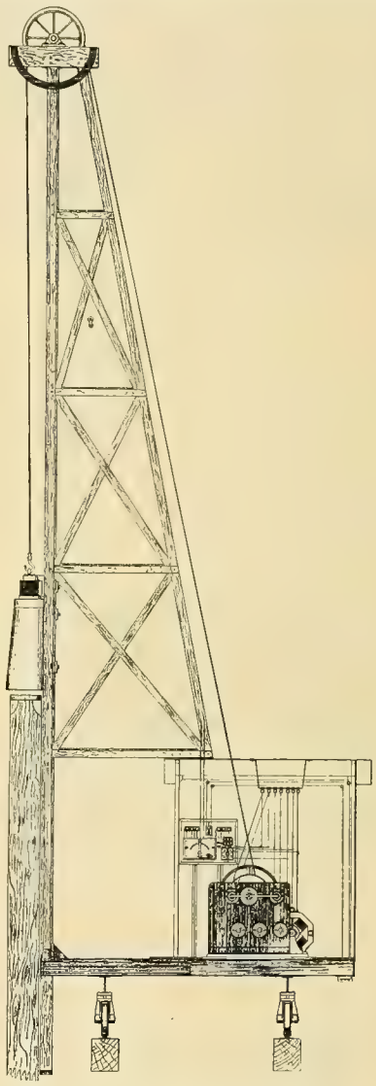
Under date of December 8th, James Knox Taylor, the supervising architect of the Treasury Department at Washington, D. C., issues official notice that sealed proposals will be received at his office until 2 p. m. on January 12, 1903, and then opened, for the construction (except plumbing and mechanical equipment) of the Physical Laboratory, National Bureau of Standards, Washington, D. C., in accordance with the drawings and specifications, copies of which may be had at Mr. Taylor's office.

The Niles (Ill.) Light and Power Company has been incorporated with a capital of $5,000 to furnish electricity for light, heat and power purposes.

Electrically Operated Pile Driver.

The operation of pile drivers is one of the recent applications of electricity to industrial uses, and the electric motors are said to have many advantages over the steam engines. The adoption of the electric system in many cases is very economical, as it does away with the necessity of making roadways for carrying coal, water pipes, and other apparatus required for the operation of the steam engine and boiler at the various points of installation. The electric pile driver not only has these advantages over the steam pile driver, but, in addition, in moving it from place to place it is lighter, as no boiler is required, and the electric conductors can be easily connected.

In the electric pile driver shown in the accompanying diagram the monkey is of the ordinary type, with a planed face on the top of which the electromagnet shown in the drawing attaches itself. This magnet is connected by wires to the motor on the crab



ELECTRICALLY OPERATED PILE DRIVER.

and worked by a switch from the crab. When the current is switched on to the magnet it attaches itself to the monkey, and the winch lifts the monkey and magnet up to the required height. The magnet is detached from the monkey by simply switching the current off, and follows the monkey down as rapidly as possible, ready for lifting again the moment the current is switched on.

The construction of the winch or hoist is such that it is in continual operation. The drum shaft is fitted with a large friction-cone clutch, right and left, and this cone is operated from the center of the drum shaft by magnets also, thus giving the least possible work for the operator and the most rapid movement to the clutch possible.

The handles that work the winch and the magnet for the monkey can be coupled together, so that the process of lowering the magnet would naturally follow immediately after releasing the monkey. The electric winch is constructed of steel plates, forming the cheeks of steel gearing, machine cut, for driving the winch. The magnet is made to lift three tons or more.

The general construction of the pile-driver frame can be seen from the drawing, which, however, is changed to suit the conditions. The four wheels on which the frame is supported can be swiveled around a complete circle, so that they can be in any position for which the frame may be required. The electric motor is also used in connection with the traveling motion for moving the frame from one part of the work to another. This interesting mechanism is manufactured by the New Southgate Engineering Company of London, England.

The Pherophon.

The pherophon is the name of a house-telephone system which has recently been brought out in Germany. Because of its simplicity and cheapness, it has met with much favor. The instrument shown in Fig. 1, combines cheapness of manufacture in quantities, and is also said to be a high-class product. The pherophon is made entirely of metal, but not a single screw enters into its construction. The apparatus it extremely simple and is hermetically sealed, so as to exclude all liability of change or damage in use. The telephone consists of a system of single magnets, made of soft-iron laminations. The diaphragm of the telephone forms the cover and is sealed. Over this cover is a sound funnel. On account of this apparatus being designed for direct switching, it was not necessary to employ permanent magnets.

The microphone consists of carbon particles, and a gold-plated diaphragm, which also serves as a cover, protected from mechanical injury by means of the sound funnel. The telephone and microphone are connected in series, and the circuit is closed automatically, by means of a switch, which is actuated by the movement of the hook when the pherophon is removed. The receiving pherophon is constructed as a duplicate of the above, with the single exception that instead of a switch operated by the hanger hook, a short-circuiting device is employed, which short-circuits the instrument when hanging on the hook.

The pherophon may be connected to any system of electric-bell wiring. No double-throw switching arrangement is needed, as the apparatus is connected directly to the bell wiring. When the instruments are not in use they are hung on their respective hooks. The room instrument is fastened to a push button and is disconnected, while the other telephone, which may be located in the kitchen, is short-circuited. Thus the bell wiring remains undisturbed, and is used in calling up. As soon as the instruments are in use both are automatically sistance of the series connected pherophones. This calling device, however, does not operate because of the decrease in current resulting from the high resistance of the series connected Pherophones. This decreased current is nevertheless of sufficient strength to accomplish the telephonic transmission perfectly.

The kitchen pherophon is short-cuited when not in use, and consequently does not increase the resistance of the circuit, from which it follows that any number of pherophones may be used. Also any desired number of room instruments may be

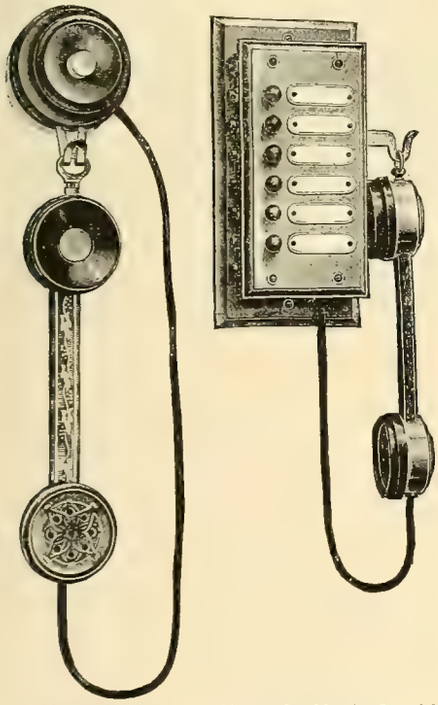


Fig. 1. Room Instrument.

Fig. 2. Combination Board for Apartment Building.

THE PHEROPHON.

employed. If it is desired to use a room pherophon at numerous points, the push buttons ordinarily used are replaced by receptacle push buttons, adapted to receive contact connections of the telephone. In the case of annunciator systems of wiring, the instrument is connected to the bell, and all connections of the annunciator remain undisturbed.

It frequently occurs that stations desire to call one another, and in this case a suitable system of bell wiring is installed and the pherophones are then connected as shown in Fig. 3. Instruments adapted to mutual calling up are made, which do not require a bell, but secure the desired result by means of a crackling sound in the diaphragm. This sound is of sufficient intensity to be readily recognized where noise is not excessive. All instruments are, of course, furnished with bells when this is desired. While it is ordinarily customary to connect all the microphones and the receivers in series, in the case of these instruments only the receiver, and its respective microphone, are thus connected. The effectiveness of this arrangement is of importance on account of the low resistance of each circuit of receiver and microphone. When a single cell is used the sound transmitted is readily understood, while with three or four cells the sound may be plainly recognized at a distance of from six to nine feet from the instrument.

To make the pherophon suitable for larger installations, a line-selecting device, shown in Fig. 2, is used. Each line is connected to a flat spring which is normally held down by a button, until the locking hook engages the spring. This locking hook is in the form of a bar and is common to all the springs. In hanging up the pherophon the locking bar to which the circuit of the apparatus is connected is raised and the spring is released,

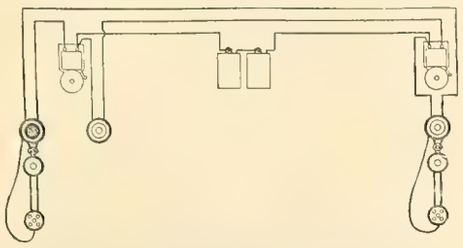


FIG. 3. THE PHEROPHON. —WIRING DIAGRAM.

thereby opening the circuit. There is a separate push button for signaling. The necessary switching is done automatically by the movement of the supporting hooks. The principle employed depends upon the use of a common battery and direct switching without induction coils. Two battery conductors connect to all apparatus, in addition to which each individual instrument has its own wire; thus in a system of five telephones, there will be seven conductors.

Instruments of external appearance similar to that shown in Fig. 2 are designed for connecting between the entrance of apartment houses and the various apartments. These apartment pherophones are simply connected in parallel to the existing apartment plates with numerous push buttons, the circuits leading to the various apartments. In each apartment a pherophon is installed at the bell. Additional wires are unnecessary. Visitors may thus ring and telephone from the entrance of the building to each separate apartment. After the installation of a general system of wiring one can also telephone from each apartment to the entrance.

Government Report on Oil as Fuel.

The Bureau of Engraving and Printing has been making experiments with oil for fuel purposes and has sent a report on the results of these to Secretary Shaw. The report deals with a 10-hour test in which oil was used as fuel for producing steam for operating machinery. Spray furnaces of an approved type were used and, it is said, that the efficiency of fuel oil was fully established.

In detail, the report showed the evaporation of 13.8 pounds of water to a pound of oil consumed, as compared with 11 pounds evaporated by a pound of coal. It is said that this result with the oil approaches closely the average obtained by the Naval Bureau of Engineering in more elaborate experiments which have been in progress now for some months. The Bureau of Engraving found, however, that the kind of crude oil burned cost, under every-day circumstances, nearly 50 per cent. more than the bituminous coal with which the comparison was made. In other words, it would cost $10.48 to produce, by oil, the same amount of heat that, by coal, would cost only $7.76. Oil cost the bureau one dollar a barrel in the above experiment and coal cost four dollars a ton. The price paid for the coal is about one dollar higher than the average, but that was considerd in calculating the results reported.

Chicago Edison Increases Capital Stock.

At the regular annual meeting of the stockholders of the Chicago Edison Company, held June 10, 1901, a resolution was passed authorizing the increase of the capital stock of the company to $10,000,000 and empowering the board of directors to issue the necessary increase in stock in such a manner and in such installments as it deemed fit.

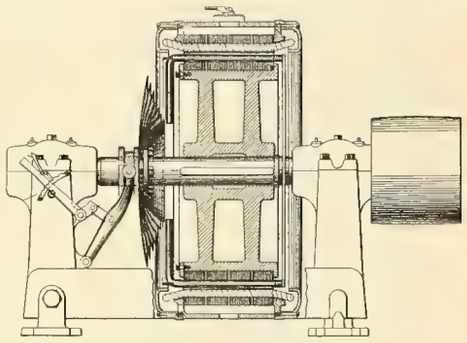
In accordance with this action the directors, on November 18, 1902, offered additional shares of capital stock, to the amount of 30 per cent. of the present outstanding stock, at par, to stockholders of record on January 24, 1903. Such stockholders shall be entitled to subscribe for the new stock to the extent of 30 per cent. of their record holdings on that date.

The purpose of this issue of stock is to carry on extensions and improvements of a general nature. The capital stock has now nearly reached the authorized limit, or at least will have practically reached it when the new stock is bought up. The total outstanding capital stock of the company will then be $9,866,571, the new issue amounting to $2,276,901.

Steinmetz Starting Device for Induction Motors.

A device that is intended to permit a safe and effective starting of induction motors has been designed by Charles P. Steinmetz of Schenectady, N. Y. The invention relates to induction motors of that type in which a squirrel-cage winding is employed on the secondary element, the object being to produce an economical and effective starting of the motor by giving the secondary winding an increased resistance when the motor is first cut in and then gradually decreasing the resistance as it rises in speed. In starting induction motors a tremendous rush of current due to the great slip causes the secondary poles to overpower those of the primary element and gives the motor a low-starting torque. In order to prevent this objectionable result, means are commonly provided for cutting resistance into the secondary circuit while the motor is starting in order to prevent a blowing out of the primary poles and to increase the starting torque, such resistance being cut out as the motor rises in speed.

Mr. Steinmetz provides for the effective starting of such motors by mounting on the secondary element a winding normally kept on closed circuit by means of a high resistance, but capable of being connected up in a series of progressively decreasing



STEINMETZ STARTING DEVICE FOR INDUCTION MOTORS

resistance paths as the motor rises in speed. Means have heretofore been provided for effecting a similar result on an induction motor having a wire-wound secondary, but have usually been complicated in construction or required rubbing contacts and outside connections. In the illustration there is employed a high-resistance connection normally completing the closure of a squirrel-cage winding and which is in circuit at all times, and a series of electrically yielding conductive disks mounted so as to be shifted to or from the conductors of the winding, to decrease or increase progressively its resistance. The conductive disks are mounted on the shaft of the rotary element, so as to turn with the same, but are capable of a sliding movement, and an actuating lever mounted on the frame of the motor permits them to be pressed toward the winding, progressively decreasing its resistance as the pressure increases.

Long-distance Transmission for Montreal.

The city of Montreal is rapidly enlarging its supply of electrical energy, in order to meet the constantly increasing demand for electricity for light and power purposes. The result of this increasing demand is shown in the fact that the Lachine Hydraulic and Power Company is now bringing electricity from Shawinigan Falls, 85 miles distant from the city. The transmission line is already completed and the power houses at the Montreal and Shawinigan ends are finished. At the beginning of the new year the transmission will be in operation and will be conveying 8,000 electrical horsepower into Montreal. It has been a big undertaking, but it has been carried out with remarkable expedition. Some 4,500 cedar poles have been planted for the support of the three bare aluminum wires. At Bout de l'Ile the river is spanned and the island of Montreal reached by means of a heavy steel cable, suspended above the water from two steel towers, one on each shore. The span is 1,800 feet in length. The current is brought into the city at 50,000 volts. At the distributing station the current is stepped down to 2,000 volts, and the 8,000 horsepower will be delivered to the Lachine Power Company at that potential. A strictly domestic aluminum is used. It is the first output from the factory of the Northern Aluminum Company, the Shawinigan branch of the Pittsburg Reduction Company.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

The second convention of the Interstate Independent Telephone Association, held in Chicago on December 9th, 10th and 11th, proved to be one of the largest, if not the largest, telephone gathering ever held. No accurate tally was kept of the delegates and visitors in attendance, outside of those who are actually members of the association, but a careful estimate places the total attendance at about 700. Of this number, fully one-half were exchange operators or persons directly interested in the operation of telephone-exchange properties, which is considered a very satisfactory showing for the Independents. The remainder were manufacturers, supply dealers and representatives of the technical press. A good line of papers was presented, although but one or two approached an essentially technical nature. The principal action taken was on the relation of the Independent companies to the Bell licensee and long-distance companies, and this drew forth the longest and most spirited discussion.

Among the exchange operators present were the following-named: Geo. N. Bandy, Des Moines, Iowa; J. S. Bellamy, Knoxville, Iowa; W. H. Butler, Kent, Ohio; William J. Bell, Baraboo, Wis.; W. J. Buck, Minneapolis, Minn.; C. F. Bennett, Waterloo, Iowa; W. B. Burke, Decatur, Ill.; C. E. Betts, Fayette, Mo.; E. M. Coleman, Louisville, Ky.; J. W. Chambers, Winchester, Ky.; Chas. G. Cockerell, Jefferson, Iowa; H. K. Cole, Owensboro, Ky.; E. R. Conklin, Aurora, Ill.; A. B. Conklin, Aurora, Ill.; W. P. Chambers, Britt, Iowa; C. B. Cheadle, Joliet, Ill.; N. N. Crary, Beaumont, Texas; W. D. Dunsmore, Oskaloosa, Iowa; C. B. Dobie, Sigourney, Iowa; H. A. Etter, Salem, Ill.; L. A. Frazee, Connersville, Ind.; W. F. Goodrich, La Crosse, Wis.; Ed. D. Glandon, Pittsfield, Ill.; Frank J. Goodwin, West Lebanon, Ind.; H. S. Herr, Ottumwa, Iowa; Chas. E. Hull, Salem, Ill.; A. L. Hutchinson, Weyauwega, Wis.; G. M. Heiserman, Albia, Iowa; R. Hannah, Fergus Falls, Minn.; A. C. Himbaugh, Burr Oak, Mich.; L. L. Hymeman, Lexington, Ill.; Wm. F. Hall, Clinton, Mo.; J. B. Hill, Waynestown, Ind.; C. M. Irwin, Macomb, Ill.; W. Guy Jones, Columbus, Ohio; O. A. Knell, Des Moines, Iowa; I. A. Lumpkin, Mattoon, Ill.; John W. Layne, Carthage, Mo.; W. F. Laubach, Akron, Ohio; G. G. Lichty, Vinton, Iowa; Will W. Morrison, Washington, Ind.; W. J. Mead, Oswego, N. Y.; C. M. McFatridge, Moravia, Iowa; E. W. Pickhardt, Huntingburg, Ind.; J. H. Parrish, Owensboro, Ky.; A. L. Parrish, Owensboro, Ky.; A. T. Presson, Iowa City, Iowa; Jerome Penn, Washington Court House, Ohio; David Prewitt, Winchester, Ky.; H. C. Raney, Fairfield, Iowa; O. Rex, North Manchester, Ind.; H. H. Robinson, Cleveland, Ohio; William Robinson, Muskegon, Mich.; C. W. Sebern, Ashland, Ky.; J. G. Schweizer, La Crosse, Wis.; M. Savage, Champaign, Ill.; G. L. Saunders, La Crosse, Wis.; A. Schuler, Streator, Ill.; G. P. Schlosser, Gibson City, Ill.; A. C. Sumner, Waynestown, Ind.; E. M. Stylston, Rochester, N. Y.; A. L. Tetu, Louisville, Ky.; J. C. Thorne, Fairfield, Iowa; W. Gilbert Thompson, Lebanon, Ohio; W. F. Vesey, Ft. Wayne, Ind.; R. Valentine, Janesville, Wis.; J. B. Ware, Detroit, Mich.; B. F. Wasson, Clinton, Ill.; E. W. Wagner, Sharon Center, Iowa; H. Wales, Rochelle, Ill.; W. A. Wright, Hillsboro, Ind.; J. E. Zeluff, Louisville, Ky.

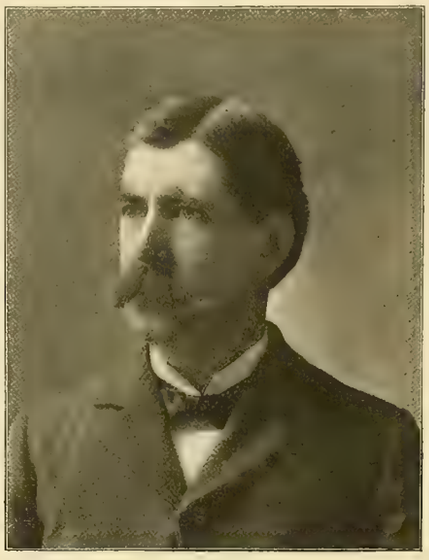
President C. E. Hull.

In the selection of ex-Senator Charles E. Hull of Salem, Iowa, as president of the Interstate Independent Telephone Association to succeed Henry C. Raney, the members chose a man of wide business experience, of integrity and of ability to handle the affairs of the association. Mr. Hull was born 40 years ago in Salem, Ill., which has always been his residence, and where for the last 20 years he has been a prosperous and successful merchant. He was educated in the grammar and high schools of Salem and at the State Normal School at Carbondale, Ill. Some years ago his efforts to have the different coal-mining properties which he owns in different parts of Marion County connected, resulted in his building his own telephone lines. His system has now extended over the entire county, and besides the main exchange at Salem, the county-seat, includes eight small exchanges and many miles of toll and farmers' lines, reaching a total of over 1,000 subscribers. Mr. Hull is the sole owner and manager of the system, which is known as the Salem Telephone Company. Mr. Hull has taken an active part in politics in his community and served for one term, from 1896 to 1900, as senator in the Illinois Legislature. Salem is the old home of William Jennings Bryan, and Mr. Hull is also a Democrat in politics. Besides handling his coal and other properties, Mr. Hull is associated with banking and other interests of his city. He is married and has two daughters. His official connection with the Interstate Independent Telephone Association has been as a member of the executive board, to which position he was elected last spring. This is the only telephone association to which he belongs, and the association may count on having his best efforts as presiding officer.

Opening Session.

The first session of the convention was called to order by President H. C. Raney in the banquet hall of the Auditorium Hotel on Tuesday afternoon. J. E. Keelyn of Chicago introduced Hon. Lawrence E. McGann, comptroller of the city of Chicago, who in brief and well-chosen words, extended to the delegates and visitors a hearty welcome to the city. He believed that there yet remains to be developed in the means of popular communication so much that the subject now under consideration is merely in its infancy. The necessity of the telephone was chiefly recognized in the city, but the farmer had awakened and had become a strong factor in the development. The existence of such an organization indicated competition, which was beneficial.

President Raney then responded on behalf of the association, saying that the members attending the convention were here as the representatives of a business interest, which in the nine states included in the convention, represented an investment of at least one hundred millions of dollars and represented the customers of business interests in Chicago which employ ten million dollars of capital, furnish labor to 15,000 citizens and which do an annual business of twenty millions of dollars. He said they were entitled to credit, not only as customers of great business interests in the city, but



CHAS. E. HULL, PRESIDENT INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

also for the work they are doing among the people of the states they represent. After a few general remarks on the development of the Independent movement he presented his annual address as follows:

President Raney's Address.

It is an honor and a pleasure to me to call to order the Interstate Independent Telephone Association, and to address its members at this its second meeting.

I wish to congratulate you, that you meet with such happy surroundings and under such favorable circumstances and that you have received such a generous welcome to this great pushing city.

The energy and push of the Independent telephone man is proverbial, and yet I may express a hope that that energy and push may receive a new impetus by our coming in contact with the business life of this great city, and especially as we come into personal contact with our royal entertainers, who stand in the very front of the great army of live, hustling business men in this city.

I wish that at the very opening of this convention every member could fully understand and appreciate the importance of this meeting, and fully realize what influences for good or evil to our business, and the business of those we represent, will emanate from this convention.

The Independent telephone business in all its branches is a comparatively new factor in the great business life of this country and of the world. But it has advanced rapidly to a prominent place in that business life.

It needs no prophetic eye to realize the immense possibilities of the business in the near future. What I have already said of its growth in the past is but an index of the future.

Realizing these things myself, and bespeaking from everyone in attendance here their careful consideration, I ask that the matters coming before us be so taken up and handled as to bring the highest degree of credit to ourselves and the greatest good to our business. May our deliberations be worthy of the business that we represent.

The work of this convention has to do in the first instance and directly with telephone business from the operator's standpoint. In immediate results, from a financial standpoint, it may more directly affect the business of the manufacturers and supply men.

But if they have special opportunities to induce us to do business and get our money, we will at least have the opportunity of knowing what is on the market, and finding out what is most adapted to our wants, and where we can get it the cheapest.

The active work of the convention readily divides itself into three parts or heads: First, our business relations with the general public; second, our business relations with one another, and third, our business relations with and standing in the financial world.

This is a case of where the last should be first, did not the last depend so absolutely on the first two. It is not for me to discuss these matters in detail.

An examination of the most excellent programme which has been prepared, both as to subjects and speakers, will at once convince anyone that the committee which prepared it understood the needs of the Independent telephone work, and knew who was best able to advise us in relation thereto.

Speaking in a general way, I may be permitted a few remarks in regard to the work of the convention along the lines suggested.

First—As to our relations to the general public. We must remember that we are of the people, that our business had its origin in the needs of the people and in their attempts to supply these needs It is for this reason that the Independent telephone movement has always had the moral as well as the financial support of the mass of the people. In this fact we find the secret of past success and the guaranty of future greatness. It is, therefore, of the utmost importance that we preserve intact the cordial relations heretofore existing between the people and the Independent telephone movement.

This means that in fixing and regulating rates of rental and toll service, a proper regard be shown to the people's side of the question. But more essential yet than this is a course of action on our part, having in view the proper treatment of our patrons, so as to retain their good will and interest in our success. And while rates must be adequate, let us take care not to "kill the goose that lays the golden eggs."

In this connection let me suggest that one of the chief objects in a meeting of this character should be the education of the public. The medical profession meet and read learned papers and have long discussions on diseases and their treatment, not so much to educate themselves, as to educate the public as to the necessity for, and value of their services. We can do much in the way of education along similar lines.

In our relation to each other as operators there is vast room for education and improvement. If there is any special source of danger to Independent telephone interests, it is found in the want of harmony and co-operation among telephone men.

The inducements which the business has offered in the way of returns on investments, and the opportunities for acquiring rights and privileges having a great future value, such as franchises and rights of occupancy in highways, have aroused in some men a spirit of avarice and greed for territory that has led to serious complications, which, unless speedily settled, will work untold injury. In other cases there seems to be a disposition to exact harsh terms for privileges granted, and a general tendency to want to do business on the "Keep-all-you-can-get" plan.

There is room for all, and we must respect each other's territorial rights. In granting privileges and concessions we must not lose sight of benefits received; and should make our grants on an equitable basis. If it is the good fortune of some company to control the business in some important center, just and equitable arrangements should be made with other companies, asking admittance to such center. We should do all in our power to enhance the value of each other's property, instead of attempting to destroy that value by demanding unfair connecting contracts.

Especially must we abandon the "Keep-all-you-can-get plan" of doing business. There is no other business in the world involving anything like the same amount of capital, where such loose business methods and practices are permitted as in the telephone business. Each company is entitled to receive the pay for the service which it renders, either in use of line or operators' services. The time has certainly come when improved business methods are demanded among telephone operators. No company should be asked to furnish service without just compensation. Neither should one company receive the compensation for the service which some other company has rendered.

In my judgment there is an imperative demand for some accurate method of settling joint business between companies furnishing a joint service.

The large amount of capital invested by the different companies makes it absolutely necessary that some plan be devised by which the capital of each company will receive just what it earns in service rendered.

One other thought along this line. I have found from experience that there is a disposition on the part of some Independent telephone men to hinder rather than advance the complete development of the Independent telephone movement. For instance, a local company is asked to enter into a contract with another company, whose object is to furnish

the local companies' long-distance service. Ordinary business judgment would say that no company could afford to furnish the money necessary to construct and operate long-distance lines without a long-time-service contract and exclusive rights, under proper restrictions.

It would seem that the ordinary telephone man would see at once that a long-distance connection would add to a good local business the one thing needful to its highest and continued success; that such a connection would give much to and take little from the business of the local company; that instead of being competitors, they would be mutually helpful. And yet there are telephone men, who, either by reason of jealousy, or want of business foresight, will turn down an opportunity to enter into such a contract on the most flimsy pretext.

I want to give you an instance. During the last summer I visited a local company, composed of more than ordinarily intelligent men. I submitted to them a contract which had been approved by a large number of good local companies. They took the matter under consideration. Some time after I received a letter, written by the telephone man of the company, in which he said that they could not accept the contract, that the compensation was inadequate.

His reasoning was as follows: He said the aggregate cost of all the exchanges connected by the proposed long-distance line was greater than the cost of the long-distance line would be, and they should share in proportion to their cost. It never seemed to have occurred to him that the additional service required of the local company would not interfere in the least with the service the local company was already giving, and would not materially increase operating expenses. Nor did he seem to realize that what the local company was offered out of the business, was almost clear gain. And he entirely overlooked the advantage of the improved service to his subscribers.

I do not wish to be understood as even suggesting that the rights of all local companies should not be carefully guarded, nor that they should not receive a proper share in the proceeds of the business, but with these provisions, it is certainly the duty and the proper thing for the local company to do all in its power to advance Independent interests.

I would urge very emphatically a more careful consideration of our duties and obligations to each other.

In the third place we must look carefully to our relations to the financial world. In the earlier history of the Independent telephone movement the financial question was not a serious one. As a rule the local company could find abundant local capital for all its wants. A comparatively small amount was required to start an exchange in the town or village.

But the almost universal experience of the small company has been that in order to protect the investment already made it must extend its service to adjoining towns and frequently over a county in the way of a toll service. In most instances this has been followed by the necessity of building farmer lines. So in many instances the financial question has become a serious one, even to the small companies; and when it comes to attempting to occupy the larger cities and build long-distance lines the difficulty has increased. Investments along these lines have been in the past, and are yet, very largely, experimental in the financial world.

Independent telephone stocks and bonds have in the past had no established standing financially. Our special enemy, the Bell company, has been very active in its efforts to injure us along this line. It has talked "natural monopoly" and "infringement suits" and other "scary" things until men with money hesitated. It has followed this with misrepresentation and misstatement of actual conditions.

Soon after our last meeting I received a letter from our vice-president, inclosing a communication, which is a sample of its efforts along that line. The following is a quotation:

Sunset Telephone Company.—Authoritative Statement by the President.—San Francisco, May 7, 1902.—To the people of Los Angeles and adjoining counties:

A year ago I assumed control of several Bell telephone companies covering the states of Ohio, Indiana, Illinois and Iowa, containing about 13,000,000 people and within which there have been installed more opposition telephone companies than in any other portion of the United States. These companies are located in cities and towns of all sizes and are connected with a complete system of long-distance lines. Much of the construction, being now five or six years old, is going to wreck, and the owners are learning something of the depreciation of telephone installations and cost of maintenance. As a warning to the people of Los Angeles and adjoining counties, I state emphatically over my own signature that with all the millions of dollars that have been expended in these opposition telephone companies in the territory which I have mentioned, no investors have ever made money, and in nine cases out of 10 they have suffered a total loss. The promoters and the construction companies have made money, and to them alone, and not to the public, has any benefit accrued, and I do not hesitate to say that throughout the Eastern district which I now represent, four-fifths of the merchants are radically opposed to two telephone companies in the same city.

Many of the first Eastern opposition telephone companies were started in good faith on honest principles, but of late years the business has fallen into the hands of men who have handled their schemes with as little chance of profit to investors as the "wild-cat" mining ventures of the early territories. The East is about "worked out" for these people, and they are seeking new districts where their methods are unknown.

But on the other hand the actual financial history of the Independent telephone movement is a matter of wonder. As we all know, the men who have engaged in the business started without any experience whatever. They had everything to learn. They made many costly mistakes. The results financially are summed up by a writer in the Saturday Evening Post as follows: "Independent companies are springing up over night, and almost without exception they are successful from the very start. It is of record that there were more failures of national banks last year than of Independent telephone companies for the last three years. Yet a dozen telephone companies are organized where one national bank is organized. And we have always been accustomed to look on a national bank as the soundest institution in the country."

So that notwithstanding the efforts of our enemies our business has already attained to a most enviable financial standing. Our future in this regard is in our own hands. A careful, conservative course, directed by our past experience, will put us on a firm financial foundation.

Such statements as I have quoted above, made by our enemies, are known to be absolutely false. I do not know of the failure of a single telephone company in the state of Iowa. And I know none that is making less money than the "Iowa Bell," judging by appearances.

The financial standing of each individual company is a matter of its own, and we must and can afford to leave that to its own management. But as an organization we can make sure that the public in general, and especially the financial public, are fully informed as to the truth concerning our business. And when the truth is known there will be no doubt in regard to the general financial standing of Independent telephone companies.

The proposing and discussing of plans and details of procedure along the lines I have suggested belong to the work of this convention and will be presented, as the different topics on the programme are taken up. I have no doubt but that they will be ably presented.

In conclusion let us again congratulate the members of this association on the success of their business and the standing it has in the business world. And I urge the consideration and adoption of such plans and policies as will insure a future history as bright and as honorable as the past.

Secretary's Report.

Secretary E. M. Coleman then presented his report. He stated the difficulties with which he had had to contend in fulfilling the duties of his office. As the members of the executive board were widely scattered, they could not be consulted; available funds were small in amount; there was no previous system as a precedent, and the secretary had to exercise his best judgment in the discharging of his duties, his work being sanctioned by President Raney. With the aid of the technical press he had obtained lists of all operating and toll-line companies, manufacturers and supply dealers in the United States, and had distributed 22,500 pieces of literature. On September 9th a meeting of the executive board was held and the programme for the convention determined upon. Messrs. Lumpkin, Bandy and Hull were appointed a committee on entertainment to consult with the manufacturers and supply dealers and the latter had taken hold of the matter of entertainment with a lavish hand. The secretary had attempted to have printed for general distribution an official handbook, but the publication had been postponed until January 15th, when it will be distributed all over the United States, and will contain the proceedings of the association and a great deal of matter of interest to the Independents. This book will be published with no expense to the association. Secretary Coleman then recommended that action be taken on the admission to membership of companies operating on Bell lines, on the plan for exchanging of business by the establishment of clearing houses and on the forming of an information bureau to distribute data so the public will not be misled.

It was then decided to appoint an auditing committee of three to examine the books of the secretary and treasurer and report later to the convention.

The next order of business was the selection of a nominating committee by the different states to report on Thursday at the call of the president. The members representing the various states then

[Continued on page 426.]

SOME OF THE DELEGATES AND VISITORS AT THE INTERSTATE TELEPHONE CONVENTION.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

An Interesting Swiss Light, Railway and Power Plant. Illustrated 415, 416
Large Power Distribution Scheme for Scotland. With map. 416
Copper Mining in Upper Michigan 416
Electrical Features of the Aurora, Elgin and Chicago Railway. By Howard Brooks. Illustrated. (Chicago Electrical Association.) 417, 418, 419
American Institute of Electrical Engineers 419
World's Fair Notes 419
Chicago Electrical Association 419
Fessenden Electromagnetic Receiver. Illustrated 420
American Society of Mechanical Engineers 420
National Bureau of Standards 420
Electrically Operated Pile Driver. Illustrated 420
The Pherophon. Illustrated 421
Government Report on Oil as Fuel 421
Chicago Edison Increases Capital Stock 421
Steinmetz Starting Device for Induction Motors. Illustrated. 421
Long-distance Transmission for Montreal 421
Interstate Independent Telephone Association. (Convention in Chicago, December 9-11, 1902.) Illustrated 422, 423, 426, 427, 428, 429, 430
Charles E. Hull, President. Portrait 422
President Raney's Address 422, 423
Proceedings 423, 426, 427
The Banquet 427
Convention Notes and Exhibits. Illustrated. 427, 428, 429, 430
Editorial 424
Two New Submarine Inventions 425
Engine Builders Meet 425
Large Gas Engine for the St. Louis Exposition 425
American Roentgen Ray Society 425
American Association Meeting 425
National Electric Light Association 425
Amendments to Cuban Tariff 425
Independents Seek Toll-line Connection with Chicago 430
Telephone Extensions and Improvements 430
Toll Rates. By H. H. Robinson. (Interstate Independent Telephone Association) 430
Northeastern Iowa Independent Telephone Association 430
Ohio Telephone Notes 431
Telephone News from the Northwest 431
Indiana Telephone Items 431
Southern Telephone Developments 431
Pacific States Telephone Company's Extensions 431
American Bell Output 431
General Telephone News 431
Electric Variable-speed Control. Part III. (Discussions at Meetings of the American Institute of Electrical Engineers.) 432, 433
Municipal Street Railway in Canada 433

DEPARTMENTS.

Correspondence 434, 435
New York Notes 434
Canadian Intelligence 434
New England News 434
Southern Developments 434
From the Buckeye State 434, 435
Detroit, Michigan 435
Information from Indiana 435
Northwestern Notations 435
Personal 435
Electric Lighting 435, 436
Electric Railways 436
Publications 436
Space Telegraphy 436
Miscellaneous 436
Trade News 436, 437
Business 437
Illustrated Electrical Patent Record 437, 438

DATE AHEAD.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

SIR WILLIAM PREECE, who is nothing if not dogmatic, delivered a presidential address on "The Science of Business" before the Society of Arts in London recently, in which he made some rather interesting observations on electrical industries. He said that the relations between capital, revenue, expenditure and profit of any business might be graphically indicated by logarithmic curves. In the central-station industry fresh developments had pointed out new sources of income. Fresh markets were opening out in electrochemistry, heat and power. Power and automobiles were "a potentiality of wealth beyond the dreams of avarice," and certainly beyond the scope of the mathematician. As to railroad operation, the speaker was no believer in the conception that electricity was to be the panacea for every evil. There was no sign of their being able to work main lines economically by electric traction. When, however, a line worked by steam was congested, and they could get no more trains through, then electric traction came in to increase the speed of running, to enlarge the carrying capacity of the line and to reduce the working expenses.

Sir William's remarks on the British telephone situation were more convincing. The telephone business of the country, he said, defied diagrammatic analysis. It had had a curse upon it from its first introduction. It was now in a state of chaotic confusion, and had been the shuttlecock of politicians and the football of local authorities. The attempt to force it on the municipalities was likely to prove a failure. In concluding, the speaker reiterated the familiar assertion that the value of scrapping—using the word, of course, in a technical, not in a pugilistic sense—was not understood in England and that the retardation of commercial progress in the United Kingdom was not due so much to want of scientific education in the men as in the masters. Except in the vigorous views on the telephone industry, there is nothing startling in the address, but the summary is of value as giving the views of a veteran electrical man of very positive convictions and long experience.

INDEPENDENT telephone men in Illinois, Wisconsin Indiana and Michigan, and indeed throughout the West, will be greatly interested in a resolution recently introduced in the Chicago City Council by Alderman Dixon. This measure seems to have for its object the providing of means whereby the surrounding Independent telephone companies may gain toll-line connection with Chicago. There is an opposition telephone company in this city, the United Telegraph, Telephone and Electric Company, operating under a liberal franchise granted by the old town of Hyde Park, which now constitutes the southeastern portion of the city. But, unfortunately for the Independents, this company has no authority by which it can use the streets north of Thirty-ninth Street and thus gain access to the downtown business district and the North and West Sides. The United company has endeavored to have its franchise broadened to cover the whole city, but so far without success. The Dixon resolution, if adopted, will permit the installation of a telephone cable in the underground ducts controlled by the city from the territory of the Hyde Park company to some convenient point downtown, where a toll station could be placed. By this means the Independent long-distance companies in Illinois and adjoining states, by co-operating with the United company of Chicago, could gain that access to the center of Chicago which they have so long and earnestly desired. The Illinois Telephone and Telegraph Company has a franchise permitting it to use the streets for telephone service, in opposition to the Chicago Telephone Company, throughout all the territory of Chicago. It has an elaborate system of tunnels under the central business district well advanced toward completion and promises to have an exchange in operation next spring. It will be some time, however, before its operations extend to the city limits in any direction, while the cable proposed in the Dixon resolution would satisfy the immediate demand of the Independents. Then, too, the relations of the Illinois company to what may be regarded as the regular or older Independent telephone movement are involved in some doubt, so that the outside Independent companies, like the New Long-distance Telephone Company of Indianapolis, for instance, may prefer to secure entrance into Chicago through the territory of the United company. Meanwhile, the Bell companies are doing the long-distance telephone business of Chicago, and as there is no way of foretelling the fate of the Dixon resolution, they may continue to do so indefinitely. The existence of three telephone-exchange companies in this city complicates the situation, and the action of the aldermen will be awaited with great interest.

THE first of what is expected to be a long series of annual conventions of the Interstate Independent Telephone Association was held in the Auditorium this week and proved to be a worthy gathering of the Independent telephone men of the West. About 700 persons were drawn together by the meeting and considerable business of importance was transacted. A full report of the three days' proceedings, with some of the papers presented (others being reserved for future publication), a portrait and sketch of the new president, a group picture of the delegates and many pictures and descriptive notes of the varied exhibits, is given in this issue of the Western Electriican. We believe that our telephone readers—and indeed all interested in electrical advancement, in which telephony plays such a conspicuous part—will appreciate our efforts to publish a complete, accurate and illustrated report of this important convention in the current issue, which is out before the last of the out-of-town delegates have left the city. Those who are familiar with the manifold difficulties that lie in the path of those who undertake work of this character, in which the quick and intelligent co-operation of writers, printers, photographers and engravers must be secured, will understand the magnitude of the task.

The association, at its first regular meeting (the convention of last spring being mainly for organization), naturally devoted its attention principally to topics of most immediate importance to the Independents, such as interchange with the Bell companies, use of Bell apparatus, Independent telephone securities as an investment, and the general subject of toll-line extension. Later it may be expected that subjects of greater technical interest may be taken up. A step in the right direction was the decision to establish a question-box, to be a feature of the next convention. Mr. Hull, the new president, is a man of substance and well-considered judgment, and under his direction the new association during the coming year and at its next meeting should show consistent improvement.

As readers of recent issues of the Western Electrician are aware, the design and construction of electric furnaces is a subject to which many electricians and electrometallurgists are now devoting their attention. Electric furnaces are built for a variety of purposes, one of the most interesting being the reduction of iron ores. In Europe the Keller process, which is now being used at Kerousse in France, is attracting attention. The first satisfactory results obtained by Keller in the reduction of iron ores were in 1899, when he used a "double-electrode" furnace. In this type there are two vertical electrodes which are inserted in the material to be fused, and around each electrode is formed a portion of melted matter. The two melted portions are put in series by the fused or heated matter, and the current thus enters the furnace by one electrode, traverses the whole mass and goes out at the other. Each electrode is regulated separately, and this system allows the heating power of each one to be increased at the expense of the other. At present Mr. Keller is using an electric furnace of a more elaborate construction which embodies the above principles. It consists of a reducing chamber of the blast-furnace type, from which the melted metal flows to a second chamber, where the operation is completed. The upper furnace has two sets of double electrodes, each pair being connected in parallel and the two groups in series. These electrodes are placed in a chamber with refractory walls which is surmounted by a masonry chimney containing the ore mixture. The metal reduced in this chamber flows out by an orifice into a second electric furnace where the remelting and refining takes place. This is a flat chamber containing the hearth which is provided with a concave cover. The two electrodes pass down through openings in the cover to the surface of the metal and are raised and lowered by a mechanical device or by hand. At the present time a series of experiments with the Keller system is in progress, and it is expected to use the process on a large scale for the production of steel. It seems that a ton of steel can be obtained at a cost of $18. The system is especially applicable where fuel is dear and where hydraulic power can be used.

Two New Submarine Inventions.

An Italian inventor, Mr. Pino, has suddenly forced his way into prominence through the medium of his original ideas in submarine work. Mr. Pino has invented, says Dr. Carlo Iberti, in the Contemporary Review for November, apparatus which promises to make him almost as famous as William Marconi. Mr. Pino's two most noteworthy inventions are his submarine boat and his hydroscope, the latter being probably the more important of the two. This new submarine boat is constructed for a purpose directly opposite to that of the commonly known submarine; i. e., to save rather than to destroy. The following interesting facts, taken from Dr. Iberti's account, give something of an idea of the design of this boat, which is only a trifle over nine feet in diameter:

The boat is to perform every kind of operation for the salvage or recoverey of sunken ships or objects with great ease; has been tested to a depth of 490 feet and has descended to the bottom of the sea at least 140 times; works successfully at a depth of 400 feet; is capable of protecting two workmen at the bottom of the sea during a period of 12 hours without once bringing them to the surface for air; ascends or descends at will at a speed of approximately 11 feet a second, being set in motion or stopped instantaneously; stops and remains perfectly immovable at any depth in perfect equilibrium, and for any length of time; travels on the sea bed on an ingenious single wheel, being driven ahead or backward by means of an electrically driven screw.

As remarkable as the above invention is, it does not equal Mr. Pino's other invention called the hydroscope. By use of the latter it is said that a person is enabled to accomplish the following: To see clearly and distinctly any object in the water down to the bed of the sea and practically at any depth; to take clear photographs of whatever he perceives there; to recover anything he likes, however large and heavy it may be, and at whatever depth it may lie. And all these three operations will be performed while standing in an ordinary small boat on the surface of the sea.

"A private experiment was made some days ago in the Mediterranean Sea, only one person being present," says the enthusiastic author of the article referred to. "The result was simply incredible; a large volume of water, covering an area of sea bed of 1,625 yards, perimeter, was so brilliantly illuminated that all the objects moving in this body of water, or lying on the illuminated sea bed, were clearly and distinctly seen. The hydroscope with which this experiment was made was a very small and cheap one."

Engine Builders Meet.

The regular annual meeting of the Engine Builders' Association of the United States was held in New York on December 1st and 2d. A number of interesting papers were read and considerable profitable discussion was entered into by the members. All papers were read at the first day's session, which was open to the public. The second day's meeting was behind closed doors. The latter session was taken up by matters relating entirely and solely to the successful management of engine-building establishments. The following-named officers were elected for the ensuing year: President, William M. Taylor of Chandler & Taylor, Indianapolis, Ind.; vice-president, C. A. Gates of the Russell Engine Company, Massillon, Ohio; secretary, F. P. Ide, A. L. Ide & Sons, Springfield, Ill.; treasurer, C. S. Bonsall, Buckeye Engine Company, Salem, Ohio. On the evening of December 2d, the annual banquet of the association was held at Sherry's on Fifth Avenue.

The following-named were among those in attendance: D. N. McBrier, Ball Engine Company, Erie, Pa.; Charles R. Vincent, M. N. McLarren, G. S. Smith and Thomas C. Wood, Ball & Wood Company, New York; C. S. Bonsall and S. B. Richards, Buckeye Engine Company, Salem, Ohio; D. W. Robb, Robb Engineering Company, Amherst, N. S.; C. A. Gates, Russell Engine Company, Massillon, Ohio; John E. Sweet, Straight Line Engine Company, Syracuse, N. Y.; S. F. Bagg, Watertown Engine Company, Watertown, N. Y.; Walter S. Kerr, Westinghouse, Church, Kerr & Co., New York; F. P. Ide, A. L. Ide & Sons, Springfield, Ill.; J. L. Lyle, Buffalo Forge Company, Buffalo, N. Y.; John Simons, New York Safety Steam Power Company, New York.

Large Gas Engine for the St. Louis Exposition.

A cablegram has just been received by the department of machinery of the St. Louis Exposition, conveying an offer from A. Borsig, the Berlin manufacturer, of a 1,000-horsepower gas engine for the "exhibitors' power plant," from which power will be distributed for the use of exhibitors. In connection with this engine, the Berlin Pintsch Company will install a gas generator, and the combination will represent a high type of development in this phase of power generation. The A. Borsig Corporation received two grands prix at the Paris Exposition of 1900.

American Roentgen Ray Society.

The third annual meeting of the American Roentgen Ray Society was held at the Sherman House, in Chicago, on December 9th, 10th and 11th. The first day of the convention was given over to a meeting of the executive committee. On Wednesday morning, December 10th, the first general session was called to order at 9:30 a. m., by President G. P. Girdwood, M. D. About 200 persons were present. After the opening business of the society was finished, the following-named papers were read and discussed: "X-Ray Physics," by T. Proctor Hall, M. D., Chicago; "Equal Potential Surfaces in X-Ray Field," by John C. Pitkin, M. D., Buffalo, N. Y. Dr. Pitkin's paper was the source of much interesting and instructive discussion, which was entered into by Drs. Hall, Burdick, Boggs, Cleavern and others.

p. m., and was opened with the president's annual address. At the conclusion of the address mittee of arrangements will be appointed by the papers were submitted, as follows: "Systematic Records" and "The Routine Use of X-rays," by M. J. Wilbert of Philadelphia; "Skiagraphy as an Art," by J. Rudis Jicinsky, M. D., of Cedar Rapids, Iowa; "Results and Technique in Treating Epithelioma with X-rays," by Emil H. Grubbe, Chicago. Discussion followed each paper. An evening session was called to order at 8 p. m., at which Dr. John B. Murphy of Chicago, read a paper on "The Roentgen Ray as a Therapeutic Force, from a Clinical Standpoint, with Illustrative Cases." Dr. Murphy's paper brought out considerable discussion on the clinical use of the X-ray and its success in surgery. A paper on the "Treatment of Three Cases of Cancer, One Case of Tuberculosis and Seven Cases of Rodent Ulcer and Lupus," was then delivered by Dr. G. P. Girdwood. Dr. Girdwood dealt with the practical application of the X-ray to certain specified cases and gave results actually obtained. "The Technique of Treatment of Malignant Growths" was next presented by Dr. J. N. Scott of Kansas City, Mo. This paper likewise elicited much valuable discussion.

General business, including the reports of committees and the election of officers opened the Thursday morning session. The following-named officers were elected: President, Arthur W. Goodspeed, Ph. D., Philadelphia; vice-presidents, John B. Murphy, M. D., Chicago, and William Gordon Taylor, Cincinnati, Ohio; secretary, James B. Bullitt, M. D., Louisville, Ky.; treasurer, Weston A. Price, D. D. S., Cleveland, Ohio. Only one new member was elected to the executive committee, the other two holding over for one and two years, respectively, in the order given below, the full term of office being three years. The committee now includes James P. Marsh, M. D., Troy, N. Y.; Walter W. Johnson, M. D., Rochester, N. Y., and P. R. Campbell. The committee of arrangements will be appointed by the chair.

After the election of officers the papers of the morning were read and discussed as follows, each paper being discussed with the same spirit that had characterized the previous ones: "Radio-therapy in Pulmonary Tuberculosis," by Gordon G. Burdick, M. D., Chicago; "X-ray Treatment in Intra-abdominal and Other Deeply Located Malignant Growths," by Clarence E. Skinner, M. D., New Haven, Conn.

"Diagnosis of Calculi by X-rays," by Russell H. Boggs, M. D., Pittsburg, was the first paper read at the Thursday afternoon session, which was attended by the same enthusiastic listeners. Then came "The Technique of X-ray Therapy," by H. Preston Pratt, M. D., Chicago, and "Result of Treatment of Guinea Pigs Affected with Tuberculosis, by High Frequency Currents," by G. P. Girdwood, M. D., and C. Higgins, D. V. S. The above three papers were received with interest and discussed thoroughly. The discussions throughout the entire convention were valuable and the papers read of an exceptionally good quality. This afternoon session completed a most successful convention. In point of attendance, expectations were far exceeded, there being nearly 200 members present and at least twice that number of interested non-members. About 100 new members were enrolled during the convention, which is a large number, considering the fact that the society is only three years old.

The ladies' ordinary of the hotel, situated on the second floor convenient to the session hall, was occupied by exhibitors of X-ray and surgical instruments. The exhibits were large and very interesting. Every form, size and style of static machine was in evidence, and all in operation. Crookes tubes for all X-ray purposes were on exhibition and were operated at the request of the spectator. A full line of Betz surgical instruments were shown in a very artistic manner, being mounted on an octagonal case set horizontally, which could be revolved to bring any one of the sides under inspection. The exhibition room was continually crowded and the exhibits were examined with almost as much interest by the Chicago general public as by the visitors. Among those who had exhibits may be mentioned the following: R. Friedlander & Co., Chicago; C. F. Birtman Company, Chicago; Scheidel & Co., Chicago; Truax, Greene & Co., Chicago; N. O. Nelson & Co., Chicago; American X-ray Company, Philadelphia; R. V. Wagner & Co., Chicago.

A register was provided for the delegates, and among those whose names appeared upon it were the following: Dr. G. P. Girdwood, Montreal, Can.; Dr. J. H. Cleavern, Council Bluffs, Iowa; Dr. O. E. Dromley, Anderson, Ind.; J. W. Adair, Marion, Ohio; L. T. Lowder, Bloomington, Ind.; P. M. Hickey, Detroit, Mich.; M. S. Inglis, Winnipeg, Man.; Allen Salter, Lena, Ill.; W. C. Abaly, Madison, Wis.; W. E. Washburn, Kewanee, Ill.; H. W. Dacheter, Toledo, Ohio; L. D. Hickman, Princeton, Ill.; W. W. Milligan, Burlington, Iowa; A. L. Chatterton, New York; T. E. Williams, Eau Claire, Wis.; H. T. Harr, Ft. Smith, Ark.; A. S. Plummer, Peoria, Ill.; H. H. Cook, Detroit, Mich.; W. J. Taylor, Cincinati, Ohio; J. M. Thorne, Pittsburg, Pa.; John McMasters, Toronto, Ont.; E. F. Root, Salt Lake City, Utah; Dr. C. E. Skinner, New Haven, Conn.; J. V. Schofield, Greenburg, Ind.; James E. Marsh, C. N. Bibbins, Watertown, N. Y.; E. H. Grubbe, Chicago; Dr. G. G. Burdick, Chicago; S. M. Keenan, Detroit, Mich.; Dr. H. E. Wait, New York; Dr. F. P. Hall, Chicago; R. F. Girdwood, Montreal, Can.; G. M. Steel, Oshkosh, Wis.; Dr. J. B. Bullitt, Louisville, Ky.; A. B. Westfall, Lafayette, Ind.; G. E. Clements, Springfield, Ill.; J. A. Johnstone, Cincinnati, Ohio; Curran Pope, Louisville, Ky.; R. D. Carman, St. Paul, Minn.; J. F. Hartz, Detroit, Mich.; E. B. Forbes, Detroit, Mich.; J. R. Pennington, Chicago; A. L. Chatterton, New York; Newton Evans, Battle Creek, Mich.; Lincoln Phillips, Cincinnati, Ohio; W. C. Borden, Washington, D. C.; J. L. Pitkin, Buffalo, N. Y.; R. H. Briggs, Pittsburg, Pa.; M. J. Wilbert, Philadelphia; J. E. Hett, Berlin, Ohio; E. D. Campbell, Flint, Mich.; R. M. Little, Dresden, Tenn.

American Association Meeting.

A general provisional programme for the winter meeting of the American Association for the Advancement of Science has been prepared. This meeting will take place at Washington, D. C., from December 27th to January 3d. The programme provides for the first general session of the association to be held at 10 a. m. on Monday, December 29th, in the Lafayette Theater. This meeting will be called to order by Professor Asaph Hall, U. S. N., the retiring president, who will introduce Dr. Ira Remsen, the president-elect. An address of welcome will be delivered, to which President Remsen will respond. The annual address of the retiring president will be delivered on Monday, December 29th, at 8 p. m. During the succeeding days of the meeting, the Council will meet each day at 9 a. m. A short general session of the association will be held at 10 a. m., and the different sections will meet each day immediately after the adjournment of the general session until 1 p. m., and again in the afternoons from 2 to 5 p. m. A public lecture will be given on Thursday evening, January 1st, at 8 p. m. on the subject, "Volcanoes of the West Indies," to be followed by the election of officers and the selection of the place of the next meeting.

National Electric Light Association.

The bound volume of proceedings of the twenty-fifth convention of the National Electric Light Association held at Cincinnati, Ohio, on May 20, 21 and 22, 1902, has just come from the press and is being distributed to the members. It contains the entire proceedings of the convention, papers read, discussions, lists of members, officers and committees and as a frontispiece an excellent likeness of the retiring president, Henry L. Doherty. An especially valuable feature of the book is that portion devoted to the question-box, taking up 162 pages. Seventy-one practical questions on a great variety of electrical topics are answered by numerous authorities. The volume contains over 700 pages and forms a reference work that should be of great value to the central-station manager. The issuing of the report calls attention to the earnest effort now making to increase the membership of the association before January 1st, when the new and higher rate of dues will go into effect. Since the Cincinnati convention 159 new active members have been added to the rolls and the list is constantly growing.

Amendments to Cuban Tariff.

The following amendments and redistributions of articles have been made in connection with the Cuban tariff: Incandescent lamps, mounted or not, have been dutiable at $2.50 per hundred. It is now provided that when they are packed in cases or barrels they shall be subject to a tare allowance of 30 per cent. and when in crates, baskets, hampers, or in any other manner, of 20 per cent. It has been provided that electrical machinery necessary for use in the manufacture of sugar, including dynamos, expressly perforated marble slabs for switchboards, ammeters, voltmeters, regulators, current cut-offs, light radiators and switchboards, shall be classified under paragraph 215, at 10 per cent ad valorem. It is expressly stipulated, however, in this new ruling that this provision shall not include arc and incandescent lights, or wire and insulating tubes. Brackets for insulators for telegraph poles or houses, of common wood, roughly painted, are rated at 60 cents per 100 kilograms, gross weight.

Interstate Independent Telephone Association.

[*Continued from page 423.*]

withdrew and selected the following members of the committee: W. Gay Jones, Columbus, Ohio; H. S. Herr, Ottumwa, Iowa; W. F. Goodrich, La Crosse, Wis.; William Robinson, Muskegon, Mich.; L. A. Frazee, Connersville, Ind.; C. E. Hull, Salem, Ill.; W. F. Hall, Clinton, Mo.; H. K. Cole, Owensboro, Ky.

Relation to Bell Companies.

A spirited discussion was then started by a motion made by B. F. Wasson of Clinton, Ill., to the effect that those companies who are using Beli transmitters and receivers be not eligible to membership in the association, the subject being in line with one of Secretary Coleman's recommendations. Charles G. Cockerell of Jefferson, Iowa, believed that the association should not countenance anybody in any way connecting with Bell companies under a contract. C. W. Sebern of Ashland, Ky., said his company had the only exchange in the town and that the large number of steel mills and other iron works located there demanded long-distance connection with New York, Chicago and other cities, and this could only be obtained over the Bell lines. He said that in his section the Bell company would enter into contract with the Independent companies for toll-line business, even if the latter connected with other Independent companies. Mr. Morrison of Bryan, Ohio, stated that whenever connection was made with the Bell lines, it destroyed the efforts for Independent growth. After more discussion by C. W. Sebern, William J. Bell and John W. Layne, the original motion was withdrawn and J. S. Bellamy of Knoxville, Iowa, moved that a committee of lawyers, if possible, be appointed by the chair from the nine states to consider the question. The Bell company was willing to take business from the Independents on almost any condition, and it was necessary to go carefully, as nothing should interfere with the building of Independent toll lines. J. B. Ware of Detroit, Mich., thought that the question was a most vital one, that two lawyers on the committee would be enough and that the remainder should be good telephone men. He suggested that the question should not be limited to the use of Bell apparatus, but should embrace the point whether the Independents were to do anv business with the Bell companies. As a substitute he moved that the whole matter of using Bell transmitters and receivers and operating over Bell lines be left to a committee representing the nine states, to report on Wednesday. A. B. Conklin of Aurora, Ill., thought that the question of connecting with Bell companies by toll lines was more vital than the use of their apparatus, and that the future welfare of the Independent companies depended on their toll systems. The association should guard those who carry their lines into Bell territory. Mr. Ware's motion was then unanimously carried and the report of the committee was made a special order for Wednesday afternoon. The chair appointed on this committee the following-named gentlemen: H. H. Robinson of Cleveland, Ohio; J. S. Bellamy of Knoxville, Iowa, William J. Bell of Baraboo, Wis., W. J. Buck of Minneapolis, Minn., J. B. Ware of Detroit, Mich., L. A. Frazee of Connersville, Ind., M. Savage of Champaign, Ill., J. W. Layne of Carthage, Mo., and A. L. Tetu of Louisville, Ky. The question brought up by O. Rex of Manchester, Ohio, as to whether a manufacturing concern that sold Independent apparatus to a company operating in opposition to an existing Independent company, should be allowed membership in the association, was referred to the same committee.

Secretary Coleman stated that he was informed that there were several Bell men present in the convention hall, and he believed the question of allowing them to attend should be acted upon. Messrs. Layne and Wasson thought no objection should be made to the attendance of Bell men at the sessions of the convention, but M. Savage of Champaign, Ill., and Dr. C. F. Bennett of Waterloo, Iowa, believed this should be a convention for the Independent men and that the Bell representatives should not be allowed to attend. On motion of A. L. Tetu it was decided not to admit to the meeting anyone unless his credentials should show that he is identified with the Independent companies' interests. A committee of three, consisting of H. K. Cole of Kentucky, O. Rex of Ohio and A. R. Conklin of Illinois, was appointed on credentials. The convention then adjourned for the day.

Wednesday Afternoon.

The session of Wednesday afternoon was called to order shortly after 1 p. m. with a large attendance. As the first business the special committee to which was referred the subject of competing Independent telephone companies in the same locality made its report, recommending the adoption of a resolution "that the association pledge its members to refuse to patronize manufacturers who sell apparatus to any Independent company entering into competition with an Independent telephone company already established and giving reasonably efficient service." Mr. Ware, secretary of the committee, who read the report, stated that his company would absolutely refuse to patronize any manufacturing company selling apparatus to competing companies. The resolution was briefly discussed by Messrs. Hutchinson, Frazee, Prewitt, Bellamy, Wasson, Presson and Himbaugh, and then it was unanimously carried.

1. Sterling Electric Company.
2. Western Telephone Manufacturing Company.
3. Farr Telephone and Construction Supply Company.
4. North Electric Company.

EXHIBITS AT THE INTERSTATE INDEPENDENT TELEPHONE CONVENTION.

The same committee, of which J. W. Layne was chairman, then presented its report on the subject of connecting with the Bell Telephone Company's lines, or the use of Bell apparatus as follows:

The success of the Independent movement thus far has depended upon, and been made possible, by the union of action and the hearty and loyal coöperation, on the part of the opposition companies in the interchanging of telephone business and in the use of apparatus made by Independent manufacturers.

The patronizing of these manufacturing institutions, competing with each other, has resulted in great improvement of telephone apparatus, in very largely reducing the cost of the same and in securing to the public such improvement in quality of service and in the lowering of rates as to lead to an increase in the number of telephones in use that can scarcely be comprehended.

To-day telephones, switchboards and other apparatus can be purchased in the open market without royalties and unexcelled and often unequaled in quality and in service results. It is conceded, by all acquainted with the telephone development during the past five years, both Independent and Bell, that, except for the patronage given Independent manufacturers, these improvements in apparatus and in service to telephone users, and the increase in the number of instruments used, would have been impossible.

Therefore we deem it for the best interests of the public and Independent companies that the competing manufacturing institutions continue to be patronized, and that any operating company or individual using Bell apparatus does that which tends to demoralize and destroy the Independent movement, and that such parties should not be admitted to membership in the national, interstate or state associations.

We believe further, that future success also depends on those who have invested, or who may hereafter invest, in Independent exchanges or lines, being insured proper connections with all other Independent exchanges and toll lines in the territory covered.

We therefore recommend that, on the operating side, only such individuals and companies who, under proper contract relation and in good faith, connect their toll lines and exchanges with other legitimate Independent companies, where opportunity offers, shall be eligible to membership in this association.

Further, we deplore individuals or companies connecting lines or exchanges with Bell licensee companies, as has been done in a few instances, in different states, as we believe that no such relation should be permitted, except, possibly, in isolated cases, which arrangement should be passed upon and authorized by the state association, if there is one, and by the executive committee of the interstate association, or the advisory board of the national association, the authority in each case to be granted only by a two-thirds vote of such state association, committee and board.

In conclusion, we urge this association, at this, its annual meeting, to adopt this report as indicating in part our willingness and determination to do that which it is believed will secure the best results, time considered, to the public and to the investor. "In union there is strength" is particularly true of our telephone business.

One gentleman said he would not be willing to submit any questions of this sort to a committee from any of the associations unless its members were not in direct competition with the Bell company. Mr. Savage said such remarks indicated that the gentleman was a Bell man, and he thought the matter could be safely left with the associations, as indicated in the resolution. Mr. Sebern stated that his company at Ashland, Ky., was Independent from the ground up, but if it could make an arrangement with Bell companies for long-distance connections and thereby keep a competing Bell exchange out of the city, he believed it was good business policy. Mr. Tetu thought that Independent companies ought to accept the Bell company's propositions for connections only up to the time that the Independents could make their own connections. The resolution was then put and carried unanimously.

Rates and Measured Service.

George N. Bandy of Des Moines, Iowa, then read his paper on "Rates—Measured Service," in which he called attention to the different rates in existence, believing that a measured service would best meet the wishes of the majority of all subscribers. A. B. Conklin of Aurora, Ill., said that the Bell company had never met the competition of a well-regulated Independent company. In paying for measured service the matter of switchboard expense should be considered, as the cost depended on the distance at which the subscriber was located from the exchange. He favored flat rates, as the disadvantage of a subwhich the subscriber was located from the exchange. was balanced by the larger number of calls sent in by the subscribers on short lines. With measured service this matter was not balanced.

Dr. H. S. Herr being unable to be present, his paper on "Sliding-scale Rates for Exchanges" was read by his daughter, Miss Herr. The paper reviewed the question of rates charged by operating companies, especially the smaller ones, and recommended a certain definite rate, which should be governed by the growth of the exchange. Miss Herr was given a vote of thanks for reading the paper. A brief discussion was given by Messrs. Presson and Glandon.

A paper on "Toll Rates" was then read by H. H. Robinson of Cleveland Ohio. Mr. Robinson's paper is given elsewhere in this issue.

St. Louis World's Fair.

Professor W. E. Goldsborough, chief of the Electrical Department of the St. Louis World's Fair, was here given the floor and briefly outlined the plans contemplated and being carried out for the exposition. He said that from 15 to 20 per cent. of all the matter used or exhibited in all the buildings would be of an electrical nature or dependent on electricity. Within the last two days he had obtained the promise of 6,000 kilowatts of electrical machinery and 1,000 arc lamps to be contributed to the exposition. Special attention is to be paid to telephone interests, there being exhibits showing the complete line of manufacture of telephone apparatus from the switchboard lamp to the completed switchboard and also exhibits showing the complete operation of telephone systems and exchanges. In behalf of the Business Men's League of St. Louis and the exposition authorities he extended an invitation to the association to hold its convention in 1904 at St. Louis. A resolution introduced by J. W. Layne that the association favor holding the annual convention of 1904 in St. Louis at such time as the executive committee may designate and that the association commend a full exhibition of telephone apparatus at the exposition was referred to a committee composed of David Prewitt of Pine Grove, Ky., and J. W. Layne of Carthage, Mo., this committee to recommend any amendment to the constitution necessary to permit the acceptance of the invitation.

Municipal and Legal Questions.

The general consideration of the subject "Restrictions by Municipal Authority, and Synopsis of the Law" was treated by a number of papers prepared by telephone operators, representative of the nine states embraced in the association. The situation in Ohio was presented in an extensive paper by W. F. Laubach of Akron, Ohio. E. W. Pickhardt of Huntingburg, Ind., discussed the situation in Indiana, and M. Savage of Champaign, Ill., that in Illinois in well-prepared papers. U. S. Alderman of Nevada, Iowa, J. C. Harper of Madison, Wis., E. E. Webster of Minneapolis, Minn., H. Linton Reeber of St. Louis, Mo., and D. L. Pendleton of Winchester, Ky., not being present to give papers for their respective states, their papers were passed and ordered printed

in the proceedings. J. B. Ware of Detroit, Mich., then spoke for Michigan. In Michigan the state owns the highways. Railroad crossings are secured from the railroad commissioners. Telephone companies have the right to trim trees in a reasonable manner, but have no right to cut down trees. The municipalities had no right to enforce the taking of franchises by the company. The Michigan (Bell) Telephone Company would not take a franchise which regulated rates, while the Independents had accepted franchises in which rates were regulated. In Michigan there was a three per cent. tax on the gross income of telephone companies, and this tax had its advantages. This tax was based on annual statements filed by the companies with the state. There were special provisions in the state law against the cutting of wires. All court decisions so far made in Michigan were favorable to the telephone companies.

After resolving to have a question box for next year's convention, which would be under the supervision of the vice-president, the session was adjourned.

Closing Session.

At the opening of the final session on Thursday morning J. W. Layne, chairman of the committee appointed on the St. Louis World's Fair resolution, made the report of the committee, which recommended that the constitution of the association be so amended as to time of meeting that the convention may meet for 1904 at the St. Louis Exposition during the month of November in conformity to the invitation given. The report and resolution were unanimously adopted.

The auditing committee, consisting of L. A. Frazee, R. Valentine and C. B. Dobie, made its report, which showed there was $128 on hand from the last convention; $160 had been received from membership since the April convention and $370 at this convention, making total receipts of $658. There was a cash balance on hand of $290.42.

William F. Hall of Clinton, Mo., suggested that a committee of one or more should be appointed to decide upon a standard of construction for city and toll-line work, to investigate companies competing with existing Independent companies and also to take some steps to prevent supply dealers from selling apparatus to farmers at the same price as to the consumers. The association should be of some use to its members, and these things were offered as a means to this end.

Toll-line Schedules.

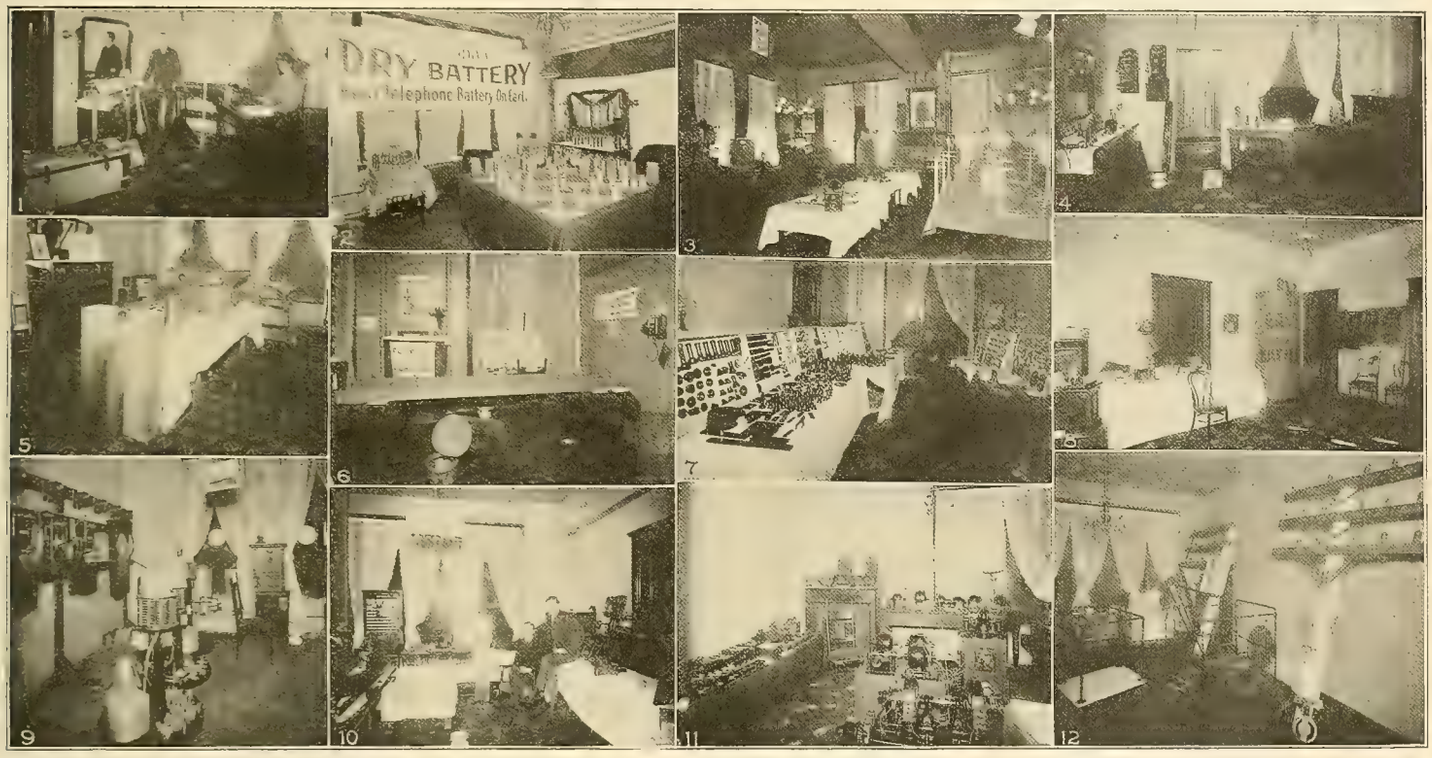
A. L. Hutchinson then read his paper on "Settlement of Toll Business Between Connecting Companies," which advocated his clearing-house idea, and will be presented in a future issue. At the conclusion of the paper, as chairman of a committee of five, appointed to submit a schedule of toll-line rates, Mr. Hutchinson presented a resolution which recommended that the executive committee of the association, with the secretary, should arrange a schedule of toll rates for connecting companies and basis for division of fees and submit the same to the several state and district associations within the Interstate territory, with a request that it be adopted and put in force, and that all Independent companies should be appraised of such schedule as soon as determined upon. The resolution was unanimously carried after a brief discussion.

Independent Telephone Securities.

In the absence of H. E. Ralston of Maitland, Mo., his paper on "Enforcement of Message-time Limit" was passed and Colonel J. D. Powers, president of the National Trust Company of Louisville, Ky., read his paper on "Independent Telephone Securities as an Investment from a Banker's Standpoint." This was a strong treatment of the subject, and on motion of Dr. H. S. Herr, it was decided to print the paper in pamphlet form for general distribution among Independent telephone companies. A rising vote of thanks was given to Colonel Powers for his able paper. C. B. Cheadle of Joliet, Ill., said this paper was just what was greatly needed by the Independents, and he would order 1,000 copies in advance.

The second paper on this general subject, entitled "Independent Telephone Securities as an Investment from a Small Investor's Standpoint," was presented after brief prefatory remarks by J. W. Layne of Carthage, Mo. A vote of thanks was extended to Mr. Layne for his able paper.

A long and interesting presentation of "The Berliner Patent, Bell's Claims of Infringement and Litigation Now Pending" was next given by J. J. Nate



1. W. H. Anderson & Sons.
2. Nungesser Electric Battery Company.
3. American Electric Fuse Company, Swedish-American Telephone Company, Illinois Electric Specialty Company and Raber & Watson.
4. Eureka Electric Company.
5. H. B. Camp Company.
6. Standard Pole and Tie Company.
7. Electrose Manufacturing Company.
8. Electric Appliance Company and Warner Electric Company.
9. Mountain State Electrical Company.
10. Central Telephone and Electric Company and Controller Company of America.
11. Holtzer-Cabot Electric Company.
12. F. Bissell Company.

EXHIBITS AT THE INTERSTATE INDEPENDENT TELEPHONE CONVENTION.

Concluding Business.

A resolution was then offered by C. B. Dobie and carried by the convention, that all supplies should be purchased from manufacturers and supply houses not affiliated with the Bell company.

R. B. Watrous, secretary of the Citizens' Business League of Milwaukee, presented an invitation to the association to hold its convention for 1903 in Milwaukee. The selection of the meeting place was left in the hands of the officers and executive board.

Resolutions of thanks were then passed to the manufacturers and supply dealers for their generous entertainment, to Colonel J. D. Powers for his able and valuable paper, to the Illinois Telephone and Telegraph Company for courtesies shown in taking the members through its tunnels, to the secretary and other officers for their efficient work and to the St. Louis World's Fair officials for its invitation to visit the exposition.

An attempt was made to reconsider the passing of the resolution about purchase of supplies from dealers selling to companies installed in opposition to existing Independent companies, but was lost.

Election of Officers.

The nominating committee, through its secretary, H. K. Cole, then made its report, which was unanimously adopted, electing the following-named gentlemen as officers for the ensuing year:

President—C. E. Hull, Salem, Ill.
Vice-president—L. A. Frazee, Connersville, Ind.
Secretary—E. M. Coleman, Louisville, Ky.
Treasurer—J. W. Layne, Carthage, Mo.

The following selections were then made by the delegates from the different states of members for the executive board:

Ohio—W. Guy Jones of Columbus.
Iowa—H. S. Herr of Ottumwa.
Wisconsin—A. L. Hutchinson of Weyauwega.
Minnesota—E. H. Moulton of Minneapolis.
Michigan—J. B. Ware of Detroit.
Illinois—A. B. Conklin of Aurora.
Missouri—W. F. Hall of Clinton.
Kentucky—David Prewitt of Winchester.
Indiana—O. Rex of North Manchester.

After adjournment a group picture was taken of the delegates and visitors on the steps of the Art Institute.

The Banquet.

The banquet at the Auditorium on Thursday evening was a great success. Many ladies were present and the total number in attendance was estimated at 600. James E. Keelyn of Chicago made the opening address and then turned the assemblage over to ex-President H. C. Raney of Fairfield, Iowa, who acted as toastmaster. Toasts were responded to as follows: "Illinois," M. Savage of Champaign, Ill.; "A Better Feeling," Frank Jones of Chicago; "The Telephone Press," H. B. McMeal of Chicago; "Ohio," H. H. Robinson of Cleveland; "Missouri," J. W. Layne of Carthage, Mo.; "The Ladies," Frank L. Perry of Chicago; "The Lawyer in the Telephone Business," F. W. Pringle of Chicago; "Poles," Edward A. Lindsley of Menominee, Mich.; "Kentucky," Colonel J. D. Powers of Louisville; "Supply Houses," J. A. Bennett; "Early Reminiscences," J. J. Nate; "The Out-of-town Telephone Manufacturer," John McHugh of Lafayette, Ind. Thomas R. Mercein of Milwaukee, James Wolff of Chicago and E. M. Coleman of Louisville also made speeches.

Convention Notes and Exhibits.

Charles Austin Rolfe, designer of sneak-current arresters, was in daily attendance.

The American Electrical Works were very adequately represented by Messrs. Donohoe and Hammond.

Mr. Meissner of the Acme Electric Company, Chicago, was in evidence on the first day of the convention.

Carl Seyler did the honors for Hubbard & Co. of Pittsburg, manufacturers of telephone-construction material.

George M. Mayer of Chicago, manufacturer of the Mayer telephone drop, mingled with the delegates and visitors.

The Central Electric Company, Chicago, made no attempt at an exhibit, but "Central" representatives, as usual, did their duty.

The John A. Roebling's Sons Company had its usual staff of representatives, among whom were

George C. Bailey, W. P. Bowman, A. B. Conover, R. B. Abbott, H. C. Griffin and William H. Slingluff.

The Universal Telephone Receiver Company appeared at the convention in the persons of H. A. Mason and H. E. Soesbe.

The Automatic Electric Company of Chicago told an interesting story of automatics. J. F. Crook and S. F. Harris were in attendance.

A. P. Hopkins & Co., Escanaba, Mich., whose name is familiar to almost every user of cedar poles, were represented at the convention.

Secretary and Treasurer Henry Tideman, of the Menominee Electric Manufacturing Company of Menominee, Mich., arrived on Wednesday.

Okonite is always in evidence at every convention, and this time that well-known wire appeared in the person of its sponsor, Geo. T. Manson.

G. W. Conover, the popular purchasing agent for Independent telephone companies of Chicago, was one of the prominent figures at the convention.

Western Agent E. M. Deems had charge of the

INTERNATIONAL TELEPHONE MANUFACTURING COMPANY S EXHIBITS.

Gordon Battery Company's exhibit, which consisted of samples of the various sizes of Gordon cells.

B. F. Vreeland came all the way from Denver to acquaint telephone managers with the quality of the cedar poles and cross-arms, etc., which he handles.

The American Steel and Wire Company was represented by C. S. Knight, Jr., manager of the electrical department, George Chandler and H. K. Sheppard.

F. B. Patten of the Illinois Electric Specialty Company, assisted by the handsomest of his specialties, did most excellent work advertising his institution.

Chicago Insulated Wire and the ubiquitous W. M. Smith are one, and the combination, of course, appeared at the telephone convention at the Auditorium.

The Wittenberg Cedar Company of Wittenberg, Wis., took advantage of the occasion to impress telephone-exchange managers with the merits of its cedar poles.

President C. H. Worcester of the C. H. Worcester Company, Marinette, took occasion, in his usual genial way, to talk Worcester cedar poles to exchange managers.

The Harloe Insulator Company, manufacturer of self-tying insulators, was one of the concerns to make its initial bow at the Auditorium. The Harloe Company's factory is at Hawley, Pa.

The American Electric Fuse Company made a very interesting exhibit of its line of specialties. Mr. Jones covered himself with glory at the banquet by making one of the best speeches of the evening.

A. T. Naugle of the E. E. Naugle Tie Company, Chicago, managed to find time to attend the convention. The Naugle company supplies many of the largest telephone companies with poles.

Mr. Hipwell came on from Allegheny to do the honors for the Hipwell Manufacturing Company. The Hipwell company has now an office in Chicago, which has of late been doing a most excellent business.

C. H. Huebel of the C. J. Huebel Company of Menominee, Mich., producer and wholesaler of white-cedar poles, took advantage of the convention to increase his acquaintance with the telephone managers.

"Wiped joints" was again the subject of an interesting exhibit on the part of the New Haven Novelty Machine Company of New Haven, Conn. H. Grant Thompson and Chas. Luke represented this company.

The Allen-Hussey Company's exhibit, in charge of Frank Heffron, showed what could be done in the matter of building superior interior telephones. The Allen company's duplex desk-telephone bracket won many friends.

The list of exhibitors with their room numbers, printed in the Western Electrician last week, was posted at the door of the elevator in the Auditorium and served greatly to help strangers in finding the various displays.

The Central Telephone and Electric Company of St. Louis was represented by President James S. Cuming, Vice-president C. H. Wallis and J. J. Joys, Chicago agent. The company had a neat exhibit of its various products and received many congratulations for its good showing.

Arthur F. Stanley, the eastern manufacturers' agent that now makes a specialty of exploiting goods for western manufacturers, strolled in from his Broadway-Maiden Lane office and mingled with the convention people.

Much interest was taken in the pole anchor shown by the Miller Anchor Company of Norwalk, Ohio. G. H. Miller, proprietor of the company, had on exhibition the various styles of anchors and augers manufactured by the company.

D. M. Fulmer, president of the D. M. Fulmer Lumber Company, whose headquarters are now in Chicago, took advantage of the convention to renew the acquaintance with his many customers among the Independent telephone fraternity.

W. J. Barr of Cleveland, who claims to be the original and only manufacturer of transmitter arms, made an interesting exhibit of the various styles of arms which he manufactures. Mr. Barr's Chicago agent, James E. Bayliss, was also in attendance.

The American Carbon and Battery Company of St. Louis appeared early Monday morning in the persons of President Henry Wrape and T. P. Gleeson. The American Carbon and Battery Company is now pushing a line of carbon specialties for telephones.

The Holtzer-Cabot Company made an interesting exhibit of motor-generators, ringing machines, hand generators, magneto bells, intercommunicating telephones, etc. E. R. Harding was assisted by C. W. Holtzer, T. Meinema, T. R. Hodgson and W. A. Wolfgrain.

Manager Procunier of the Moon Manufacturing Company made no attempt at an exhibit, but the delegates were made welcome at the Moon Manufacturing Company's factory on Canal street. The Moon telephonic specialties are well known throughout the West.

The Warner Electric Company of Muncie, Ind., always takes advantage of telephone gatherings to impress the fraternity with the merits of the Warner switchboard power generator. The company had a neat exhibit at the convention, which was in charge of Mr. Warner.

The W. G. Nagel Company of Toledo, Ohio, presented an exhibit in charge of H. E. Adams. The Nagel display consisted of a line of "ready" telephone specialties, among which were the ready payout reels, pole seats, balconies, cable cars, cable trolleys and duct roads.

The Chicago Die and Electric Company, manufacturer of Maxstadt fuses and other telephonic specialties, made no attempt at an exhibit at the Auditorium. A most cordial invitation, however, was extended to the telephone men to call at the company's Chicago works.

H. W. Reade of the Pittsburg and Lake Superior Iron Company, Escanaba, Mich., producer of cedar poles, was among the prominent pole men at the convention. Mr. Reade states that his company is doing a larger pole business than ever before in the history of the company.

The National Autophone Company made a most interesting exhibit. The president of the company is Samuel Insull, with C. H. Wilmerding as secretary. The autophone is a device to distribute service and the present exploitation by the National Company is full of interesting points.

Western Agent Chas. L. Hibbard of the Varley Duplex Magnet Company was in constant attendance during the convention. Mr. Hibbard has worked up since his connection with the Varley Company, a fine business with the various telephone manufacturers through the country.

Roth Bros. & Co. of Chicago were represented by C. H. Roth and G. A. Roth. This concern has supplied many of the leading telephone companies with its electrical machinery for telephone purposes and received many words of praise from customers at the convention for the excellence of its product.

"A Few Facts About Storage Batteries," was the title of an interesting pamphlet distributed by the Electric Storage Battery Company, as a reminder of the large number of central-energy storage-battery equipments that owe their existence to the excellence of Chloride accumulators. G. H. Atkin represented the company.

E. B. Seeley of Couch & Seeley, Boston, appeared on Tuesday. As a bit of news from J. Allen Haines, it may be mentioned that the Haines & Noyes Company of Chicago has just been affiliated with the Couch & Seeley Company, and from now on Haines & Noyes will act as the western department for the Couch & Seeley Company.

Western Manager James Wolff of the New York Insulated Wire Company, which institution is now making a specialty of manufacturing receiver shells in addition to its extensive wire business, as usual, distinguished himself through his high qualification as a member of the entertainment committee. Mr. Wolff was most prominent in this gathering of telephone people and his work will long be remembered by those that are in a position to understand what is required of one in his position. The matters of entertainment went off without a hitch, and Mr. Wolff's successful efforts were greatly appreciated.

The Manhattan Electrical Supply Company was, as usual, strongly represented in the person of Western Manager F. M. Pierce. The Manhattan Electrical Supply Company is holding a large trade, particularly with the Independents, but in this case made no exhibit, further than an invitation to delegates to visit its emporium in Chicago.

The Standard Underground Cable Company was represented by P. H. W. Smith and A. A. Anderson of Pittsburg, and J. R. Wiley, E. J. Pietzcker, and W. M. Rogers of Chicago. It had a handsome show of samples in Parlor 134. The company's new copper wire mill is now running in full blast, and samples of copper telephone wire were shown.

The Electrose Manufacturing Company, in the persons of Vice-President Jos. Steinberger and Western Agent H. E. Cobb of Chicago, did the honors of their company and exhibited a vast number of telephonic forms, showing the applicability of Electrose and Marbloid in telephonic equipment. Electrose receiver shells are popular specialties.

The only Kirkpatrick of the McRoy company, as usual, did himself proud. It is a difficult matter to display conduits at telephone conventions, and this time, as has been customary, Mr. Kirkpatrick contented himself with reminding the people that the McRoy conduit may be found underground in practically every city of any size in the United States.

Of course the irreproachable Barnard of the Standard Vitrified Conduit Company, New York, was in attendance. Mr. Barnard is a man possessed of a host of friends in Independent telephone circles, and the present successful position of his institution with underground people is due largely to his enterprise and tact in the exploiture of "Standard Vitrified."

John H. Fowler, Chicago, the popular cedar-pole man, was everywhere in evidence at the convention. Mr. Fowler's business with the Independent telephone companies has grown wonderfully, and, as a consequence, he met many customers at the meeting. Mr. Fowler has lately shipped 40 cars of poles to one of the leading Kansas Independent telephone companies.

One of the most unique exhibits at the convention was that of Raber & Watson, the cedar-pole producers of Chicago. The exhibit consisted of a miniature cedar-pole railway, which was constantly

AMERICAN ELECTRIC TELEPHONE COMPANY'S EXHIBIT.

in operation hauling cars of miniature poles. A miniature telephone line enclosed the railway track. The exhibit was in charge of A. D. Watson, assisted by M. E. Brown.

A new coin-controller, for combating "dead-head" calls, attracted much attention. This was exhibited by the Controller Company of America, whose headquarters are in St. Louis. With the use of this device it is impossible to lift the receiver from the hook without depositing the coin. The device refunds the coin upon failure to get party called. The exhibit was in charge of George L. Mosell.

The Chicago Pay Station Company was represented by J. C. Finch, manager, and G. H. Morgenstein, sales manager. In addition to the fine line of coin collectors, this company took the opportunity to bring before the telephone consumers a fine time stamp to be used for recording trouble complaints, timing correspondence, etc. A new type of pole and pay counter was also shown.

The Maltby Lumber Company of Bay City, Mich., was an exhibitor. I. A. Maltby interested many of the telephone-exchange managers in the company's products. Photographs of the Maltby pole and tie yards, as well as illustrations of some of the company's large shipments, were shown. The Maltby

company's business with the Independent telephone companies has shown a gratifying increase. Manager A. Maltby arrived on the second day of the convention.

As a recompense to the manufacturers and supply dealers who had been so energetic and generous in providing entertainment for the delegates, two half days of the programme were devoted exclusively to the examination of the many exhibits shown in the rooms of the Auditorium Hotel. No session of the convention was held at these times, and the arrangement was regarded as a very satisfactory one by all.

President I. J. Kusel was, as usual, to the front with Eureka apparatus. Mr. Kusel was assisted during convention hours at the Auditorium by H. Kusel, D. L. Canman and H. Rosenow. These gentlemen exhibited and explained the Eureka Electric Company's transmitters, receivers and generators. A small Eureka central-energy, multiple-type switchboard was also shown, which excited considerable comment.

Western Manager E. L. Draffen of the Gould Storage Battery Company made an interesting exhibit of the Gould Storage Battery plates in one of the parlors on the sixth floor of the Auditorium. The Gould Company has a storage battery eminently suitable for the needs of telephone people and Mr. Draffer is now making a strenuous campaign, pushing this battery still further throughout the telephonic field.

The H. B. Camp Company's exhibit was in charge of J. A. Hammett, and consisted of a full line of samples of conduit. Sections of vitrified-clay conduit, from single-way duct to nine-way duct, were shown in their various forms. The exhibit attracted much attention, and especial interest was taken in the samples of nine-way conduit. The company states that it is the only concern manufacturing nine-way conduits.

George L. Moselle, installing superintendent of the Controller Company of America, of St. Louis, Mo., made an interesting exhibit of his company's automatic pay station and controller. The peculiarity of this controller is that it is unlocked from a distance and automatically by a subscriber's call, the money being returned to the waiting subscriber if the correct connection is not given. These devices are not sold, but leased to exchanges.

Between 450 and 500 of the delegates and visitors enjoyed a trip through the tunnels of the Illinois Telephone and Telegraph Company on Wednesday afternoon. The party, which was under the guidance of J. F. Crook of the Automatic Electric Company and S. F. Harris of the Illinois Telephone and Telegraph Company, entered the tunnels at 334 Franklin Street and left at State and Lake Streets, making a trip of about 1¼ miles.

W. H. Anderson & Sons of Detroit, Mich., showed one of their cable-reel jacks, used to support reels of underground cable, as well as other telephone-construction tools. Their souvenir took the form of a bronze button, illustrating three of the tools

CHICAGO PAY STATION COMPANY'S EXHIBIT.

they are manufacturing. W. R. Anderson, secretary and treasurer of the firm, was in attendance in Room 640, where the exhibit was located. Mr. Anderson's stenographer gave her services free to all who had letters to write.

President Jos. C. Belden of the Belden Manufacturing Company, Chicago, appeared on Wednesday. Mr. Belden is already manufacturing wire at his new plant, but owing to the fact of having some patents underway the output for a few weeks will be more or less limited. Facilities, however, are being rapidly added and it will not be long before the company is running full blast, manufacturing windings, all sorts of magnets and other goods suitable for telephonic adaptation.

The Stromberg-Carlson Telephone Manufacturing Company's representatives were: William Bowen, R. B. Tyler, A. J. Rousseau, J. J. Nate, Paul D. Meyers, E. L. Brown, G. H. Pierce, Mr. Hewitt, A. B. Smith, E. C. Lewis and F. L. Martin. The company had its headquarters in Room 136 and there the above-mentioned gentlemen held forth night and day during the convention. Owing to the company's large factory being so near at hand no effort was made to present an exhibit at the Auditorium. A most interesting display, however, was made at the Stromberg-Carlson factory, the offices being decorated with palms and cut flowers and a reception committee being in constant attendance to take Independent convention visitors through the extensive plant. Two buses were kept running, making half-hourly trips to the factory.

The Calculagraph Company of New York was represented by its president, Henry Abbott, H. C. Wilson and W. C. Garrison. The company exhibited its well-known calculagraph, which is used in about 1,200 of the prominent telephone exchanges. The calculagraph is a device which automatically shows the elapsed time consumed in talking over the telephone, and is, of course, largely used in toll service. The company's three types of instruments for telephone service were also shown.

Among those in attendance at the convention was Fred L. Merritt, secretary and treasurer of the Standard Pole and Tie Company of New York. The company had an attractive exhibit, consisting of Florida heart-pine cross-arms, manufactured at the company's own mills at Brooksville, Fla.; also samples of southern white-cedar or juniper poles. The Standard company distributed a neat souvenir, consisting of an octagonal penholder, a facsimile of Standard octagonal poles. Mr. Merritt was assisted by W. E. Mitchell.

The Western Telephone Manufacturing Company was well represented. The company's staff at the convention consisted of President A. E. Ziehme, F. W. Pringle, J. E. Keelyn and H. S. Pringle; also W. S. Peacock and Chas. Saunders. The Western company came to the front with interesting apparatus in the shape of new forms of combination exchanges and toll-line switchboards. There was one especially handsome 200-drop combination switchboard. This last-named equipment was built especially for Dowie's Zion City.

The interests of the Lindsley Brothers' Company, Chicago, one of the largest producers of cedar poles in the country, were well taken care of by President George L. Lindsley, Vice-president C. P. Lindsley (who came from Spokane, Wash.), Edward A. Lindsley, manager of the northern branch, and Assistant Manager J. A. Navarre. Photographs of the company's various yards, and interesting illustrations showing methods of cutting poles were shown. The company distributed a unique button, representing a "pole cat."

Among the most interesting exhibits at the convention was that of the Farr Telephone and Construction Supply Company. President C. W. Farr and General Manager E. W. Hurst were present in person to extol the merits of the Farr products. Much interest was taken in the company's special high-grade bridging telephone, with its 150,000-ohm generator. This telephone is especially adapted for country lines, and received critical inspection. The company also exhibited a full line of its various products, so well and popularly known.

Frank B. Cook, so well known to every buyer of Independent telephones, now running a finely equipped factory in Chicago, manufacturing telephone accessories, made a fine exhibit in one of the parlors on the sixth floor. Mr. Cook's 24 years of experience in practical telephone engineering, a great deal of which time was spent in the closest study of the best Bell practice, now stands him good stead and the Cook telephone accessories embody a number of valuable features. Mr. Cook is now making a specialty of looking after the manufacture of parts and accessories in the telephone line.

The Nungesser Electric Battery Company, through the efforts of H. G. Robbins of Cleveland and Thomas G. Grier of Chicago, made a most interesting exhibit of the various Nungesser batteries. For a number of years the Nungesser company made a specialty of a high-grade battery, peculiarly suitable to telephone needs. At this convention the Nungesser 1900 type of primary battery was decidedly in evidence. The Nungesser display was a tasteful one and covered practically all of the company's more important types of Nungesser batteries.

The Mountain State Electrical Company of Wheeling, W. Va., had an attractive exhibit, which consisted of a line of pole-top terminals and side-bracket terminals for underground and aerial cables. The company also exhibited a line of special hardware for cable work. These specialties were designed by F. B. Hall, who was in charge of the exhibit. Another device shown by this company which attracted wide attention was the selectaphone, a new party-line selective ringing lockout system. The merits of this system were thoroughly explained to those interested by A. F. Poole. The selectaphone is the invention of Messrs. Hall and Poole.

The American Electric Telephone Company's contingent appeared in great number and was headed by President Burns and General Manager Ihmsen. The American Electric Telephone Company showed its shrewdness in the matter of clever advertising. The electric illuminating sign on the parlor floor and especially the pathway sign under foot created quite an impression. The American company's exhibit was so extensive and the large switchboard which it presented was so large that it was compelled to extend from the two parlors engaged out into the hall. It would take too much space to enumerate all the American Telephone Company's specialties presented, but the handsome switchboard excited no end of comment. Otto Leich of the American company explained the merits of the Leich four-party-line selective-signaling system and the other products manufactured by the company. H. P. Clausen, chief engineer, was also in attendance.

The Sterling Electric Company of Lafayette, Ind., was represented by W. E. Doolittle, H. A. Taylor, S. B. Fowler, F. E. Rotchka, H. T. Doolittle, E. M. Johnson, Evan Shelby, George W. Metcalf and Miss Ethel Henderson. Its exhibit was a full line of telephone apparatus, including a complete common-battery lamp-signal multiple switchboard, power board, Ideal board, Standard Sterling board, distributing board, protectors of all kinds; also common-battery and magneto telephones. A feature was an electrically lighted painting of the entire plant at Lafayette. The Sterling company gave away watch-charm souvenirs that were greatly appreciated.

The Kellogg Switchboard and Supply Company had at Room 614, at the Auditorium, simply a rendezvous for those who wished to meet the Kellogg men and go over to the factory. Automobiles furnished by the Kellogg company were constantly making trips back and forth to the factory, and there was a steady stream of visitors there all day.

FRANK B. COOK'S EXHIBIT.

Among the Kellogg men at the Auditorium were K. B. Miller, A. E. Barker, W. P. Booth, W. W. Dean, R. L. Ames, R. H. Manson, A. B. Kratz, W. R. Hind, J. C. Lewis, R. S. Mueller, D. D. MacKay, H. E. Krause and G. L. Ainsworth. Mr. Gunn, the new advertising manager, was also present.

W. H. Butler, manager of the Kent (Ohio) Home Telephone Company, was an interested visitor at the Interstate Telephone Convention at the Auditorium. Mr. Butler is well known throughout that section of Ohio, with Kent as a center and the Home Telephone Company's lines now connect Ohio and a number of the surrounding states to the extent of hundreds of miles. The Kent Company is now in Independent long-distance communication with Pittsburg and other distant points. Mr. Butler has been in the telephone business in Ohio for a number of years and has brought the Kent Company into such prominence that it is now considered one of the finest telephonic properties in Ohio.

The Electric Appliance Company had headquarters at Room 612. In the Lake Front Park, in front of the hotel, a four-inch layer of snow made it possible for four or five boys employed by the company to track in 25-foot letters the legend "E. A. Co., Room 612." This attracted considerable attention. In Room 612 the "largest current-giving battery in the world," labeled Eaco was displayed, being something like eight feet high and 3½ feet in diameter. The self-talking Eaco telephone and the first house built upon the World's Fair grounds attracted their share of attention. The exhibit was in charge of S. A. Dinsmore, I. A. Bennett, J. B. MacMullen, S. A. Rall, E. Brown, O. T. Kimmel, P. R. Boole, F. J. Crane and George Levee.

The International Telephone Manufacturing Company of Chicago had a strong delegation. In attendance were President Henry Shafer, W. E. McCormick, D. L. Barry, M. H. Bently, D. E. Corliss, W. Hennessy, John C. Burmeister and R. N. Stites. The International company exhibited a handsome 400-line hotel switchboard, built especially for the new Claypool Hotel in Indianapolis. This board is equipped with central-energy lamp signals, the same as the public exchange boards. There was also exhibited a power switchboard for East Aurora, N. Y., and a section of distributing board and a lightning arrester of a 12,000-International board for Detroit. The company also showed power machines for a 2,400-capacity central-energy board at Bloomington, Ill.

The North Electric Company of Cleveland had an elaborate exhibit in Rooms 601 and 602 at the Auditorium. The larger room was equipped with four large switchboards representing the company's new unit-type switchboard, two of which are of a magneto-call and two common-battery. A large exhibit of telephones was also made, most of which were in direct communication with the various switchboards, and shown in operation. A handsome power board was also in full operation. The company gave

out a good-luck badge, consisting of a celluloid button with a rabbit's foot attached thereto. In addition to this, a miniature transmitter finished in gold was passed around and was universally found in the lapels of the delegates and other visitors. The exhibit was in charge of F. F. Sapp, ably assisted by L. G. Bowman, George B. Pratt, H. G. Knight and J. F. Davis. C. H. North, president, and G. C. Steele, secretary and treasurer of the company, were in evidence on Wednesday and Thursday, and met many of their large circle of acquaintances.

The Swedish-American Telephone Company, through the enterprise of President E. B. Overshiner, was conceded to have secured one of the most attractive and prominent locations in the hotel. The south parlor, joining the ladies' reception room, was literally filled to overflowing with Swedish-American specialties and friends. The apparatus was well exhibited, especially the company's central-energy apparatus, and magneto call-bell apparatus. A good illustration of the sensitiveness of the Swedish-American transmitter was presented in the form of an arrangement of transmitter and receiver with horn attached, whereby the speaker was enabled to hear his own voice at a distance. In the matter of convention advertising, the Swedish-American Company distinguished itself. The stairway advertising of the company was particularly noticeable, and it is safe to say that there was no telephone man coming into the Auditorium but "bumped" into Swedish-American signs and banners. Other attractions were the balloons that carried the Swedish-American banners to the ceilings throughout the various hallways and the rotunda of the Auditorium. The Swedish-American company was represented by E. B. Overshiner, C. H. Macklin, A. V. Overshiner, T. Lidberg, F. M. Ferguson and R. L. Scott.

Independents Seek Toll-line Connection with Chicago.

A resolution was introduced at last Monday's meeting of the Chicago City Council which may prove to be of much importance to Independent telephone men. For some time past, the Independent companies in the territory surrounding Chicago, have been endeavoring to gain admission to the city, and should the above-mentioned resolution be passed, that point will have been gained. The resolution, which follows, was introduced by Alderman Dixon, and, after having been read, was referred to the committee on gas, oil and electric light.

"Whereas, The United Telegraph, Telephone and Electric Company is operating a telephone system in the town of Hyde Park, by virtue of an ordinance passed by the town of Hyde Park, authorizing the said company to use the streets and highways of said town for the purposes of its business; and

"Whereas, The said company is desirous of extending its service into the city of Chicago, for the purpose of affording communication between the citizens of Hyde Park and the business center of the city of Chicago;

"Therefore, Be it resolved, that the city electrician of the city of Chicago be authorized, and he is hereby authorized, to rent to the United Telegraph, Telephone and Electric Company space in the underground system of the city of Chicago for not to exceed one cable, containing not more than 10 conductors, for the purpose of establishing communication between an office of said company to be established in a place convenient to the general public in the city of Chicago.

"The agreement granted to be revocable by the mayor at any time at his discretion."

EXTENSIONS AND IMPROVEMENTS.

The Wayne County Telephone Company has about completed the installation of its system in Clyde, N. Y., and Charles A. Lux of that place, president of the company, states that the Independent telephone system inaugurated by his company will be extended throughout the entire county.

In a statement recently issued by the Cumberland Telephone and Telegraph Company, the growth of its business during the month of October is shown as follows: Number of subscribers, October 1, 1902, 87,626; number added during the month, 4,545; number discontinued during the month, 3,251; net increase for October, 1,294; total number of subscribers October 31, 1902, 88,920.

The Independent telephone exchange at Bloomington, Ill., which was established nearly seven years ago, is being greatly enlarged. A large amount of cable is being placed under ground, as well as on poles, and the exchange is being re-equipped with an International lamp-signal central-energy multiple switchboard and long-distance central-energy telephones. The plant will have a capacity for 2,400 subscribers. The Equitable Construction Company of Chicago has charge of the work.

A number of persons interested in the new Crawfordsville (Ind.) Co-operative Telephone Company held a meeting at Crawfordsville on November 26th and a final decision on the matter of incorporation was reached. The articles of incorporation, as prepared, were approved and filed with the secretary of state on November 29th. There are about 60 men interested in the company. Another meeting will be held soon to elect officers and to make arrangements for the construction or acquiring of a telephone plant.

Toll Rates.[1]

By H. H. Robinson.

Long-distance, or, more properly speaking, interurban telephone service, was established in the early '80's by various licensees of the American Bell Telephone Company. The rates established for service over these lines were not based upon the cost of producing it, from any information I have been able to secure, but rather upon the telegraph rates, which at that time represented the only competition. These rates varied in different parts of the country, from less than one-half cent to 1½ cents per mile, and the time limit varied from five to 10 minutes, although overtime was seldom charged. It was not until the incorporation, by the Bell interests, of the American Telephone and Telegraph Company that any considerable time and thought were given to this most important subject.

In the early '90's a rate convention was called by the American Bell Telephone Company, and delegates attended from many of the licensee companies. As a result of this convention, and the vast amount of preliminary work which preceded it, a standard basis of computing rates was adopted, which not only fixed the rate per mile and established the time limit, but also established the method of computing overtime, measuring mileage and computing rates so as to avoid the odd cent. I will state briefly the main features of this schedule. All rates were to be based on a charge of one-fifth of one cent per mile per minute. The time limit adopted by the American Telephone and Telegraph Company was five minutes, and the limit adopted by other licensee companies was three minutes. In computing the mileage, it was decided that the air-line distance would work a great hardship upon the companies, because of the few routes which then existed and the roundabout way which nearly every message had to be carried. It was also decided that pole mileage would work a hardship on the patrons, who were not responsible, and should not be required to pay for the failure of the telephone company to provide direct facilities. Therefore, as a compromise, it was decided to use the nearest railroad mileage. Overtime was to be computed at one-third or one-fifth of the initial rate, according to whether a three or five-minute schedule was used, and in cases where this method of computation produced an uneven number of cents, the minute rate was fixed at the nearest nickel. In order to avoid the large number of uneven rates, which would exist, if rates were based on the exact mileage, the following table was prepared:

Five miles or under, 10 cents; six to 15 miles, 15; 16 to 24 miles, 20; 25 to 35 miles, 25; 36 to 45 miles, 30; 46 to 50 miles, 35; 51 to 60 miles, 40; 61 to 75 miles, 45; 76 to 85 miles, 50; 86 to 90 miles, 55; 91 to 112 miles, 60 cents.

The only matter of importance not touched on by the rate convention was the subject of special rates for night and Sunday service, and it was not until 1896 that the licensee companies adopted the half-rate night schedule, and it was not until 1899 that the American Telephone and Telegraph Company followed suit.

In the latter part of 1899 or the early part of 1900 the American Telephone and Telegraph Company changed from a five-minute to a three-minute basis for all rates on either side of Buffalo and Pittsburg. Rates going from one side of this imaginary boundary line to the other side are still based on a five-minute period.

In certain parts of the United States, most notably in California, a period of 15 seconds was introduced and has been quite successful, owing to the peculiar geography of that part of the country and the careful way in which the subscribers were educated. One-minute rates have been introduced in various other parts of the country, but have not been successful, either from a financial or operating standpoint. The principal reasons for the failure of this short period to succeed were, first, because of the inability of the companies to furnish facilities in the shape of direct circuits, and, second, because of the magnitude of the task of educating so large a number of subscribers separated into small communities, each having several centers of commercial influence.

To make this point more clear, I will say that, from the very careful study I have made of the subject, the fractional-minute rate, or even the one-minute rate, will never be practicable until toll-line companies are able to furnish a sufficient number of direct circuits between points where it is desirable to establish such rates to handle the business promptly, and also to furnish each direct circuit with an operator at either end having no other business to handle. Furthermore, toll-line patrons will have to be educated to the point of either transcribing or memorizing their proposed conversation before the connection is established.

I will now try to reply to the inquiry, which, without doubt, is uppermost in your minds: "How did the rate conference arrive at its minute-message-mile-rate of one-fifth of one cent per mile per minute?" When I first decided to prepare this paper, I made a strong effort to secure from certain officials of the American Telephone and Telegraph Company the minutes of the first rate conference, as I preferred to quote from them verbatim. I was, however, unable to secure this rather important document, and I must therefore be content to describe briefly the process and line of thought by which the initial-rate basis, which is now almost universally used, was devised. Let us create for our purpose a toll-line property, consisting of 30 miles of pole line, 10 miles of which consists of the very best construction, 40 30-foot, seven-inch-top poles to the mile, with an ultimate capacity of 50 wires and a present capacity of 20; we will suppose that the second 10 miles represents the average construction of 30 25-foot 6½-inch-top poles to the mile, with an ultimate capacity of 20 wires and a present capacity of 10 wires; the third 10 miles to consist of a 25-foot bracket line, built upon the cheapest possible specifications, and used presumably as a feeder to reach some small town. We wish to discover what rate we can safely make per minute-message-mile and show a profit on our investment. Our first section will cost us approximately $950 per mile, or $9,500; our second section will cost approximately $500 per mile, or a total of $5,000; our bracket line $150 per mile, or $1,500, giving us a total investment for this imaginary property of $16,000. Figuring interest at five per cent. and depreciation at five per cent., our fixed charges will be $1,600. Operation and maintenance, including taxes and general expense, and extraordinary maintenance, may be safely figured at 10 per cent. more. We must therefore earn $3,200 per annum on the $16,000 investment before we can show any profit for stock. We cannot, as in an exchange proposition, base our prospective earnings upon our number of subscribers and our average earning per subscriber, for toll business is strictly a measured service, and no matter how good our facilities, we cannot handle business until it is offered. The telephone day averages from four to seven hours per day, according to locality, and from several hundred peg counts which I have examined, the circuit load varies from one-half message per circuit-mile per day to three messages per circuit-mile per day. As we wish to be conservative, we must adopt the minimum figures, if we would have a safe rate. Now, this little imaginary system of ours contains 310 circuit-miles. On the basis of one-half a message per circuit-mile per day, we would handle 155 three-minute messages per day per circuit-mile, and if these messages averaged 10 miles, as they probably would, we would handle 1,550 message-miles per day. To reduce this to minute-message-miles, we multiply by three, which gives us 4,650 minute-message-miles per day, or 1,674,000 minute-message-miles per year. Now, we have seen that we must earn at least $3,200 per year in order to cover our interest, depreciation, operation and maintenance, so by dividing $3,200 by 1,674,000 minute-message-miles, we find that we must charge and receive .0019 of one cent per minute-message-mile. The Bell rate conference decided upon .002 of one cent per minute-message-mile, and the result of our little computation shows that by charging that rate, we will still have .0001 of one cent per minute-message-mile to spare, on the basis of the most conservative figures we can possibly use. Please bear in mind that, aside from the estimated circuit load, the figures which I have used are selected arbitrarily and mean nothing except to demonstrate the line of thought.

This basis of computing rates is being used to-day by nearly all of the larger Independent toll-line companies and is found to be profitable. As to the future, it is difficult to anticipate the readjustments which are bound to come as labor and material increase in cost, but, as a personal opinion, which you can accept for what it is worth, I would say that I believe that improvements in operating and advances in the art will more than offset the increases in construction and maintenance. For the present, we stand in urgent need of uniformity, for there is no one branch of the business where the lack of it is so sadly felt as in this great question of toll rates. In nearly every other part of the business, details of operation have an effect upon the local situation only, but their effects on toll-line service are as far-reaching as the country itself.

1. A paper read before the Interstate Independent Telephone Association at Chicago, December 10, 1902. Mr. Robinson is assistant general manager of the United States Telephone Company of Cleveland, Ohio.

Northeastern Iowa Independent Telephone Association.

At a meeting held in Waterloo, Iowa, last month the Northeastern Iowa Independent Telephone Association was formed. The preliminary meeting was called to order by S. S. Lichty of Vinton, Iowa, who gave a short talk on the benefits to be derived from permanent organization. W. M. Traer was then chosen temporary secretary. Before proceeding toward a permanent organization, brief addresses were made by some of the telephone men who were present. Following these talks, a committee was appointed by the chair to consider the subject of a permanent organization. This committee was composed of E. D. Naven, Vic. Stevens and E. C. Hampton. It reported in favor of an association. Officers were immediately elected as follows: President, Vic. Stevens of Dubuque; vice-president, J. F. Van Vors of Independence; secretary and treasurer, S. S. Lichty of Vintno. Constitution and by-laws were adopted, and a special committee was appointed to prepare a programme for the next meeting of the association in February next at Independence, Iowa.

The Ohio Valley Traction Company of Carroll County, Ky., certifies to an increase of capital stock from $25,000 to $100,000.

Ohio Telephone Notes.

President Dickson will shortly call a meeting of the directors, and his plans for refinancing the Federal Telephone Company will be explained. He says that it will take half a million dollars or more to put all the subsidiary companies on their feet and make the improvements and extensions needed, and that this money will either be put into the company by the Everett-Moore syndicate or it will be obtained by selling some of the stock to outside parties. All the plants will receive aid at once, after the money is secured, except the Cuyahoga, for which nothing will be done until the city authorities see fit to grant the company the right to increase its rates. The United States Telephone Company will be given more money at once and needed extensions and improvements will be made.

The Circuit Court of Ashland County has reversed the decision of the lower courts in the contention of the Central Union Telephone Company for a franchise in the town of Ashland, and the company will be allowed to install a plant there. The grounds for reversing the decision was that it was against the evidence and against the law of the state.

The Urbana Telephone Company, Urbana, has elected officers as follows: President, C. H. Marvin; vice-president, J. I. Blose; secretary, J. F. Brand; treasurer, John C. Powers.

It is said that the farmers about Fostoria are making so many applications for service that the lines of the Federal company cannot supply half of them. Plans are now being made to extend the lines in order to accommodate all.

The Federal Telephone Company announced some time ago that it would be willing to pay a snug little sum to the successful inventor of a call register. It is said that the officers have been kept busy for some time with would-be inventors with all kinds of contrivances which they have put together, but none of them proved what was desired. They believe, however, that this will result in securing an idea upon which to base such a piece of mechanism.

The Cincinnati Telephone Company, Cincinnati, has been incorporated with a capital of $50,000 for the purpose of operating telephone and telegraph lines from within the city of Cincinnati to Lebanon and other points in the surrounding country. Robert W. Seebaum, R. C. McCracken, Jr., Sheldon Browne, John S. Nowotny and James P. Hughes are the incorporators. It is said this company has been organized for the purpose of operating in competition with the Bell company, which has had a monopoly of the business up to this time.

An ordinance has been introduced in the City Council of Hamilton for a franchise to be granted to A. J. Wells and E. E. Bowman. Claude Wyant of Toledo has also applied for a franchise to build and operate a plant in that city.

The Hamilton Home Telephone Company, Hamilton, has filed a mortgage of $200,000 to the Cincinnati Trust Company to cover a bond issue of the same amount, the proceeds to be used in completing the plant, which has been under construction for some time, or probably to pay what is owing on it.

It is said there is again a war on at Wellington between the Independent company and the Bell. The latter has been making gains of late and threatens to overtake the Independent in the number of telephones in use. O. M. C.

Telephone News from the Northwest.

It is announced that the Duluth Telephone Company has accepted a condition imposed by the council of Duluth, Minn., that it pay a gross earnings tax of one per cent. if permitted to restore its instruments to the city offices. The city fought the company in the courts to compel its retirement after the expiration of its franchise, but lost. Then all the company's instruments were ordered out of city buildings. The company made overtures to replace them and the council made a demand that the company pay the same tax which its competitor did. This proposition has now been accepted.

The Dakota Central Telephone Company will rebuild the entire exchange at Oakes, N. D., recently purchased.

Edwards, Wood & Co., grain commission merchants of Minneapolis, have bought a controlling interest in the North Dakota Telephone Company of Aneta and Northwood, N. D. The company has a metallic line between Mayville, Devils Lake and Starkweather, and will extend it further in the spring.

The Northwestern Telephone Exchange Company has completed long-distance connection with Winnipeg, giving connection with the Twin Cities and the entire Bell system.

The Interurban Telephone Company has secured a site at Alexandria, Minn., for the erection of a brick exchange building.

The Northfield (Minn.) Telephone Company finds that $1.50 a month for business connections is not a profitable venture and announces a raise to $2 a month.

The storm of December 2d cut off telegraphic connection between the Twin Cities and Chicago, but the long-distance telephone wires remained in order, and the daily newspapers received a good deal of their outside news by that medium.

Judge Smythe of Burlington, Iowa, has decided that a private telephone line on a farm becomes a part of the realty. The owner of a stock farm on which he had a private telephone line, sold the line to a telephone company. Later he sold the farm to others, without making any reservation for the telephone line. The property owners promptly disposed of the line, which brought the matter into court, with the result named.

The Rocky Mountain Bell Telephone Company has been refused admission to Red Lodge, Mont., and has just opened an office on the edge of the town limits.

The Pacific States Telephone Company plans a number of long-distance extensions in Eastern Washington. By the use of the new "phantom circuit" several additional lines are to be fitted up between a number of cities—as between Spokane and Walla Walla, between Spokane and Wenatchee, Spokane and Cœur d'Alene City, Moscow, Idaho, and Colfax, Wash., and Walla Walla, Wash., to Portland, Ore. R.

Indiana Telephone Items.

The Co-operative Telephone Company of Crawfordsville has filed articles of incorporation.

The directors of the Mason Co-operative Telephone Company have decided to construct new trunk lines to Mechanicsburg and Cyclone.

The commissioners of Grant County have granted the Citizens' Co-operative Telephone Company of Fairmount a franchise to operate in Grant County. By an agreement with the Central Union company the new concern has the use of its lines to Marion subscribers.

The city of Evansville was for several days practically without telephonic communication with neighboring towns and cities in Southern Indiana, Southern Illinois and Northern Kentucky, as the result of a storm. Lines were down in all directions and 400 city telephones were also put out of use.

The Kinlock Telephone Company of St. Louis has asked for a franchise for a long-distance line from the Illinois state line to Terre Haute. The company has completed its line to Casey, Ill., and wants to connect with the Citizens' company at Terre Haute, and will thereby establish direct connection with the long-distance system of the Indiana Independent lines through Indianapolis.

The Independent Telephone Company of Kokomo has announced an advance in rates for private houses to $1.50 a month. The present rate is $1.25. This is likely to precipitate a renewal of the war between the Bell and Independent companies. The Bell company has charged $1.50 per month for residences, and to recover its hold will probably reduce its rates to $1.25.

The Logansport Home Telephone Company gave a reception last Tuesday to hundreds of visitors, exhibiting the plant and explaining the workings of the telephone.

The Louisville Home Telephone Company of Louisville, Ky., has complied with the Indiana law by filing articles of incorporation with the secretary of state and procuring a license. The company has $75,000 capital represented in Indiana, principally in the city of New Albany. The capital stock of the concern as represented in both states is $1,500,000. F.

Southern Telephone Developments.

The Southern Bell Telephone Company is building a long-distance line to Waycross, Ga.

The South Carolina Telephone Company of Columbia has completed rebuilding a line between Camden and Sumter, S. C., which is connected with Columbia.

The Southern Bell Telephone Company has purchased a site at Charlotte, N. C., for building a three-story modern exchange building.

An injunction has been issued against the Hampton (Va.) Telephone Company to restrain the company from discontinuing its service in Norfolk, Va., in connection with the Southern States Telephone Company. This is said to be the beginning of a long fight between the Bell company and the local company at Norfolk, Va.

Mrs. Annie McElroy Brett, who owns telephone systems in El Paso, Texas, and other cities, will probably be granted a franchise to install a system in Chattanooga, Tenn., with the privilege of putting the wires underground. The grantees guarantee that $100,000 shall be expended in six months from the passage of the final ordinance.

It is reported that the Southern Bell has purchased the local telephone interests at Pickens, S. C.

The Polk County Telephone Company of Tryon, N. C., has been chartered, among the stockholders being Thomas C. Mills. The capital stock is $5,000. L.

The Chicago Drainage Canal and its possibilities as a waterway and for waterpower purposes formed the general subject of a talk by Lyman E. Cooley before the Chicago Referendum League recently. During his talk Mr. Cooley said that he estimated it possible to develop 150,000 horsepower easily in the canal, and that the cost of this enormous power would approximate $15,000,000. He said further that the development of the canal would add to the wealth of the state $700,000,000 and would bring at least 750,000 more people to its banks.

Pacific States Telephone Company's Extensions.

The Pacific States Telephone and Telegraph Company (Bell) is planning for many miles of new telephone lines to be built next year. One improvement will virtually amount to an additional line from Spokane to Walla Walla, from Spokane to Wenatchee, Spokane to Cœur d'Alene, Moscow, Idaho, to Colfax and Walla Walla to Portland. In addition to this, next spring may find Spokane and Tacoma using a direct line, thus saving the delay of having to be switched around by way of Portland. Because of the shorter distance to Tacoma direct instead of by way of Portland, a direct line would be a great improvement.

In speaking of the plans for next spring and summer, District Manager Charles W. Reynolds said: "We are trying a new invention called the phantom circuit. By means of this we can put in a new circuit between two places without additional wires. The only provision is that there must be two circuits using the same sized wire to work on. At present it takes two wires for a circuit, or four wires for two circuits. If we have two circuits with the same sized wire, we can put in an additional circuit without stringing additional wires. In other words, four wires will serve as three circuits, and conversation can be carried on over all three circuits at the same time."

Louis Glass, vice-president and general manager of the Pacific States company, in an interview, is thus reported: "We contemplate a number of extensions, north, south and east, which will cover the whole Inland Empire and both sides of the Willamette River. Arrangements are now being made for this work, which will certainly begin in the spring, and possibly during the winter. The various telephone systems have now covered the whole continent, so that a man in Portland can talk as far as some points in Wyoming and I believe it would be possible to carry on conversation across the continent. But telephone business is not a commercial success over a greater distance than 1,200 miles, for the wires consume so much copper that we should have to fix the rate at a higher figure than the business would stand. Beyond that distance it is cheaper to use the telegraph, because the messages can be sent over a light iron wire, although we send telegrams over our wires at the same time that conversation is going on over them."

American Bell Output.

The American Telephone and Telegraph Company has issued its report for the periods ended November 20th:

Month:	1902.	1901.	1900.	1899.
Gross output	93,487	88,497	52,208	69,117
Returned	36,838	27,510	36,412	19,992
Net output	56,649	60,987	15,796	49,125
December 21st to November 20th:				
Gross output	994,422	867,323	576,570	608,715
Returned	420,682	352,173	257,110	183,263
Net output	573,740	515,150	319,460	425,452
Total outstanding Nov. 20.	3,099,346	2,467,966	1,899,965	1,550,702

GENERAL TELEPHONE NEWS.

The F. E. Bell Telephone Company of Desplaines, Ill., certifies to a change of name to the Desplaines Telephone Company.

The People's Telephone Company of Jackson, Mich., has been sold to the Citizens' Telephone Company of Grand Rapids, and its name has been changed to the Citizens' Telephone Company.

C. C. Kritzer, the retiring manager of the Zenith Telephone Company of Duluth, Minn., received a testimonial from the employes of the exchange in the shape of a handsome gold-mounted umbrella.

Danish and Swedish telephones have been connected with the submarine cables between the two countries. The two governments have agreed that the toll rate shall be 25 cents for a three-minute talk. The charge over the London-Paris telephone cable for a similar conversation is $2.

Connecticut capitalists have organized the Hudson River Telephone Company to compete with the Bell company. The company's headquarters will be at Hudson, N. Y., and its capital is $50,000. R. J. Foster of New Hartford, Conn., is president, and R. L. Andrews of New Britain, Conn., is secretary.

A Berlin (Germany) dispatch states that after extensive experiments with Professor Pupin's long-distance telephone invention, Siemens & Halske have acquired his patents for Europe, and intend to connect all the great centers. The experiments have shown that with the Pupin circuit a message is plainly audible to a person standing over 10 yards from an ordinary receiver.

Commissioner Allen of the Patent Office has handed down a decision granting a motion made by Kempster B. Miller to suppress the testimony of Harold D. Stroud in an interference case involving the invention of a telephone-exchange system, deciding that "where it appears that the testimony taken by one of the parties to an interference relates solely to public use it will be suppressed."

Electric Variable-speed Control.

PART III.

DISCUSSION IN NEW YORK (NOVEMBER 21ST).

R. T. E. Lozier of New York: What I particularly want to point out in my paper is the very close relation that the individual motor, with its variable-speed drive, bears to what is now known as the new shop method. Perhaps Edison was one of the first men to enunciate the principle that it is better to waste the tool if you can save your labor. He put that theory in practical operation in his large cement works; and I know that for years he has always worked to the end of increasing his product as being the most practical means of increasing the profit. Experiments were tried, beginning some four years ago, at one of our largest steel works, and thousands of dollars were expended in experimenting, not only with cutting steels, but also in variable speeds. It is found that the general machine-shop practice was far, far behind the possibilities of what could be gotten out from the work of a shop with a given equipment and pay roll. These tools, instead of applying the thumb rule, apply the rule best adapted to the work, and increase the output from 100 to 300 per cent., and in some cases 500 per cent. Given the exact amount of time to displace certain amount of material, given the shape of his cutting tool, not only is the operator watched, but bringing up the speed under these conditions the demand on the power is improved. I was told by the superintendent of one of the largest shops in this country two weeks ago that by using the variable-speed motors they increased the output over 40 per cent., which was a very great gain for them to attain; and so I say that the variable-speed motor bears an intimate relation to these new shop methods. I think the mechanical engineers have not been disappointed in placing upon us the responsibility of introducing these new methods of operating their tools.

What is involved in a multi-voltage circuit? The multi-voltage circuit involves a given source of supply—isolated plant or central station having two wires. It then involves a balancer. The balancer is not, as is generally supposed, a large compass and device, having a capacity sufficient to carry all the motors at the lowest speed. The larger the number of tools driven by motors controlled with the speed variation, the larger the number of tools, the smaller the balancer may be; and we have taken it as a rule that the armature of a multi-voltage balancer need not be larger than sufficient to operate the largest single motor on the circuit at its lowest speed, and that is borne out in practice in a number of cases.

Gano S. Dunn of Ampere, N. J.: The company with which I am connected is at present engaged in litigation involving a number of the features presented here this evening, and the attorneys of the company have requested that I do not take part in the discussion. However, I think I may with propriety refer to the behavior of motors under weak field. Several of the authors who have presented papers describe systems in which a motor was expected to give a constant horsepower over a speed range varying from two to one, by means of field weakening. This means that if a motor is fully loaded at one speed it will take the same current and deliver the same horsepower when its field is weakened to an extent that will increase the speed 100 per cent. Now, such is not my experience. It is particularly important in connection with the operation of machine tools, because as in the case described by Mr. Storer, in which the motor might be a motor used to drive a lathe, the heavy torques would occur in the lower ranges of the speed, and his motor, which he describes as a five-horsepower motor, running at 375 revolutions per minute, normally, might be called upon for that five horsepower at a speed almost equal to 750 revolutions per minute, under a field weakened 50 per cent. If the motor is properly designed to give proper commutation with that maximum current, and maximum field strength, then it, in my opinion and experience, will not give it with only half of that field strength. I admit that there are motors that would do that, but they do it only because they start off initially with a great excess of field strength and which, therefore, may very properly be weakened. If you have a motor which is susceptible of as great an amount of field weakening as this, it is a special motor and expensive; or if you submit a standard motor to this degree of field weakening and expect it to commutate the same current at double speed, the commutation will be unsatisfactory.

H. E. Heath of Windsor, Conn.: I agree with Mr. Dunn in saying with the ordinary construction of the standard motor, if you propose to get a wide range of speed, or variation of field, it will necessitate the use of a much larger motor. But that is not saying that special construction of motors cannot be made, because I know that a form of motor can be made that will give us practically sparkless commutation over a fairly wide range, and still not be largely in excess, with regard to either cost or weight, of the standard motor.

S. T. Dodd of Pittsfield, Mass.: I was interested in Mr. Leonard's article on the application of this multiple-unit voltage speed control to railway systems. There is one question I would ask Mr. Leonard, and that is what facts he can give us in regard to the weight and efficiency of such a locomotive as he describes. It will be impossible to apply such a system as he describes, of single or small units, and the only field for such a locomotive will be for trunk-line service. Now, let us consider a large locomotive like the Baltimore and Ohio tunnel locomotives, weight 96 tons. I do not know exactly how much waste room or waste weight there is. I do not think there is much of either. These locomotives are operated by a motor-generator set, which weighs 36 tons. It raises the voltage from 500 to 700 volts. Suppose it generated 700 volts. To develop that amount of current it would require about a 750-kilowatt motor-generator, weighing somewhere between 50 and 60 tons, and making the total weight 150 tons. Thus, it will be seen for large locomotives they would get a weight somewhere in the neighborhood of 150 tons, which will cut the weight efficiency down less than we could expect to have it in electric motors of this style.

Arthur Williams of New York city: Our experience in applying motors directly to shop tools has been very much as has been described by Mr. Lozier, but I think we took almost too low an average for the demand upon the supply service. If I understand his average, it is about 10 per cent. Our experience is it is more nearly 25 per cent. to 30 per cent. There is also the point to be remembered in using the neutral wire for the three-wire distributing system, that large power loads are apt to unbalance the three-wire system and possibly interfere with the quality of the service.

The cost of installing individual motors, I think it is admitted, is much larger in the first place. The additional expense of the motor, however, is offset by the saving in shafting. But as soon as two factories are compared, one using the ordinary belt shafting and the other using the individual motors, there is no question whatever as to the favorable inferences to be drawn in favor of the installation of individual motors. The highest speed at which the work can be turned out, sometimes 100 per cent., and even larger percentages, constitutes a very great saving; and then there is the great economy in power. I think it is not improper to say that the average losses of power in the machine shop where belting and shafting are used is 50 per cent. of the total power consumed; and by the application of individual motors a very great per cent. of this loss of 50 per cent. in power, if not substantially all, during the hours of operation of the shop can be saved. Such a saving runs into a very large sum annually. The cost of the individual motors in actual practice is about six or seven cents a kilowatt-hour as the price at the meter, and figures from $20 to $30 per year per horsepower. The cost figures are based on the capacity of the plant, but they are actual figures in general machine-shop work, and these figures are also obtained from the operation of several of the largest printing establishments.

Philip Lange of Pittsburg: Our whole establishment is driven by variable-speed control direct-current motors; and we have also tried to accomplish what has been described by alternating-current motors, and I must say that we have partly succeeded. We have not the individual-motor drive, except for very large tools, and there we accomplish the variations in speed by mechanical devices, such as countershafting. Mr. Lozier says that it is possible to decrease the time to one-half by use of proper speed-controlling devices. We have accomplished the same thing by mechanical devices in countershafting. We have no variable-speed alternating-current motors.

Charles Day of Philadelphia: I have not heard an answer to the question which the president put forth, which is of the utmost importance to all manufacturers to-day contemplating improvements and extensions—Does it pay to put individual motors on machine tools? And, if so, does it pay to go to the additional expense of obtaining variable speed? Mr. Lozier touched on that subject in the latter part of his paper, but I think he probably did not get credit far enough back for investigations as to the method of driving machine tools up to the limit. I read not long ago in an old engineering magazine an article by B. J. Arnold on the question of the power limit, where he recommends driving tools to the limit. The article was written in 1895. It is practically exploited in that article. The trouble about the application of the individual motor is due to lack of knowledge on these lines. We must know the character of cast iron, the various speeds that can be run with different tool steels, and the facilities for determining the cutting speed, before we can say what increments the speed should increase in. In the average machine shop I should say that not more than one-half of one per cent. of the work permitted increasing the speed as you approached the center; whereas, it is possible to keep the speed practically constant by turning the controlling handle as the tool approaches the center. But the question of variation in motor speeds and ranges required should be determined by the average range of temperature in working with a given lathe or boring mill, and the amount of work which such a lathe or boring mill will do. The minute we have to change the gearing a loss of time is involved; and the present practice in every case consists in a combination of mechanical and electrical control.

The problem really is, does it pay to put the motor on the tool? and how large the motor should be, and all other questions should be ignored. The question is largely governed by taking the maximum cutting the tool will stand and running to the destructive limit of the tool in every case. By the introduction of the individual motors, on the multi-voltage system, the workman has the control under his own hands, and can get any speed he desires within 10 per cent., and there is no possible incentive other than to run as close to the speed as he can possibly arrive at. Then, by the introduction of the premium plan, or some other method, he can be kept as close to that rate as is desirable. In the shops using the multi-voltage unit, it is important to understand upon what character of equipment the electric control should be placed.

In order properly to understand the saving effected, we must have complete data regarding the character of the equipment of the shop, the number of the machines on duty, what proportion of the machines were idle, etc. It is through the indirect savings due to the introduction of these various systems, if we understand the possibilities of the system, which makes it pay to install them.

In the Link Belt Engineering Company we have data extending over four years, data which we have endeavored to accumulate and from which to secure exact results. We have shown in some cases a saving of 30 per cent. on the labor bill, giving 10 per cent. to the workmen in shorter hours at the same wages. That is due to better methods, better tool steel, and better methods of driving the tools; and the saving is largely in excess of the interest and depreciation on the entire expenditure necessary to effect it.

President Scott: What Mr. Day says reminds me of the remark which I heard the superintendent of a factory, which is at present enlarging its capacity, make within the last week. He said that of the new machines which were being ordered, a very large number were ordered specially at an excess cost of 50 per cent., simply in order that they may be mechanically strong so as to stand the high speeds at which it is expected to operate them.

Mr. Lozier: One point that has been referred to by Mr. Williams is the question of distributing motors over a system operated on the three-wire system. If you are using a three-wire system, with only two voltages, and these voltages cannot be combined to give three voltages, the motors will bunch up on one voltage much more than if you distribute them among the six. We have not found that the balancer is at all disturbed by the motor running at any one speed bunching up on one voltage. The wires have got to be taken care of in running at the lower speeds, but in some cases it is found that while the torque may be the same, the horsepower required of the motor is not so great at the lower voltages. If the cutting tool is all right the motor is all right. It is up to the tool builder to give us tools which will be strong enough.

N. W. Storer of Pittsburg: I believe the only question raised in regard to my paper was brought up by Mr. Dunn in regard to the commutation of the motors with a weakened field. He claims that it is impossible for a standard motor, properly designed, to communicate with a field one-half its normal strength. I am entirely unable to agree with Mr. Dunn in that respect. The point I sought to bring out in the example that I gave referred to a 10-horsepower, 220-volt, slow-speed motor. Running that at half the voltage, half the output, the current in the armature would be the same as at the normal rate of 10 horsepower. It would run at a low voltage. It ought to be well understood that a motor running at a lower voltage than its normal will commutate through a greater range of load with a weak field. If you consider the Ward Leonard system, which is quite well known, you will find a generator which commutates from possibly one-fifth or one-sixth of its normal voltage up to its maximum voltage with any load within its range. A low voltage gives greater possibility for the motor, and the standard motor on a low voltage, the motor being properly designed, ought to be able to commutate with an extremely weak field. It is well known that in designing and in building large lines of motors the combination of standard parts is such that it is very simple for some combinations to get better proportions than would be made if you ordinarily were to design for some exact condition. It is so with a 220-volt motor.

The three-wire circuit requires a somewhat different type of motor; it is ordinarily a good commutating motor, and I believe there are a half dozen different firms in the country which will put out such a motor. A multi-voltage system requires a special motor, or a motor designed for speed out of range, in view of what is ordinarily required. It must be designed with the idea of using it for the multi-voltage system.

There is a point in regard to Mr. Leonard's paper. Mr. Dodd struck the nail on the head. Such a system, I believe, will increase the weight of the locomotive far beyond what is ordinarily required for the power of the locomotive. I believe that if you take a large locomotive you will have scarcely any excessive weight necessary, if you consider the motors and the necessary parts of that locomotive. I believe if you add to that a motor-generator outfit you will have a locomotive which is 50 per cent. heavier than it should be.

H. Ward Leonard of Bronxville, N. Y.: Before touching the question of the weight of the locomo-

tive, I would like to make a slight response to the point of the multi-voltage system requiring something special in the shape of a motor. I think if there is any system that requires nothing more than the simplest standard form of motor, it is that system. The first time the multi-voltage system was tested was when I presented it to William Sellers & Co. in 1892, and the simple standard shunt motor in use at that time was tested over the entire range of the various motors touched on this evening with perfectly satisfactory results in every way.

As to the locomotive question, I will not spend any time on the Baltimore and Ohio locomotives, which, although historic, we all know are absolutely uncommercial as a possibility in the direction of freight haulage on trunk-line service. It is really essential that you get more weight upon the drivers of any locomotive such as I am considering. Furthermore, admit, for the sake of argument, that the point is well taken that the weight hauled is increased by the motor-generator, I still wish to point out that such a motor-generator would not be designed so that its weight would be such as would compare with the weights of the motor, nor with the weight of the motor-generator which is put in a sub-station. Such a motor-generator as would be employed on a locomotive would be such as the generators that are driven by steam turbines, as to size and weight. Detailed figures as to the weight of a motor-generator relative to the total weight of the locomotive are given in a paper read before the Oerlikon by Mr. Huber last March, describing locomotives for the Zurich company, which were built on my system, and which will go into commercial use in the next few months.
into commercial use in the next few months.

Discussion in Chicago (December 2d).

Professor D. C. Jackson of University of Wisconsin: The presentation of these papers simply shows how far the commercial application of variable-speed motors has taken possession of the minds of the electrical manufacturers, and how far it is soon to take possession of the minds of the users of electrical machinery and machine tools. The reason, I think, that the variable-speed motor has not been more fully adopted by the users of machine tools and electric motors is the very great delay on the part of the electrical people in the development of reasonably satisfactory speed control, and then putting it on the market at a price at which the ordinary user could afford to purchase it. That is partially due to the fact that the electrical people have been so busy that they were not willing to undertake anything with so many difficulties, without charging 10 prices for it.

B. J. Arnold of Chicago: Mr. Foster, in reading Mr. Lozier's paper, laid considerable stress upon the increased efficiency in operation of the multi-voltage system, all of which is undoubtedly true, but that is simply an increased efficiency in the consumption of power. He failed to mention the fact that that system or any other system which requires a large number of individual motors, or a larger size of motors used ordinarily by the companies for constant speed, must necessarily cost considerably more, and the interest on the increased investment more than eats up the saving in power.

Another point is that, if I understood it correctly, that paper as well as other papers advocates individual motors on tools as against the grouping of a number of small tools on a piece of shaft and running that shaft by a motor. The grouping of motors increases the investment greatly and also loses the advantage which you gain by putting a few tools on a short piece of shaft. In my own experience, in every case where I have had to deal with railroad shops, we have figured on the grouping-of-the-motor principle when it came to buying the motor.

On heavy railway work there is no use in talking of equipping trunk lines electrically on the sub-station scheme, because you cannot make the efficiency which you gain by the adoption of the electricity in operation, enough more to offset the fixed charges. In other words, the copper necessary and the labor in the sub-stations necessary to operate them will eat up or overcome any saving in expenses that you can show. Therefore, we must look to some other form of motor or method of using the current in order to get the benefit of using the higher voltages.

George B. Foster of Chicago: I was very glad that Mr. Arnold brought out the point of the first cost. The saving in the fuel is really a minor saving. The great saving of the individual motor driven on machine tools is an increased output of that tool. That increase ranges all the way from 25 per cent. to 100 per cent., owing to the work done.

I know of a case where there were two plants in operation—one electrically equipped and the other of the mechanical type—and it was claimed that the saving was over 25 per cent. I do not know what the character of the lathe was. Of course, a good deal depends on the character of the lathe.

Mr. Arnold: It is a question of machine-shop economy; a question of how much more work you get out of the two. I would not like this grouping of tools for large tools. I would put individual motors on large tools always. It is only for small tools that we should group the tools on a short piece of shaft, and put individual motors on a larger shaft.

Ernest Gonzenbach of Chicago: I have just been through the experience of the equipment of individual motors for the repair shop of an interurban railway. I commenced to get prices on individual motors and found that the cost of the motors for driving would be $6,500, that the cost of machinery would amount to $4,000, and that the total horsepower capacity of the motors would be about 35 horsepower, if individual motors were used, while by grouping the tools (we finally decided upon two groups) we were able to drive the whole outfit with two five-horsepower motors.

I think anyone who has been connected with polyphase railways has "bumped against" that question of sub-station maintenance very hard. It has been my fortune to be connected with three railways in succession operating polyphase sub-stations, and in every case I found that the most serious difficulty was putting the complicated equipment which is necessary in the rotary sub-station into the hands of comparatively inexperienced men. It seems to be impossible to get men capable of running sub-stations except at exorbitant figures. The man in charge of the station has really more responsibility than the man at the power house. He has to rely on his own wits.

Another thing which may be urged against sub-stations is the fact that, in order to run a train service in any way similar to steam railroads, one has to be very careful not to bunch trains or cars between sub-stations, otherwise your unit in sub-stations will become very large. For instance, with the Aurora, Elgin and Chicago Railway we have a total of 12,000-kilowatt capacity in rotary converters, which are necessary to operate from a plant of 3,000-kilowatt capacity (two generators), simply for the reason that it is possible that there are times when trains are more numerous on one part of the road than on another. With the avoidance of sub-stations, or with alternating-current systems, it becomes easier to put more of that load on the power station and divide the load among a larger number of stations.

Professor Jackson: The question of grouping is largely a matter of engineering and common sense. If you have to deal with the large engine or locomotive shops, enormous boring mills, etc., there is no question but that individual motors with variable-speed attachments give the best results, and the individual motors undoubtedly have shown by experience in various shops increased output from 20 per cent upward. I know of one shop where the increased output was 40 per cent. by simply properly employing electric motors. On the other hand, in a small shop for all sorts of work and where they have different classes of tools more or less of small size, the plant being idle a considerable portion of the time, grouping is undoubtedly the right thing to use. It may be taken for granted that a great manufacturing establishment that has a reasonably uniform product—that is, a product of one kind at least in the iron-manufacturing line—should ordinarily be greatly improved by electric drives with a great many individual motors applied with the individual tools and a large proportion of those motors of the variable-speed types.

R. H. Pierce: Judging from the figures I have in my own mind, the saving in power is a comparatively small matter. For instance, the cost of the fuel in an ordinary manufacturing establishment which I have in mind amounts to only three to five per cent. of the cost of the product. Should the output be increased 20 per cent. or a great deal less than 20 per cent., the average would amount to more than the total saving in fuel.

H. H. Cutler of Milwaukee: I think I can speak on this subject from an unbiased standpoint. There are two difficulties in using the Leonard system for hoisting coal. In the first place, it is very slow to act. The first thing desired is to get as much coal out of that vessel in a certain time as possible. It is not possible to alter the field strength on a generator for a few seconds of time. The second reason is that the Leonard system compels the use of a plain shunt-wound motor, which will not pick up the load as quickly as a plain series-wound motor. It appears to me that the best system to operate large coal hoists is one similar to several we have in operation in which we use a plain series-wound motor with ordinary armature resistance, controlled by magnets, which eliminate all sparking, thereby obtaining the maximum speed acceleration that it is possible to get out of a motor.

Mr. Lozier advocates the multi-voltage system, and the discussion has brought out that there was a great saving in the output, but this does not by any means prove that that output is due to the use of the multi-voltage system. There are plenty of other systems which can be used. It is absolutely necessary for me in my business, when any particular application of the motor is brought up, to have some system which I can freely recommend as appearing to me to be the best suited.

My idea of operating machine tools is to let the motor alone, as far as possible and to learn our lessons from the automatic manufacturer, and use sliding gears, etc. This will give a motor which is not too large for the work and can be put in at the minimum cost and will give exactly the requirements which are necessary for the machine to do the work. There are several disadvantages with respect to the multi-voltage control.

There are several methods of operating printing presses which have not been brought out at all. I am a firm believer in the double motor, for the reason that the system gives the actual speed required in practical work. The practical work only requires it in steps. The storage-battery system of operating printing presses I would look at with a good deal of mistrust, especially if we have to use storage batteries in multiple-series connection. I think the whole question of motor control sifts right down to the "survival of the fittest" and the selection of the proper system. As a rule, the consumer is overwhelmed with a number of salesmen, all talking their particular system, and he does not know what to use. There is simply one remedy—let him consult the engineer, and we will all be benefited thereby, as well as the consumer.

In the machine tool the torque must increase as the speed decreases, which you cannot get commercially on a motor without using an abnormally large one, and I do not advocate any change in the speed of the motor greater than possibly the 20 per cent. variation, or 15 per cent. in shunt field.

H. R. King of Chicago: It is a case of good engineering judgment as to which system we should install. When a designing engineer has a motor problem in which the motor shall have a normal rating of 100 horsepower and 500 revolutions, and shall vary its speed in steps of 10 per cent. down to 10 per cent. of the total speed, that proposition is entirely different from a proposition where he only has a variation of 25 per cent. in speed or a variation of 15 per cent., and I think that each case requires its own solution. We have a mechanical variation of speed which is to be used to good advantage in special cases. We have the 125-volt motor with the armature regulation and the variable-shunt regulation, which I might say in practical conditions should run from 15 to 25 per cent. of the speed, and then we take this same system after being worked on 125 volts, and we really throw it on 250 volts, and work the same deal over again. In the multi-voltage we work the same deal, except on various voltages, so it amounts to about the same thing.

George A. Damon of Chicago (communicated): The individual motor is gaining favor, as the advantages of its use become more generally understood and as investors begin to appreciate the dividend-earning possibilities of an investment in electrical-drive equipment. Nearly all the tool builders are redesigning their products so as to accommodate the individual motor, and the results indicate that the more flexible connection of power and the wider range of speed control made possible by the motor drive have allowed for a great improvement in the design of the tool itself. With the higher cutting speeds made possible by the individual drive, with the deeper cuts allowed in new steels and other material, it is not unreasonable to expect the new tool to have 50 per cent. greater output than a tool of the former belt-driven type. Under these conditions, the individual motor appears to be good practice. The tendency at present seems to be to arrange the old belt-driven tools in groups, allowing a 10 to 20-horsepower motor for each group.

If the shop is to run on a piece-work, premium or similar system of compensation for its mechanics, then the use of elaborate systems of speed control for individual motors may be justified. On the other hand, there are situations in which an easy method of controlling the speed may be a disadvantage. If full advantage is to be taken of refined methods of electrical control, the operators in charge should also be worked up to their highest efficiency. The practice at present seems to be to put all tools requiring five horsepower or over on the individual-motor basis and group all the smaller tools. There is certainly a tendency toward equipping even smaller machines with separate motors, down perhaps to three horsepower and also a corresponding tendency to reduce the size of the shafting motors driving groups, with the idea of having as far as possible one standard size for shafting motors all through the plant.

[*The end.*]

Municipal Street Railway in Canada.

The St. Thomas Street Railway Company stopped running its cars about two months ago in St. Thomas, Ont., and the city took back the company's charter and franchise, and on November 25th started to run the road as a municipal concern, meeting all trains at the various depots. During the two months the road has been shut down, all necessary repairs have been made and everything is in fair running order. The operation of this road will be watched with keen interest throughout Canada, as it is the pioneer road to be run as a municipal enterprise. Already the question of cheap fares is being agitated, so as to induce all classes to use the car service, which, for the present, at least, will be as good as that of the company, which did not pay. The city has control of the system by virtue of a mortgage on the property in which was a clause to the effect that if the cars should not be operated for 60 days, the mortgage could be foreclosed.

The Blue Grass Traction Company of Lexington, Ky., certifies to an increase in capital stock from $10,000 to $350,000. The company proposes to build a line to Paris, Ky., and has changed its articles of incorporation so as to allow it to sell light, heat and power and maintain summer resorts.

CORRESPONDENCE.

New York Notes.

New York, December 8.—The recent consolidation of the elevated and underground interests of the city is the chief topic of talk in rapid-transit circles. The question which is heard everywhere is: "What advantage will the public gain from the deal?" An official of the Interborough Rapid Transit Company is reported as having answered the question in the following manner: "Our company holds its right to operate the tunnel roads under a contract with the city, and eventually the city is to become the owner of the underground roads. We are therefore controlled to a great extent by the public. The Manhattan elevated railroad's franchise gives the public no such hold upon its policy. The fact that the Manhattan and Interborough have been joined certainly shows that the city is to have at least an indirect control over the former. The systems are to be run harmoniously, and so the city, controlling one of them so completely under the law, necessarily acquires control over the other." This is probably the greatest gain made by the general public. It now can control the elevated road which formerly was independent of city and public censure. The general, though not official opinion, is that the two systems will be not only run "harmoniously," as was stated above, but will run as a unit under one management.

The Pennsylvania tunnel franchise has passed the Railroad Committee of the Board of Aldermen by a vote of five to four. The decision of the board will be known by Wednesday, as the franchise will now come before the board on Tuesday night.

At the annual meeting of the stockholders of the Metropolitan Street Railway Company the following-named directors were elected: H. H. Vreeland, P. A. B. Widener, Thomas Dolan, D. B. Hasbrouck, H. A. Robinson, William Fahnestock, DeC. Moorehead and R. W. Meade. The only new member on the board is William Fahnestock.

About 100 property owners from the upper West Side attended a public hearing a day or so ago before the Rapid Transit Commission on the matter of the board's action in rescinding its plan to have a subway station at One Hundred and Fourth Street and Central Park, West. The commission postponed its decision in the matter to a later date after hearing several speeches on the matter. Controller Grout expressed himself as in favor of a station at the above-mentioned point, and said that he would vote in that way. Property owners in the neighborhood of the point in question are much incensed at the action of the board.

Fire of a somewhat mysterious origin crippled the service of the Johns Street telephone exchange for many hours last Wednesday. It was quickly extinguished by the office employes, but is said to have destroyed 90 per cent. of the wires running over the switchboards in that office. There was no explosion and the fire was devoid of especially exciting or spectacular accompaniment. It was just a smoulder in the heart of the vast network of wires interwoven, so that none but experts could trace them over the back of the switchboard. The territory of the John Street exchange is that part of Manhattan between the East River, Nassau Street, Chambers Street, and Maiden Lane. There are in this territory about 5,000 telephones.

The New York Central and Hudson River Railroad Company last Tuesday presented to the Board of Estimate and Apportionment its new plans for the improvement of terminal facilities in this city.

The New York Tunnel Company has been incorporated with a capital stock of $250,000. This company will have, according to Consulting Engineer William Barclay Parsons, the work of constructing a tunnel under the East River from Battery Park to Clinton Street, borough of Brooklyn. This tunnel is the second section of the three, the contracts for which have been let by the Belmont Company, now constructing the rapid-transit subway. The first section extends from Ann Street to Battery Park, and the third from Clinton Street, borough of Brooklyn, to Atlantic Avenue, Flatbush. Mr. Parsons gave it as his opinion that the cost of constructing the second section would approximate from $4,500,000 to $5,000,000.

The American Dry Battery Company of New York (capital, $2,000) has been incorporated. The directors are J. R. Colburn, L. A. Merrille and F. J. Byrne.

The International Wireless Telegraphy Company is another new comer. It was incorporated with a capital of $10,000. The directors are Isaac Neberger, A. W. Rose and M. J. Kenny. O.

Canadian Intelligence.

Toronto, Ont., December 5.—Application will be made at the next session of the Ontario Parliament for a charter for an electric railway to run between Lac Seul and the Mikado mine and to develop and transmit electric power. It will pass through Keewatin, Norman and Rat Portage. A new feature of the project is that the company, which is a very strong one, agrees to place a stated number of settlers in the country to be opened up, which is a very valuable section, containing much timber and rich mineral deposits.

All the grading for the Grand Valley Electric Railway between Brantford and Paris has been completed and the line is laid to within a mile of Paris, and the company expects to be in a position to commence running on this line by about the first of the year.

The new Pacific cable is reported by A. R. Dearlove, the English expert engineer who has just left Toronto for England, to be finished and in good working order. He says that the working speed of 100 letters a minute attained in transmission on the Pacific cable is relatively very fast and from 10 to 15 per cent. better than expected. He reports the cable in first-class shape and that it will be open for service messages on December 8th. Mr. Dearlove stated that in some of the Atlantic cables a rapidity of 450 letters a minute is secured in transmission, which is about 11 times faster than that of any Marconi telegrams sent across the Atlantic. A rate of 22 cents a word has been made for press messages between any point in Canada and Australia and New Zealand. H.

Ottawa, Ont., December 5.—Toronto and Pittsburg (Pa.) capitalists propose building a belt electric line through the most fruitful part of the Niagara Peninsula. The route is to be from Homer to Niagara-on-the-Lake, thence along the river road to Queenston, and along the Q. & G. stone road back to Homer. Frank Broderick and Herbert L. Dunn of Toronto, Ont., and H. L. Christy of Pittsburg, Pa., are promoting the scheme. Work is to be commenced next spring and completed by July 1, 1905.

Mr. George Johnson of Ottawa, the Dominion statistician, has revised his statistics for publication in respect to the use of electricity for lighting purposes. He shows that the number of companies doing business in electricity, in connection with lighting, has increased from 259 in 1898 to 312 in 1902. The arc lights increased from 10,389 to 12,884 during the same period. The incandescent lamps number 995,056, making an increase of 179,380 lamps over last year, and 531,441 over the year 1898. Reckoning each arc lamp as equal to 10 incandescents, the use of electricity as a light giver, has developed in Canada during the last four years from 565,505 lamps in 1898 to 1,125,896 in 1902. Of the total 312 companies, Ontario has 195, or 62½ per cent. Quebec province has 3,605 arcs and 340,120 incandescents, or, reduced to the standard of incandescents, a total of 376,170 lights, an increase of 218,979 in four years, but of this total the city of Montreal has 208,718. In the whole province there are 52 plants. Nova Scotia's equipment of 409 arcs and 46,475 incandescents, equal to 50,565 incandescents, is distributed among 22 cities and towns, and is supplied by 24 companies. New Brunswick is supplied with the electric light by 11 companies and municipalities. Prince Edward Island's modest share in the total of Canada, is three electric-light companies, with 87 arcs and 11,330 incandescents. Manitoba has six plants, distributing light by 53 arcs and 26,635 incandescents, the territories five plants, with 31 arc and 6,081 incandescents, and British Columbia 16 plants, with 770 arcs and 85,135 incandescents. W.

New England News.

Boston, December 6.—Albert E. Leon of Boston purchased the Buffalo, Hamburg and Aurora electric railway at the receiver's auction sale in Buffalo, N. Y., last week. The price paid was $51,500. Mr. Leon states that the road will be extended to Aurora, N. Y., as soon as possible.

The Connecticut Railway and Lighting Company is arranging to build an extension of its electric road up the Naugatuck Valley to Seymour, Conn. The company will ask the General Assembly for a charter for a line between Seymour and Naugatuck. At the latter place it will connect with the Waterbury Street Railway Company's system.

The Johns-Pratt Company, manufacturer of insulators and fuses, is to enlarge its plant at Hartford, Conn., by the erection of two brick additions two stories high and measuring 31 by 70 feet.

The Connecticut State Board of Equalization has assessed the transportation companies' taxes. The total tax of this description is $1,284,312, of which electric railway companies are assessed $252,139. The Connecticut Railway and Lighting Company is assessed $84,521, the largest amount of any exclusively electric-railway company.

Poor coal led to such low steam pressure at the Boston Elevated Company's power station last Tuesday morning, that it caused an hour's total suspension of traffic on several of the company's lines in the Roxbury District. One crowded car was stalled about 150 feet from a point supplied by power from another source, and the male passengers pushed it that distance after about half an hour's delay.

The Central Electric Construction Company, of New York, has the contract for the Union River Light and Power Company's new brick power station at Ellsworth, Me. The station will be two stories high and will cost $100,000.

The Worcester and Eastern Connecticut Street Railroad Company is contemplating an addition to its Webster, Mass., power plant, to cost $18,800.

William P. Schofield of Malden, Mass., has been appointed receiver of the Marlboro Street Railway Company by Judge Braley of the Middlesex County Superior Court. The company applied for a receiver on the ground that it could not meet the claims for damages based on several accidents which occurred last summer. The company had offered $25,000 in settlement of claims, but three claimants refused to accept the amounts offered them, thus rendering it impossible to make a legal settlement in this way.

The Montague (Mass.) Electric Light and Power Company has been incorporated under Massachusetts laws. Its capital is $2,000. Isaac Chenery is president and F. O. Johnson is treasurer.

The Connecticut Railway and Lighting Company's annual report shows gross earnings from railways of $1,113,177, from electric lighting of $297,137 and from gas plants of $204,470, a total of $1,615,784. The total operating expenses were $936,301, leaving net earnings of $679,483. The company's capital stock amounts to $15,000,000, its funded debt is $9,350,000, and its construction and equipment are appraised at $24,523,339.

The annual report of the Boston Elevated Railway Company for the year ended September 30th shows gross receipts of $11,321,030 and expenses of $7,862,571, leaving net earnings of $3,458,458. Deducting other charges and dividends a surplus is left of $21,898 for the year. The number of revenue passengers carried was 222,484,811, as against 213,107,600 for the preceding year. The annual report of the Massachusetts Electric Company shows gross receipts of $5,768,080, expenses of $3,567,677 and net earnings of $2,200,412. The surplus for the year is $194,724 on a capital stock of $11,910,700. B.

Southern Developments.

Charlotte, N. C., December 4.—At a meeting of the directors of the Richmond and Petersburg Electric Railway Company held at Cleveland, Ohio, O. F. Sitterding of Richmond was elected president, and L. E. Spencer, secretary and treasurer. This company has bought machinery which will increase the horsepower of the plant by 5,000. The new power house of the company will be completed by May 1st.

J. F. Bass and R. A. Denny have gone north to perfect financial arrangements for extending the local electric line at Rome, Ga., to Lindale, a new village owned by the Massachusetts Mill Company. The extension is to be completed in six months.

The town of Barnesville, Ga., will, at an early date, vote on a bond issue, $6,000 of which will be used for a local electric-lighting plant.

The Columbus Railroad Company of Columbus, Ga., will, on January 1st, increase the wages of motormen and conductors from 12 to 13 cents per hour. A 10 per cent. bonus is also given for good service and absence of accidents.

The Yazoo and Mississippi Valley Railroad purposes to install its own electric-lighting plant in the shops of the railroad at Vicksburg, Miss.

It is reported that the Chesapeake Beach line from Washington, D. C., may be converted into a trolley line. David H. Moffatt of Denver, Colo., is owner of the line.

The street-car employes of Houston, Texas, have won out in a strike because of the refusal of the Houston Electric Company to increase wages from 19 to 24 cents per hour and to recognize the union. An advance and partial recognition were secured.

The Berkley (Va.) Railway and Light Company has bought the local electric-light plant and franchise and proposes to construct an electric-railway, light and sewerage system.

It is reported that a company of outside capitalists will build a factory at High Point, N. C., for the manufacture of trolley cars. Plans have been settled upon and a site secured and everything will be in readiness by spring. L.

From the Buckeye State.

Cleveland, Ohio, December 6.—After the lapse of four or five months since the announcement that the Grand Trunk Railway Company had purchased the Detroit and Toledo Shore Line from the Everett-Moore syndicate, the sale has been ratified, but it seems that instead of being sold to the one company the sale was made jointly to the above-named road and to the Clover Leaf. The price fixed is $1,500,000, in four per cent. bonds, which the creditors of the syndicate have agreed to accept for their claims against the electric road. The syndicate reserves the electrical equipment of the road, and it will likely be taken by the Mulkey-Black syndicate, as indicated in the Western Electrician some time ago. The Everett-Moore people will come out clear on this deal and all the creditors will be paid in full. In this connection it is stated that the Lake Shore will be financed in January. A bond issue of $4,000,000 will be made for this purpose. The syndicate will be well on their feet again as soon as these two deals are finally arranged.

The county commissioners have granted the Central Market Street Railway Company of Columbus a franchise to build a short strip of road along the Groveport pike. It is understood that the company will build lines to the southern portion of the county and will also build an outing park later on.

The directors of the Indianola Heating and Lighting Company of Columbus have elected the following-named officers: President, W. E. Swisher; vice-president, W. H. Sharp; secretary and treasurer, Paul DeLong.

The Lorain and Eastern Railway Company of

Cleveland has been incorporated with a nominal capital stock of $1,000, by A. B. Stuber, W. D. Young, George L. Cooley and others. It is the intention to build a line from the western corporation line of Cleveland to Lorain, about midway between the two lines, which are already in operation.

The electric-light plant at Millersburg has been sold to a number of Cleveland men, and it will be improved and the service extended.

A report comes from Toledo that Colonel William Heckert has invented a machine which will warm houses in winter and cool them in summer. It may also be used for cold-storage purposes, and a storage battery may be operated in connection to furnish lights. He calls it a trimoheater, and says that it is a combination steam and gas motor, and that crude oil is used as a fuel.

The Cleveland Gas and Electric Fixture Company of Cleveland has been incorporated with a capital stock of $100,000.

The United States Carbon Company, a New Jersey incorporation, with a capital stock of $400,000, has been authorized to transact business in Ohio. Parks Foster of Cleveland is president of the company.

Former Governor Asa Bushnell of Springfield seems to be taking a great interest in electric-railway matters, and it is reported that he has joined hands with John G. Webb of the same place to build a system of roads. Mr. Webb is one of the principal owners of the Columbus, Delaware and Marion road, and is also heavily interested in the Appleyard lines.

The Cincinnati, Georgetown and Portsmouth line has been opened up as an electric road, and a regular schedule is being maintained between Cincinnati and Georgetown.

The City Council of Defiance has granted the People's Rapid Transit Company of Toledo a franchise to operate its line in that town.

A. E. Appleyard is having plans drawn up for sleepers to be used on his lines. The idea is to make them 72 feet long, the same as Pullmans, and provide them with all the conveniences that are found in the best sleepers on the steam roads. He believes that electric roads will be able to control a great deal of the night travel in this way, because of the absence of smoke, steam and dirt.

The Athens, Nelsonville and Hocking Valley Traction Company of Athens, which was incorporated last spring, has passed into the hands of a number of Pennsylvania men, and it is said it will be built within the next year. The officers of the company are now as follows: President, J. D. Woodard, Warren, Pa.; vice-president, D. H. Siggins, Warren, Pa.; treasurer, L. M. Riddlesperger, Warren, Pa.; secretary, H. H. Hanning, Athens. Mr. Woodard will act as general manager as well as president. Mr. Hanning was connected with the original incorporators, and has had much to do with the promotion of the road. It will extend from Athens to Nelsonville, a distance of 12 or 15 miles.

The Fort Wayne Electric Works of Fort Wayne, Ind., has been authorized to transact business in Ohio, with T. J. Ryan of Cincinnati as Ohio agent.

A company has been formed at Dayton to manufacture an electric brake, invented by Gustave DuWeills. George P. Campbell of Cincinnati, Colonel Glen Goss of Cincinnati and Joseph Dowling and John Brake, both of Dayton, are interested in the manufacture of the invention.

The Youngstown and Ohio River Railroad Company of Salem has been incorporated with a capital stock of $10,000 to build an electric line from Youngstown to East Liverpool, on the Ohio River. Max P. Goodman of Cleveland is the promoter of the road, which will be about 53 miles long and will carry both passengers and freight. O. M. C.

Detroit, Mich.

Detroit, Mich., December 8.—Within a few days the Rapid Railway of Detroit will inaugurate a new through service between Detroit and Marine City, St. Clair and Port Huron via its new short line, which has just been completed between Anchorville and Marine City. This line shortens the distance between Detroit and the points named materially, and will result in lessening the schedule time by as much as half an hour.

A company known as the Peninsula Power and Light Company is being organized to build an electric railway from Port Huron to Port Austin in the extreme eastern part of the state, and touching at all the points now reached by the Pere Marquette railroad. The power for operating, it is said, will come from the "Soo."

The Michigan Central Traction Company, which proposes to build an electric road between Lansing and Battle Creek via Grand Ledge and Charlotte, has been granted a franchise through Lansing and Battle Creek. It is understood that Samuel Burgert of Cleveland, Ohio, is financing the new company.

The project to build an electric line between Grand Rapids and Saginaw via Belding, Alma and St. Louis is being revived. The City Council of Belding has extended the charter which expired on December 1st for one year. G. S. Johnson, general manager of the Grand Rapids Railway Company, is backing the enterprise with all the resources at his command.

Chicago and Cleveland capitalists are negotiating for the purchase of the water rights of the Menominee River at White and Chappee Rapids, respectively 20 and seven miles from Menominee. If the rights are secured, the purchasers will utilize the power for the operation of an electric railway between Menominee and Escanaba. Power will also be transmitted to Menominee, and will be great enough to run all the factories in both that city and Marinette just across the river in Wisconsin.

Charles R. Floyd has been relieved of his accounting duties with the Grand Rapids, Holland and Lake Michigan electric railway and appointed traffic manager and purchasing agent. J. Van Volkenburg will succeed Mr. Floyd as accountant. Extensive improvements are being made at the Holland sub-station.

Prominent Saginaw capitalists are said to have taken up the work of building the electric road between that city and Flint. A private right-of-way has been secured nearly the entire distance of 34 miles and considerable work has been done by the Union Traction Company which claims to have 50 men and 35 teams now at work on the grade north of Mt. Morris in Genesee County.

A project is now on foot for the building of an interstate interurban line connecting Ohio and Indiana with the fruit belt of Michigan. Franchises have been granted the Kalamazoo (Mich.) and Elkhart (Ind.) line for the entire distance between the places named, and in many places work has been begun. Counties in Indiana have ordered a special election to consider the question of granting subsidies to aid in the construction of the line connecting South Bend, Elkhart, Warsaw and Winona. This line is the connecting link of the Fort Wayne, Dayton and Cincinnati electric railway now building from Cincinnati to Ft. Wayne and will give the latter a direct route to the peach region of Michigan. C. G. W.

Information from Indiana.

Indianapolis, December 9.—The Michigan City Traction Company has been incorporated with a capital stock of $50,000. The purposes of the company are to construct, own, acquire and operate street and interurban electric railways in the streets of Michigan City and in the townships, towns and cities of Laporte and adjacent counties in northern Indiana, for passenger and freight traffic. H. B. Harrison, J. B. Collins, M. C. Shutt and S. G. Boyd are the incorporators.

The commissioners of Tippecanoe County, on December 6th, granted a franchise from Lafayette to the east line of the county to the Townsend Reed Company in the interest of the Indianapolis, Lebanon and Frankfort Traction line, a portion of which is already built and which will in a few days change its name to the Indianapolis and Northwestern Traction Company. The company has made arrangements with the Lafayette Street Railway Company to use the local tracks as a terminal. The Commissioners of Marion County, the next day, granted the same company a franchise right to cross highways and to lay tracks in certain unincorporated towns from Indianapolis to the Boone County line. The company filed a bond to complete the road next year and to keep the highways in good condition. This completes the arrangements for the second largest interurban system in the state.

The Union Traction Company, encouraged by its good luck in Anderson, has asked the City Council of Marion for an extension of charter rights in that city. The Union Traction Company succeeded to the franchise rights held by the Marion City Railway Company, the Queen City Railway Company and the Marion Transit Company, and the request is that these be merged into one grant and extended for 50 years. J. A. Carley, claiming to represent Chicago capitalists, has also asked for a franchise for a terminal line in Marion. He says the line will come in from the north through Wabash. He claims his company was building from Chicago to Terre Haute, and desired to extend branch lines through this section of the state.

The Terre Haute Street Railway Company made a pretense of building an interurban road west from the city to the river, a distance of six miles on the National Road. The franchise was granted in the afternoon of December 1st, and late at night 100 men began laying ties and rails. There was no pretense at building a track on which cars could run. The object was to head off another company, which was organized at Paris, Ill., to build a line to Terre Haute. The promoters of the Paris company are ex-Congressman Andrew Hunter, United States Marshal Charles Hitch and some Cincinnati capitalists. It is claimed that these men are connected with the proposed merger of the Indiana and Ohio traction lines, and it is said their proposition is to build west from Paris to reach St. Louis by connecting a number of smaller lines, for the opening of the World's Fair.

Preparation is being made to build an electric railway from Goshen to White Pigeon and other Southern Michigan towns and cities next year.

Considerable interest attaches to the incorporation last week of the Indiana company at Camden, N. J., with a capital of $1,000,000, with $500,000 paid in. The company, according to its articles of incorporation, is to construct electric railways and electric-light plants in Indiana. The directors are Thomas Dolan, Randall Morgan, Frank H. MacMorris, C. N. Latourette and G. H. Martin, most of them Philadelphians.

The friends of the muncipal electric-lighting system, which has been in operation for five months in Richmond, are well pleased with the showing made. They assert that as soon as the plant can get the consumers connected there will be an income sufficient to maintain the plant without the street lighting, which now goes to a private company at an expense of $15,000 per year. When this is turned into the city company's coffers the plant is expected to speedily pay for itself.

L. K. Davis of Indianapolis has purchased the Martinsville electric light plant for a consideration of $8,500. Mr. Davis will repair and improve the plant and will put $50,000 worth of new machinery, pipe lines and wires in the plant. F.

Northwestern Notations.

Minneapolis, December 6.—After a prolonged contention between the street-railway company and the council of Fargo, N. D., on the question of iron or wooden trolley-wire poles, a compromise has been reached on the basis of iron poles for the business district and wooden poles for the residence portions.

A right-of-way has been nearly completed for the projected electric-railway line from Green Bay, Wis., to Kaukauna. A company has been formed and orders are now being placed for rails and other materials.

New machinery is being installed by the electric-light company at Jamestown, N. D.

The Sioux City Traction Company expects to start work next season for the construction of new barns and car shops at Sioux City, Iowa, to cost more than half a half million dollars. The car barns will be erected at once. The power house is to be enlarged and the capacity of the car shops doubled.

The Tri-city Railway Company of Davenport, Iowa, has placed orders for a large amount of materials for new work next season. These orders represent a value of about $125,000.

The Davenport and Western Interurban Railway Company has filed a formal acceptance of the franchise passed by the City Council of Davenport, Iowa.

A mass meeting at Nicollet, Minn., voted in favor of an electric-lighting plant.

The School Board of St. Paul has appropriated funds for the purchase of equipment and material for a new electrical course, to be added to the Mechanics' Arts High School.

The Winnipeg Power Company is transporting machinery to the new electric power plant beyond Lac du Bonnet, near Winnipeg, Man. About $100,000 will be expended on machinery for this new station, where large buildings have been completed. The company expects to be transmitting power for general use in Winnipeg in about one year.

The city of Park River, N. D., is taking bids for the position of superintendent of the city electric-light plant for a year from January 1st. R.

PERSONAL.

T. Charles Young, representing the Woodward Governor Company of Rockford, Ill., was a Chicago visitor earlier in the week.

R. S. Masson has been appointed consulting electrical engineer of the Los Angeles Railway Company of Los Angeles, Cal., and will report to the general manager, J. A. Muir.

Professor W. F. Williams of the Agricultural College of Bozeman, Mont., has resigned and accepted a position as assistant professor of electrical engineering in the University of Illinois at Urbana, Ill.

Mr. and Mrs. Jerome Jones of Boston have announced the engagement of John Bellamy Taylor of the engineering department of the General Electric Company at Schenectady, N. Y., and their daughter, Marcia E. Jones.

C. H. Mackay, president, and George G. Ward, vice-president of the Commercial Cable Company, and W. H. Baker and E. C. Bradley, vice-presidents of the Postal Telegraph-cable Company, are in San Francisco to witness the beginning of the laying of the new Pacific cable.

Charles C. Burton, who has been electrical engineer at Little Falls, Minn., for the Morrison County Electric Company for the last year, has resigned, to accept a position with an electrical manufacturing company in Chicago. Mr. Burton is a Chicago electrical man of wide experience, and his friends note his return to town with great pleasure.

A. A. Anderson has resigned as general manager of the Pennsylvania and Mahoning Valley Railway Company of Youngstown, Ohio, and W. C. Smith has been appointed to the position. A few days ago the employes of the road tendered Mr. Anderson and his wife a reception and presented them with an expensive mahogany "grandfather's clock."

ELECTRIC LIGHTING.

Reinbeck, Iowa, has let a contract for the installing of an electric-light and heating plant. D. E. Mann of Gladbrook, Iowa, will install the plant.

The Hayward (Wis.) Electric Light and Power Company has been incorporated with a capital stock

of $25,000 by T. S. Whitton, J. H. Hellweg and Henry Murry.

The Douglas (Wyo.) Electric Light Company has been incorporated. John T. Williams is president of the new company. A complete new plant is to be erected, and new machinery installed.

The Otsego Light, Heat and Power Company of Oneonta, N. Y., has been incorporated with a capital stock of $100,000. The directors of the company include E. C. White, H. T. Jennings and C. V. D. Peek.

The Empire Manufacturing Company of Franklinville, N. Y., has recently purchased the Citizens' Electric Light Company's plant of that city and desires circulars, catalogues, etc., of machinery and supplies. The company intends to install a 100-horsepower engine and a 1,000-light dynamo.

The Meridian (Miss.) Light and Railway Company has recently installed two 200-kilowatt, three-phase, self-compensating, General Electric generators and accompanying transformers to furnish current for 150 arc lamps for the city. A new marble switchboard, 12 by 7½ feet in size, is in place. The work of installation was under the supervision of J. F. MacWilliams, superintendent of the company.

A party of electricians and engineers visited St. Joseph, Mo., recently to consult with J. H. Van Brunt, general manager of the St. Joseph Railway, Light, Heat and Power Company, with reference to the enlargement of the company's plant. Part of the visitors are stockholders in the company and the others were called in for consultation purposes. The party was composed of the following-named gentlemen: M. S. Hopkins, general manager of the Columbus Street Railway Company; John J. Lichter of St. Louis; E. F. Williams of the Quincy Engine Company, and Mr. Lyman, electrical engineer for the General Electric Company of Chicago.

ELECTRIC RAILWAYS.

A recent press despatch announces that plans have been submitted to the French minister of the interior for the construction of an electric railroad to the summit of Mount Blanc from the village of Les Houches, on the Savoy side of the mountain.

The Citizens' Elevated Electric Railway Company of St. Louis, Mo., has been incorporated to build a double-track elevated electric railway in that city. The capital stock is $100,000. The incorporators are J. R. Dwyer, Charles Erd, T. F. Meyer, E. R. Darlington and A. V. Brecht.

The Michigan City (Ind.) Traction Company has been incorporated with a capital stock of $50,000, one-half of which is preferred. The directors are Colonel R. B. Harrison, J. B. Collins, M. A. Schutt and Samuel G. Boyd. It is understood that this is but a reorganization of the Lake Cities Electric Company.

According to a table of street railroads in operation in the District of Columbia, prepared by the engineer commissioner, there are 37 miles of double track and 9.93 miles of single track used in the underground electric system, while the overhead electric system employs 28.80 miles of double track and 2.96 miles of single track.

It is reported that a big electric-railway deal was recently consummated in Wilkesbarre, Pa. The Wilkesbarre and Wyoming Valley Traction Company and several other important electric-railway systems in Pennsylvania, New Jersey and Delaware, of which J. A. Rigg of Reading, Pa., is the president, were sold to a syndicate headed by George Gould of New York.

It is said that Frank Battle of Philadelphia has secured control of two important roads in New York state. It has been decided to extend the Cortland electric line from Cortland to Homer, through to Syracuse. A deal has also gone through for the purchase of the Erie and Central New York steam railroad, which at present runs from Cincinnatus to Cortland.

The Vandergrift Construction Company of Philadelphia has accepted the proposition of the Executive Council of San Juan, Porto Rico, for a franchise to build an electric railway from San Juan to Ponce, and has deposited a $10,000 bond as a pledge of faith. The council will now draft the conditions of the franchise, which, if accepted by the construction company, will entail the furnishing of bonds to the amount of $100,000.

It has been officially announced that the Indiana Traction and Terminal Company of Indianapolis will lease the Indiana Street Railway Company's lines for a period of 30 years, and will issue $5,000,000 in bonds. Of this issue $1,500,000 will be distributed among the stockholders of the railway company as a bonus. The terminal company has a franchise and a contract with all the interurban roads entering Indianapolis and will erect a station to cost $1,000,000 in a few months.

A recent London dispatch credits Prime Minister Balfour with the announcement in the House of Commons that the government was considering the appointment of a commission which shall be empowered to hold a complete inquiry into the subject of underground railways. The appointment of such a commission, according to the view of the solicitor of Messrs. Parks and Yerkes and the chairman of the District Railway, will involve the hanging up of Mr. Morgan's and other schemes yet unsanctioned for two or three years, as a commission is not likely to report in less than that time. Meanwhile the Yerkes and Speyer schemes will go ahead.

The Auburn City Railway Company, comprising the entire street-railway system of Auburn, N. Y., has consolidated with the Auburn Interurban Electric Railroad Company under the name of the Auburn and Syracuse Electric Railroad Company. Besides the street-railway system in Auburn, the new company owns an interurban line which, when completed, will connect Auburn and Syracuse. Fourteen miles of this interurban line has been completed and the remaining 9½ miles to Syracuse has been graded and entrance to the business center of Syracuse has been secured. The total trackage of the new company when completed will be over 37 miles.

The New York Central Railroad Company is making a hard fight to prevent trolley roads from paralleling its line through the center of New York state. A writ of certiorari, granted by Justice Nash of Rochester, on the application of the Central's attorneys, has been served on the State Railroad Commission, directing it to certify to its proceedings in granting to the Rochester, Syracuse and Eastern Railroad Company a certificate to construct and operate a line between Rochester and Syracuse. In its application for the writ of certiorari, the steam railroad company argues that its line runs through all of the towns concerned between Rochester and Syracuse, by a route six-tenths of a mile shorter than the trolley. It points out that the West Shore road also runs through most of these places, and that a third railroad connects Rochester and Syracuse by way of Auburn. For those reasons it argues that public convenience has no need of a fourth or trolley line.

PUBLICATIONS.

The London Electrician (Salisbury Court, Fleet Street, London, E. C.) is gathering material for the forthcoming (1903) edition of its well-known Electrical Trades' Directory and Handbook, which is to be issued in January. This is otherwise known as the Blue Book and has won an international reputation for accuracy and care in preparation.

The latest additions to the trade publications of the Fort Wayne Electric Works of Fort Wayne, Ind., include bulletins describing their B. & B. commutator-truing device and mast arms and pulley outfits for outdoor arc lamps, flyers descriptive of primary fuse boxes and of a type-A transformer struck by lightning, and a calendar card for December, illustrating the firm's form C arc lamps.

The Frank Adam Electric Company of St. Louis, Mo., issues new bulletins, Nos. 105 and 106, which apply to its new line of drawn-copper tablet boards and wood and iron box cabinets. This line was made up at the request of a number of its customers, and is arranged in such form that one can readily figure a complete job for tablet boards and cabinets, thereby saving considerable correspondence. The bulletins illustrate and describe the general arrangement of the tablet boards and cabinets.

A complete line of direct-current turbine dynamos of capacities ranging from 1½ to 300 horsepower is shown in a 22-page bulletin issued by the De Laval Steam Turbine Company of 74 Cortlandt Street, New York city. All units from 50 to 200 kilowatts inclusive consist of two generators mounted side by side and geared together. The generators are built for 125, 250 or 500 volts and are adapted for either power or lighting. The bulletin is well illustrated with various sizes of units and detailed parts. A table of data shows that the speed runs from 5,000 revolutions a minute for a one-kilowatt unit to 900 revolutions for a 200-kilowatt set.

The Western Electrical Supply Company of St. Louis has recently gotten out two attractive catalogues of seasonable articles. One of them illustrates a complete line of electrical toys and small motors and dynamos. While these are toys, they are exact miniature reproductions of large apparatus, and are mechanically, and are said to be electrically, perfect in every detail. The company says there has been an increase of the demand for this catalogue. The company has also issued a new catalogue on miniature incandescent lamps and fittings, showing a full line of socketless, series lamps, which can be used to advantage in decorating rooms and trees for Christmas.

SPACE TELEGRAPHY.

It is announced that the French Government does not consider that the practical use of space telegraphy, except at sea, has been demonstrated as yet. The Government will permit the installation of a system only under its own control.

It is said that Marconi has announced that he will leave Glace Bay, C. B., shortly for off-shore experiments. The Tablehead station, it is expected, will be opened within a few days by Lord Minto, governor-general of Canada, who will send a message to King Edward VII.

A recent demonstration of Anders Bull's system of space telegraphy before the Danish Polytechnic Society is said to have convinced Danish scientists of the practicability of the system. Mr. Bull also demonstrated, it is said, that secrecy could be obtained through the method of tuning the receivers.

MISCELLANEOUS.

The Connecticut Railway and Lighting Company reports for the fiscal year, ended June 30, as follows: Gross income from railway, $1,113,778; electric light, $297,136; gas light, $204,470; total gross income, $1,615,384; operating expenses for railway, $616,723; electric, $188,938, and gas, $130,639; total expenses, $936,301; net earnings, $697,083; surplus, $87,813.

A speed test was made recently of the electric hoisting machinery of the new Northwestern coal dock on Superior Bay, near Duluth, Minn. These hoists are the only ones at the head of the lakes operated entirely by electricity and, accordingly, the test was watched with interest. Eighteen hundred tons of coal was unloaded during the test in 5½ hours. The buckets used in the test have a capacity of 2,500 to 3,500 pounds. It is asserted that no dock machinery at the head of the lakes can equal the above record.

Professor Robert W. Wood of Johns Hopkins University is said to have discovered a substance that is transparent to the ultra-violet rays of the solar spectrum alone. Dr. Wood had known for some time that substance called nitroso-dimethylaniline would keep out all the visible and heat rays, except some red and violet, and that it would also let through the ultra-violet. He combined the known substance with cobalt glass and obtained a screen that lets through only ultra-violet. One striking peculiarity of the new screen is the fact that it gives a spectrum about 30 times as broad as that produced by the ordinary quartz.

Observations in the Alps, at a time of rapid alternations of fair weather and storms, have shown W. Caspari, he says, that the air is strongly electrified—or "ionized"—during the clear periods, and that the prevalence of positive or negative ions changes to correspond with the fair or stormy weather.. Mountain sickness is thought to be closely connected with atmospheric electricity, an excess of free ions appearing to act as poison. The Lyssjoch, which is 13,000 feet high at the edge of a vast ice cleft, has a bad reputation for mountain sickness, and here the dissipation of electricity is probably the greatest ever observed.

The Helena (Mont.) Light and Traction Company has again met with a loss by fire. This time an oven used for drying out the coils of the transformers damaged in the recent fire was completely destroyed. The coils at the time of the first fire were water and oil soaked, and it was thought that by putting them in an oven and baking them they might be saved. The coils had been under great heat for several days, and a man was employed to tend the fire and watch the oven night and day. The tender, however, put in a big fire and went to dinner. During his absence the oven took fire and was burned up, destroying the coils completely.

The board of inspection and survey of the recent trials of the submarine boats, Adder and Moccasin, in reviewing the tests, states that the storage batteries were not in proper condition at the time of the trial. In the three hours submerged the Adder struck the bottom. The board calls attention to the fact that the battery cells of the Adder and her class are entirely open on top, so that if the craft were to change trim to a considerable extent, as she would do in all probability in a seaway, the liquid contents would spill over, and into the neighboring parts of the vessel. It is recommended the design of future storage batteries be made with water-tight covers.

TRADE NEWS.

The Adrian (Mich.) Electric Light Company is in the market for dynamos, rheostats, switchboard, wire, arc lamps, transformers and cedar poles.

A convention of the salesmen of the General Electric Company situated in the Middle West will be held at the Grand Pacific Hotel, Chicago, on January 6th, 7th, 8th and 9th, to discuss questions of general interest.

The Scheeffer Instrument Company of Peoria, Ill., has been incorporated with a capital stock of $12,000 to manufacture electrical instruments. The incorporators are G. A. Sheeffer, Hugh H. Moody and Judson Starr.

The Cadott Manufacturing Company of Cadott, Wis., has been incorporated to manufacture and deal in electrical machinery and appliances. The capital stock is $20,000 and the incorporators are F. L. Munroe, W. T. Gilbert and W. H. Smith.

George W. Conover, purchasing and forwarding agent for Independent telephone companies, announces that owing to his rapidly increasing business he has found it necessary to engage larger quarters.

Mr. Conover is now located in suite 1112 Merchants Loan and Trust Building, 136 Adams Street, Chicago.

The Electric Gate and Signal Company of Omaha, Neb., has been incorporated with a capital stock of $500,000. The incorporators are J. C. Small, George F. Hamilton, H. C. Chambers, B. A. Karr, J. A. Clark, W. M. Gaines and W. Michaelsen. The company is organized to enter into the manufacture of an electric gate for railway crossings, a switch signal, an automatic semaphore and block system, and an electric alarm.

The Electrical Equipment Company of 939 Monadnock Block, Chicago, issues a circular, of which this is a part: "The Electrical Equipment Company wishes to announce that Mr. J. Holt Gates has retired from the presidency of this corporation, having disposed of his interests therein, and is no longer connected with the company in any capacity whatsoever. Mr. J. W. Peterson has been elected president and will continue in the active management of the business." J. Holt Gates writes: "J. Holt Gates & Co., contracting engineers, Chicago, have removed their offices to 927 Monadnock Block, where they will continue the business of complete installation of electric and steam plants."

BUSINESS.

Users of poles will be interested to learn that the Lindsley Brothers Company, Chicago, one of the largest producers of poles in the country, has just purchased a tract of cedar land comprising 11,000 acres. This is said to be the largest purchase of its kind ever made, and assures the Lindsley Company a supply of poles for at least 10 years. The land is in the best cedar-growing section of the state of Michigan, being in Marquette County.

The Electric Appliance Company of Chicago, selling agent for Guttmann alternating-current wattmeters, announces that although it is shipping hundreds of these meters every week, it is still able to keep up with its orders and make prompt deliveries, owing to the increased facilities at the factory. The company desires to give wide publicity to this fact, as the rapid growth of its meter business during the last three years has not always found it in this enviable position.

The Cambridge Electric Light Company of Cambridge, Mass., has reecntly purchased from the Westinghouse Electric and Manufacturing Company 99 induction motors, which will take care of the bulk of the present direct-current power service, comprising every possible use of electric power in a city of this kind, from public works to small tailoring establishments. The order comprises 11 motors of one horsepower, 26 two-horsepower, nine three-horsepower, 19 five-horsepower, 25 7½-horsepower and nine 15-horsepower.

Iwan Bros., Streator, Ill., have placed on the market a patent improved auger, which is said to be meeting with special favor among construction men. This auger is largely used by street-railway, electric-light, telephone and telegraph companies for digging pole and post holes, etc. The manufacturers say that it has met with universal satisfaction under all conditions of soil, is effective in operation and unexcelled for easy and quick work. This auger was awarded a medal and diploma at the World's Fair for convenience and effectiveness of operation and excellence of material and construction.

The Electric Storage Battery Company of Philadelphia has recently closed a contract with the Oakland Transit Consolidated, located at Oakland, Cal., for the installation of a battery of Chloride accumulators, to be used on the purchaser's railway system. The battery consists of 264 cells, having a capacity of 550 kilowatts, and in connection with a booster is to be installed at the center of distribution of the system about 2½ miles from the generating station. It is to be used to reduce the amount of feeders otherwise necessary, and to regulate the fluctuations of load on the generators at the power house.

The Western Electric Company of Chicago is now western selling agent for the house-goods specialties, such as burglar alarms, door openers, bells, watchmen's clocks, electric-light door switches, etc., that are manufactured by Edwards & Co. of New York city. It is carrying a stock in Chicago of all the more important items and issues special catalogues of the goods. At the present time the Western company is energetically pushing these specialties, as well as its Sunbeam lamps, and as a means of bringing the material before the trade is sending out attractive circular letters. Numerous replies have already been received and a large increase in the business along this line is expected.

The Crocker-Wheeler Company, Ampere, N. J., manufacturer of electrical machinery, has included among its shipments of engine-type generators for the month of November one 400-kilowatt, for the Stephen Girard Building, Philadelphia, Pa., one 100-kilowatt and one 125-kilowatt, for the Missour Pacific railway, St. Louis, Mo.; one 300-kilowatt, for the Grand Crossing Tack Company, Chicago, Ill.; one 400-kilowatt, for the Lake Construction Company, Erie County, Pennsylvania; one 250-kilowatt for the Wilmington City Electric Company, Wilmington, Del.; one 225-kilowatt, for the Pine Bluff & Western Railway, Pine Bluff, Ark.; two 150-kilowatt, one 200-kilowatt and one 75-kilowatt for the Woodward & Lothrop Building, Washington, D. C. The company reports that its new mill building is now being occupied, enlarging its floor space by 60,000 square feet, giving increased facilities for prompt deliveries on large orders.

About a year ago Arthur F. Stanley of the supply house of Stanley & Patterson, New York, sold out his interest in that well-known institution and commenced business alone as manufacturers' agent in the Broadway-Maiden Lane Building in New York. Since that time Mr. Stanley has been representing the Robbins & Meyers Company, Springfield; Warren Electric and Specialty Company, Warren, Ohio; Proctor-Raymond Manufacturing Company, Buffalo, N. Y.; Renim Specialty Company, Boston, and Indiana Rubber and Insulated Wire Company, Jonesboro. As his business has rapidly grown, Mr. Stanley, of course, constantly added facilities, until with his present office organization he finds himself in position to add to his line of first-class specialties. Western houses in the electrical trade feeling the need of eastern representation, are requested to correspond with Mr. Stanley. Mr. Stanley has been in the electrical business for 20 years, starting with the Western Electric Company in 1873.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office, December 2, 1902.

714,680. Pay Telephone. Charles E. Egan, Durham, N. C. Application filed April 22, 1902.

The receiver hook occupies a position at the lower end of the channel and is adapted to support a deposited coin when the hook is in its elevated position and the receiver is removed therefrom. Contact members arranged at the lower end of the channel are adapted to be bridged by a deposited coin and thereby to complete the circuit through the instrument and over the main line. Means are provided for determining the route of travel of the coin when the hook is lowered and the coin permitted to pass from between the contacts. (See cut.)

714,681. Signal Bell for Telephone Systems. Charles E. Egan, Durham, N. C. Application filed September 17, 1902.

The apparatus comprises an electromagnetic actuator, a condenser combined therewith in a unitary structure, and circuit connections between the actuator and condenser, whereby the condenser will be alternately placed in the line in series with the actuator and cut out therefrom upon the passage of current through the connections and operation of the actuator.

714,695. Electromagnetic Traction-increasing Device. Albert A. Honey, Tacoma, Wash. Application filed April 1, 1902.

In the device are combined a wheel, an idle wheel, a magnetizable bar extending between the wheels, and an electric coil or helix for magnetizing the bar and wheels.

714,716. Combined Curb and Conduit. Frank Lappin, Washington, D. C., assignor of one-half to John J. Weed, Washington, D. C., and Edward D. N. Whitney, Minneapolis, Minn. Application filed May 12, 1902.

The combined curb and conduit described consists of rectangular metal troughs having covers with depending flanges fitting into the upper ends of the troughs. The troughs have flanges at their ends for bolting them together, and hooks on their inner sides to receive the electric cables.

714,718. Overhead Conduit for Electrical Service Wires. Fred C. Locke, Boston, Mass. Application filed May 31, 1902.

An uninsulated span wire is combined with supports at intervals on the span wire, and insulated service wires or pairs, independently strung along the supports.

714,721. Armature Winding for Electric Motors or Dynamos. Robert Lundell, New York, N. Y. Application filed January 23, 1902.

A winding for a drum or cylindrical armature consists of upper and lower sets of separable coils for similar form or construction disposed in concentric surfaces, the adjacent upper and lower coils being connected to their respective commutator bars in sequence.

714,734. Electric Block Signal. Edgar M. North, Brooklyn, N. Y. Application filed March 22, 1902.

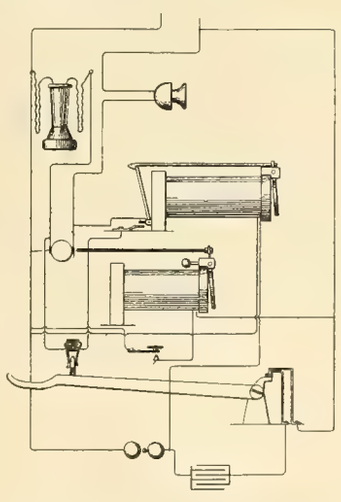
The signal has a semaphore lever pivotally mounted at the initial end of the block, and suitable means to place the lever in the control of the passing wheel, whereby the lever will be elevated.

714,746. Electric-railway System. William Robinson, Boston, Mass. Application filed January 15, 1898.

An electromagnet has its terminals connected to two stationary contact conductors, and a car is provided with a circuit instrument or device arranged to make electrical connection between the conductors and a switch included in or forming a part of the circuit instrument, the switch being arranged to disconnect and to establish electrical connection between the respective sections of the instrument.

714,756. Method of Selective Electric Signaling. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed February 8, 1900.

The method of developing free or unguided simple harmonic electromagnetic waves of a definite frequency is described. It consists in producing forced simple harmonic electric vibrations of the same frequency in an elevated conductor.



NO. 714,680.—PAY TELEPHONE.

714,759. Telephone System. Alfred F. Swan, Bayonne, N. J. Application filed May 11, 1901.

A single horizontal pivoted switch arm is connected with the line, the arm having a widened and bifurcated end thereon. A rotating cylinder is operated by makes and breaks in the line and pins are disposed thereon so that one set of the pins in unison in contact with the bifurcated switch arm will cut the telephone to line and the other set out of line by short-circuiting.

714,760. Electric Annunciator Drop. Edward G. Thomas, Cambridge, Mass., assignor to the Electric Gas Lighting Company. Application filed March 29, 1900. Renewed June 3, 1902.

In the drop are combined a magnet and a support therefor of an armature pivoted to the support below and to one side of the magnet, and tending to fall away therefrom by turning on its pivots, the support being slotted to receive one of the pivots of the armature, a catch carried by the armature and a stop therefor, the catch being arranged to be withdrawn from its stop by a non-rotational movement of the armature lengthwise of the slot, and an indicating device movable with the armature.

714,769. Carbon-holder for Dynamo-electric Machines. Charles Zabel, Bruno Zabel and William Zabel, Edgewood Park, Pa. Application filed October 28, 1901.

A clip for clamping the end of the carbon comprises two substantially parallel arms or members arranged to receive the end of an ordinary flat commercial carbon between them and adapted to bear on the inner and outer faces thereof and leaving the side edges thereof exposed.

714,775. Electrical Process of Locating Running Water in the Earth. Fred H. Brown, Los Angeles, Cal. Application filed March 31, 1902.

The process consists of a method of transforming the vibrations set up by the running water into electrical pulsations, then transforming these electrical pulsations into sound waves, then comparing the volume of sounds taken over a section of earth containing running water as compared with a similar section of earth removed from and not containing running water.

714,786. Controlling Electric Motor. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 26, 1900.

One claim reads: The combination of a motor, a generator electrically connected thereto, manually controlled means for gradually building up the field of the generator in either direction, and a synchronous electromotive device operatively connected to the motor and arranged to operate in synchronism therewith to cut down gradually the field of the generator.

714,810. Thermostat. Alfred T. Le Vesconte, Minneapolis, Minn. Application filed February 7, 1901.

The thermostat comprises a liquid-containing chamber having a diaphragm which is moved by pressure generated within the chamber. A pair of electrodes is movable in and out of contact by the diaphragm.

714,811. Brush-holder. Walter D. Litchfield, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 30, 1901.

A contact piece is arranged to bear on the top of the brush and a spring is arranged to bear on the contact piece to force the brush against the commutator. A piece of good conducting metal is arranged in contact with the spring to shunt current therefrom. (See cut on next page.)

714,813. Joint for Telephone-transmitter Arms. Charles T. Mason, Sumter, S. C. Application filed June 3, 1902.

Mechanical features of the joint are described.

714,824. Process of Starting Induction Motors. Alfred Schwartz, Cologne, Germany, assignor to the Helios Electrical Construction Company, Cologne, Ehrenfeld, Germany. Application filed March 18, 1901.

The process consists in pushing the armature out of the field when the field coil is inserted in the circuit, imparting a slight rotation to the armature, whereby the motor may be rotated at its normal speed, then bringing the armature back into the field, and automatically operating a clutch device through the movement of the armature.

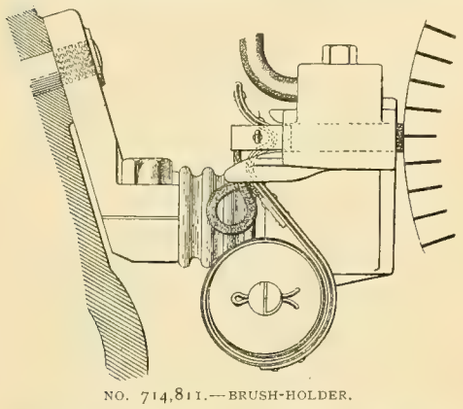
714,831. Apparatus for Selective Electric Signaling. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Original application filed

February 8, 1900. Divided and this application filed January 23, 1901.

The inventor describes a system for developing free or unguided simple harmonic electromagnetic signal waves of a definite frequency, the system comprising an elevated conductor and means for developing therein forced simple harmonic electric vibrations of corresponding frequency.

714,832. Apparatus for Amplifying Electromagnetic Signal Waves. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed January 23, 1901.

In an apparatus for producing high-frequency simple harmonic electromagnetic signal waves are means of developing simple harmonic electric oscillations of high frequency in a primary circuit, an elevated conductor and a step-up transformer having its primary helix associated with the primary circuit, and its secondary helix associated with the elevated conductor.



NO. 714,811.—BRUSH-HOLDER.

714,833. Method of Amplifying Electromagnetic Signal Waves. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed January 23, 1901.

One claim reads: The method of developing high-frequency simple harmonic electromagnetic signal waves which consists in producing simple harmonic electric oscillations of corresponding frequency in a primary circuit and causing the same to reproduce inductively corresponding simple harmonic oscillations at increased amplitude in an elevated conductor.

714,834. Apparatus for Selective Electric Signaling. John S. Stone, Cambridge, Mass., assignor to the Stone Telegraph and Telephone Company, Boston, Mass. Original application filed August 8, 1902. Divided and this application filed October 4, 1902.

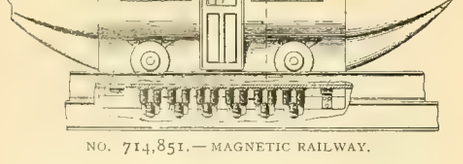
A condenser telephone constitutes one of the tuning elements of a resonant receiving circuit.

714,851. Railway and Car and Magnetic Appliances Therefor. Albert C. Albertson, New York, N. Y. Application filed April 8, 1902.

One claim reads: A railway having along its line and substantially parallel with its track rail or rails, an armature rail, and a car or vehicle, for the railway, carrying a magnet, the pole piece or pieces of which are so disposed as to move in a path below and under the armature rail when the car is in motion, with their poles directed toward the smooth under face of the armature rail. (See cut.)

714,861. Process of Electrolytic Separation of Copper and Nickel. David H. Browne, Cleveland, Ohio, assignor to the Canadian Copper Company, Cleveland, Ohio. Application filed January 27, 1899. Renewed September 19, 1902.

The process consists in, first, treating copper-nickel matte to form copper-nickel alloy substantially free from sulphur, then treating the alloy with chlorine and a solvent for cuprous chloride.



NO. 714,851.—MAGNETIC RAILWAY.

714,862. Controlling Electric Motor. Harold W. Buck, Niagara Falls, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 17, 1900.

Combined with a motor are manually controlled means for supplying current to the motor, and an electromotive device which operates in synchronism with the motor and acts to shut off the supply of current to the motor.

714,869. Connector. George W. Cravens, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 1, 1901.

The device consists of a cup-shaped socket and a cup-shaped plug both of moldable insulating material, with insulating barriers adapted to coact to prevent a short-circuit of the generator leads.

714,891. Transformer and Means for Winding Same. Edwin R. Gill, New York, N. Y., assignor to the Invention Developing Company. Application filed May 4, 1899.

The core is composed of sections, each of which is composed of a practically continuous coiled strip of iron, the sections being shaped to fit together in one common section.

714,893. Electric Current Regulator. James W. Hammond, Fredonia, N. Y. Application filed July 23, 1902.

Parts of the regulator are a centrifugal governing device, an arm pivoted to a sleeve and provided at one end with a longitudinally disposed slot, a standard having a pin adapted to the slot, a binding post, a switch lever for connecting the binding post and the standard, a number of insulated blocks, resistance coils connected in series with the blocks, a block or brush carried by the arm and adapted to be traveled over the surface of the blocks by the centrifugal governor, and an electric circuit in which both the insulated blocks and the contact block or brush are connected.

714,904. Electromagnetic Device. James S. Hodges, Troy, N. Y. Application filed April 14, 1902.

The device is adapted to produce a unidirectional effect while the exciting current varies from a positive to a negative maximum, and comprises electric circuits of different time-constants and a number of magnetic circuits, the magnetic circuits being controlled by the electric circuits.

714,905. Electromechanical Clock. Samuel H. Hoggson, New York, N. Y. Application filed November 27, 1901.

An electromagnet is used in the operation of a clock.

714,913. Track Brake for Electric Cars. Orlando Keen, Allentown, Pa. Application filed April 23, 1902.

A spring is arranged in the hanger and bears against the shank. The shoe is provided intermediate of its ends with a vertical bore or channel and has its contact face shaped to conform to the surface of a rail. A pipe supplies sand to the shoe, and shoe locking and unlocking mechanism are operatively connected with the shank.

714,916. Automatic Clutch. James W. Kellogg, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 17, 1902.

In a wheeled vehicle are combined the driving motor, the motor supporting frame, the traction wheels, power-transmitting gearing from the motor to the traction wheels, friction-clutch mechanism interposed in the gearing, and means whereby the friction-clutch mechanism becomes locked to the motor-supporting frame when the power transmission gearing begins to run faster than the motor.

714,927. Rheostat. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1901.

The rheostat is composed of a number of resistance grids, each coated with a thin adherent layer of insulating enamel assembled and clamped together with intervening heat-radiating plates.

714,928. Plug and Receptacle. Norman Marshall, Newton, Mass., assignor to the Marshall-Sanders Company, Boston, Mass. Application filed November 7, 1900.

An insulating body for electric coupling is provided with shouldered recesses adapted to receive metallic sleeves, and with slots upon the sides opening into the recesses and is adapted for binding screws in the metallic sleeves

714,934. Means for Preventing Breakdown of High-potential Windings. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 26, 1902.

Combined with a winding for electrical apparatus are terminals for the winding, insulation of comparatively great dielectric strength for portions of the winding near a terminal or terminals, and insulation of less dielectric strength for other portions of the winding.

714,973. Measuring Alternating Electric Currents. Milton E. Thompson, Ridgway, Pa., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 30, 1896.

The wattmeter has a series coil, a potential coil in a circuit of high inductance for lagging the current therein, and an auxiliary circuit or device whose function is still further to increase the phase difference between the current and potential magnetic fluxes up to a normal amount of 90 degrees, when the current does not lag in the consumption circuit.

715,016. Manufacture of Spongy-lead Plates for Secondary Batteries. Herbert W. Butler and Joseph H. May, London, England, assignors to John Irving Courtenay, London, England. Application filed January 2, 1901.

The process consists in subjecting a paste of lead oxide and powdered carbon, applied to a grid or support, to the action of an electric current in a forming solution or solutions, the current being first applied while the element or plate being formed is attached to the positive pole of the source of electricity so as to oxidize the carbon or any desired portion thereof and convert the lead oxide into porous peroxide and then passing the electric current in a reverse direction to reduce the porous peroxide to spongy lead.

715,019. Means for Synchronizing Motors. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 11, 1899.

Motors in series are combined with means actuated by an increase in electromotive force of any motor above that of others for diverting current from such motor to the other or others.

715,036. Trolley Harp. Harry S. Doyle, St. Louis, Mo., assignor of one-half to James C. Davis, St. Louis, Mo. Application filed August 15, 1902.

The harp has resilient adjustable arms.

715,043. Current-operated Receiver for Electromagnetic Waves. Reginald A. Fessenden, Manteo, N. C. Application filed August 27, 1902.

See page 420.

715,058. Electromagnetic Brake. Frederick Haber, Washington, D. C., assignor of one-half to Parley H. Eaton, Washington, D. C. Application filed April 21, 1902.

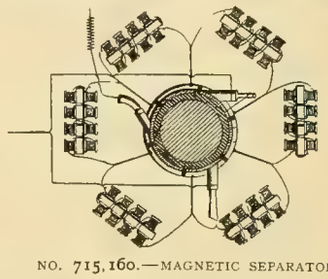
A magnet and its armature are combined with a series of supplemental armature disks spaced from each other and from the magnet armature, and screws mounted in the armature disks and having headed portions slidably connected to the disks next above.

715,071. Electric Trolley Protector. William W. Hoffman and Francis W. Powers, West Lafayette, Ind., assignors to the Electric and Steam Railway Supply Company of Lafayette, Ind. Application filed April 18, 1902.

In the device are a winding drum upon which one end of the rope is wound, means for exerting a yielding force upon the drum tending to wind the drum, supplemental means adapted to be thrown into engagement with the drum to wind up the rope when the trolley wheel leaves the trolley wire, and electromagnetically operated mechanism connected to the conductors for throwing the parts into operation.

715,126. Rectifier for Single or Polyphase Alternating Currents. Albert Nodon, Paris, France. Application filed April 30, 1902.

The electrolytic transformer described comprises an electrolyte formed of a saturated solution of bibasic phosphate of ammonia $PO_4H(NH_4)_2$, a vessel for containing the electrolyte, an electrode made of an alloy of 95 per cent. aluminum and 5 per cent. zinc and another electrode made of iron, or its alloys, and terminals connected with the electrodes.



NO. 715,160.—MAGNETIC SEPARATOR.

715,160. Magnetic Separator. Carl Scholl, Göppingen, Germany. Application filed September 13, 1901.

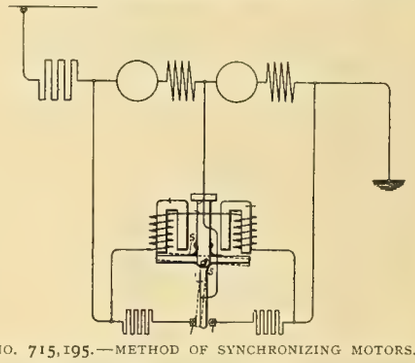
In the magnetic separator are a rotary separating drum in combination with a series of electromagnets for producing a partial magnetic field on the surface of the drum; a rotary sectional current-distributer ring; two brushes for supplying current of one polarity and so arranged as never to impinge against adjoining distributer sections, the third brush impinging against an intermediate section and arranged to supply current of opposite polarity, and connections between the coils of the electromagnets and the sections of the current-distributer, whereby current is fed only to a portion of the coils and a portion of the surface of the separating drum is thus constantly non-magnetic. (See cut.)

715,170. Hot-wire Electric Meter. Robert S. Stewart, Detroit, Mich. Application filed April 25, 1902.

The meter comprises a frame, two wires suspended therefrom, a pointer fastened to the wires and free to deflect when the length of the wires is changed, means for measuring the deflections of the pointer, and electrical connections for sending electric currents through either or both of the wires for the purpose of heating the same.

715,195. Method of Synchronizing Motors. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed February 11, 1899. Divided and this application filed April 16, 1902.

The art of regulating two or more motors in series consists in simultaneously cutting down the current in any motor the electromotive force of which rises above that of the other or others, and increasing the current in that or those of lower electromotive force. (See cut.)



NO. 715,195.—METHOD OF SYNCHRONIZING MOTORS.

715,203. Selective Signaling by Electromagnetic Waves. Reginald A. Fessenden, Manteo, N. C. Original application filed August 27, 1902. Divided and this application filed November 13, 1902.

At the sending station are means for generating electromagnetic waves of the same character, and means for causing the emission of such waves in two or more groups at different emission rates. At the receiving station is an indicating mechanism operative by the conjoint action of the respectively responsive devices.

715,209. Face Plate for Electric Couplings. Norman Marshall, Newton, Mass., assignor to the Marshall-Sanders Company, Boston, Mass. Original application filed November 7, 1900. Divided and this application filed April 14, 1902.

Mechanical features of construction are described.

715,220. Method of Measuring Alternating Electric Currents. Milton E. Thompson, Ridgway, Pa., assignor to the General Electric Company, Schenectady, N. Y. Original application filed December 30, 1896. Divided and this application filed May 7, 1902.

The method of obtaining a magnetic field in quadrature with the impressed electromotive force consists in lagging a current derived from the electromotive force, producing thereby a lagging primary magnetic field, producing independently of the primary magnetic field an auxiliary magnetic field, and combining such primary and auxiliary fields to form a resultant field of the required phase relation.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXI. CHICAGO, DECEMBER 20, 1902. No. 25

Metropolitan Railway System of Paris.

By A. De Courcy.

In a few years Paris will have an extensive system of underground electric-railway lines which will make it the best equipped city in Europe in this respect. To the Metropolitan railway eight new sections are to be added, giving the whole system the appearance shown in the map on the next page. The existing Metropolitan, marked No. I., passes across the city from east to west from the Maillot to the Vincennes Gates, with a branch to the Dauphine Gate. There are to be two semi-circular lines, one in the northern and one in the southern part of the city, which join on to the end of the old Metropolitan. The first of these, No. II., starts from the Place de l'Etoile and is laid under the exterior boulevards for the most part. It passes the North and East Depots, then southeast to the Place de la Nation, where it again joins No. 1. A similar line runs through the southern part of the city, marked No. III., joining No. I. at the Etoile and traversing the left bank of the Seine past the Sceaux and Orleans Depots, then crossing the Seine again and joining No. I. The sections II. and III., as will be observed, make a nearly circular line around the city, which is bisected by the old Metropolitan.

The next section to be constructed is No. IV., which lies in the northern part of the city and runs nearly parallel to No. I. Nearly at right angles to it runs No. V., which starts at the North Depot and passes to the south, joining Nos. II. and III. near the river. A short section, No. VI., serves to connect No. III., near the Orleans Depot, with the first two lines at the Place de la Nation. One of the most important lines will be No. VII., which will give an easy access between the northern and southern parts of the city. It traverses the old Metropolitan nearly at right angles and will cross the Seine on a special bridge. The last two concessions of this extensive system are No. VIII., which passes in a northeasterly direction, and No. IX., which starts from the Opera and proceeds to the west, crossing the Seine twice upon viaducts.

The map shows the whole system as it will exist in about seven years, when it is expected that all the above lines will have been completed. The whole of the system will be underground except where local conditions have made some overhead constructions necessary. The semi-circular line No. II. will be the first to be finished, and in fact the work on the tunnel is about completed at present. A short section toward the west is already in operation and trains have commenced to run over this part. On the remainder the work is being actively carried on, and it is expected that the whole line No. II. will be running within a few months. On the line No. III. the work is not so far advanced; at present the tunnel is being constructed, and this work has been retarded in some points, especially where the tunnel passes through the region covered by the vast galleries of the Catacombs. Here special measures had to be taken to consolidate the soil.

The north section (No. II.) which is now very nearly finished, lies mainly in tunnel, but it was found necesary to construct an overhead portion of considerable length, owing to the fact that the road crosses two of the main railroad lines which pass out of the city from the North and East Depots. The two railroads each have a great number of tracks sunk below the street level, and this proved a serious difficulty for the Metropolitan. Two solutions were proposed, one underground below the tracks and the other overhead, but on account of the depths of the tracks the underground section would have to be considerably below the main portion, and this was found impracticable, owing to the difficulties which would occur in the transfer of passengers. It was thus decided to pass over the railroads by an elevated structure which should clear them both at the same time. In this way the road comes out of the tunnel and mounts a rather heavy grade to the overhead section, passing three stations and then descending into the tunnel. The total length of the No. II. line is about six miles and it has 23 stations, including those overhead.

The tunnel, which has about the same elliptical section as before, has been pierced by the ordinary methods of tunnel construction. The shield system was not found to work well in the case of the old Metropolitan and its use has been abandoned. In some of the main crossing points and terminals a considerable amount of underground work had to be done. For instance, at the Place de l'Etoile the new line crosses the old, and the new tunnel had to be dug below the latter. At the Avenue de Villiers, which is the connecting point of the future No. IV., a large double station has been constructed which will serve for both these lines. At this point the first portions of the No. IV. tunnel have been commenced. It is at the Place de la Nation, to the east, that the underground work has been the most considerable. The old line passes through this point, where a large station already existed, forming the collecting point for the cars which come here at the end of the day's run to be sent to the main car station. The new station lies alongside of it, separated by a masonry partition which has four communicating doors. There are also several loops passing under the Place, in order to allow the necessary movements of the trains. The execution of this work, in spite of its importance, has been carried out without any difficulty.

Fig. 1. Overhead Portion at St. Martin Canal.

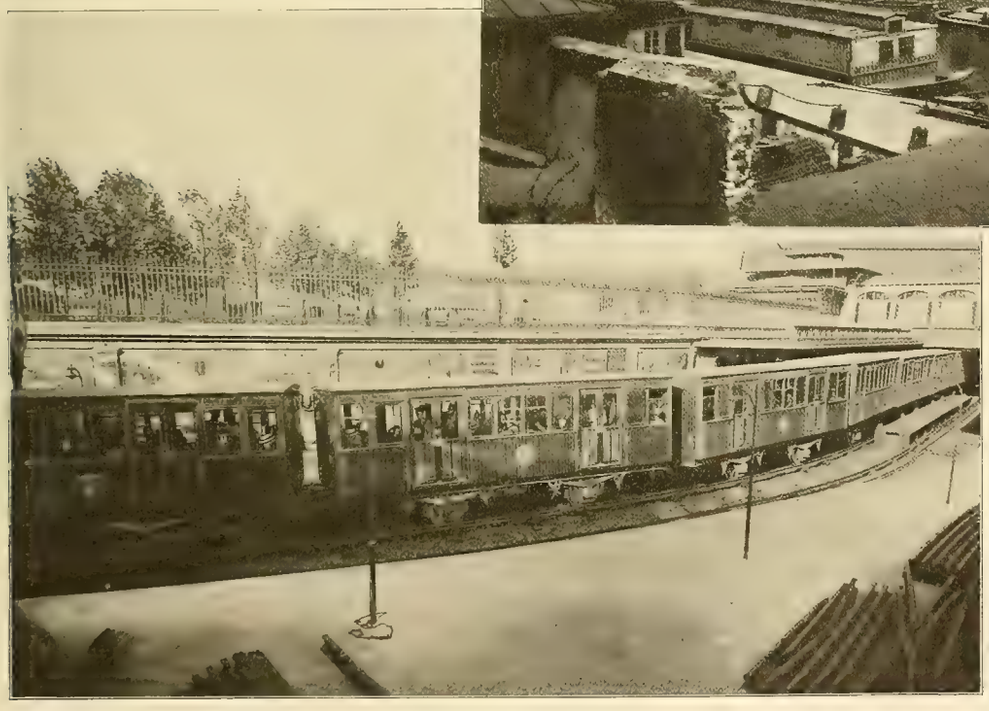


Fig. 2. Eight-car Train.

METROPOLITAN RAILWAY SYSTEM OF PARIS.

The overhead structure, which presents some points of interest, covers a total length of 1.6 miles and is made up of a series of metallic bridge trusses resting upon iron columns. This construction will be observed in Fig. 1, which shows the part of the line where it passes over the St. Martin Canal, just before it descends to the tunnel. The portion of the overhead structure seen on the left gives an idea of the general construction, using columns spaced 22 feet apart. The roadbed lies about 20 feet above the street level. Fig. 4 shows the arrangement of the trusses and cross beams. Between the latter are brick arches which serve to consolidate the whole. As there are three stations on the overhead part, these had to be provided for. Here a platform for the passengers has been added on each side of the main construction, as will be noticed on the right of Fig. 1. The inner part is now supported on two trusses six feet high and 50 feet long resting upon columns, and the outer portion of the platform, rests upon trusses supported upon masonry pillars. The length of the station platforms is 278 feet. The main part of the construction is 18 feet wide; at the stations 12 feet has been added on each side for the platforms, making a width here of 30 feet. The trusses are built in different lengths to suit the varying conditions, as when passing over streets, etc. As the boulevards are sufficiently wide the structure does not come very near the houses.

The construction of a tunnel through as old a city as Paris presented considerable difficulties. Not

to speak of the great number of sewers, etc., which had to be shifted and replaced, the portion which passed through the Catacombs gave a great deal of trouble. The Catacombs, which were originally a vast network of stone quarries forming long galleries, left the ground in an unstable condition, and special precautions had to be taken to consolidate the soil. Where the galleries were well preserved, a series of transverse side walls were constructed, about four feet thick and spaced 12 feet apart along the tunnel. In other cases the galleries had fallen in and the space filled with loose soil, and to support the tunnel structure a special foundation was necessary. Wells were sunk down to the solid ground, about four feet in diameter, and these were filled up with béton, forming thus a kind of column. A long line of double columns, braced across by a béton construction, thus upholds the tunnel. This construction is shown in Fig. 5.

The cars and locomotives used on the new systems will be of the same type as are now employed. The locomotives resemble the cars in appearance, but have a motorman's cab at the end. At first, trains of four cars, including one locomotive, were run on the Metropolitan, but for some time past an eight-car train has been used in times of heavy traffic. The appearance of such a train will be observed in Fig. 2, and it is this type which is to be generally adopted in the new lines. A locomotive is placed at each end of the train and the circuits are arranged so that one controller operates the whole system.

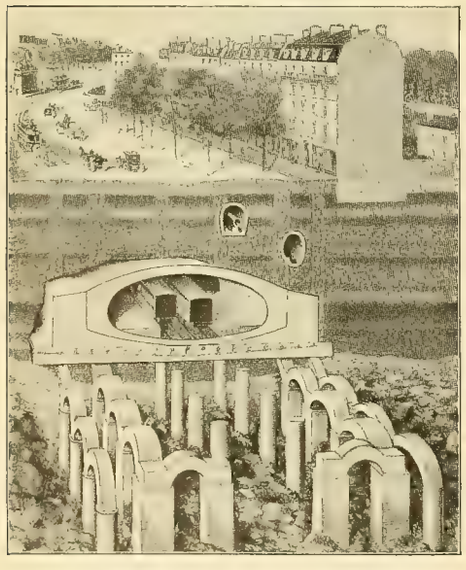


FIG. 5. METROPOLITAN RAILWAY SYSTEM OF PARIS.—TUNNEL FOUNDATIONS IN THE CATACOMBS.

The Union Pacific Railroad Company has sued for an injunction restraining the Kansas City (Mo.) and Topeka Railway Company from condemning a part of the old Union Pacific right-of-way in the Kaw Valley. The Union Pacific right-of-way, granted by the government, is 400 feet wide. The Kansas City and Topeka Railway is a trolley line, and it is understood that the success of this road in obtaining right-of-way would be followed by the Rock Island and Orient also seeking an outlet from Kansas City.

St. Louis Exposition Power Plant.

Hon. David R. Francis, president of the Louisiana Purchase Exposition, Mayor Wells of St. Louis, Isaac Taylor, director of works, Henry Rustin, chief electrical engineer, and Directors J. E. Smith and L. D. Dozier, together with Guido Pantelleoni, the St. Louis representative of the Westinghouse Electric and Manufacturing Company, have returned to St. Louis from a trip to Pittsburg, New York and other eastern points, where they have been inspecting the work of the Westinghouse company on the $1,000,000 contract awarded to it by the exposition company.

While in Pittsburg that portion of the machinery now complete was put in operation for the benefit of the visitors, and they were enthusiastic in their comments regarding the progress of the work. After the tour of inspection, Governor Francis said: "I am pleased to state that the officials of the St. Louis Fair and myself, as president, are entirely satisfied with the work done for us by the Westinghouse company. This city [Pittsburg] will certainly play a large part in the fair which I represent. I wish the entire Legislature of Pennsylvania were here, that I might congratulate this state, as well as this city, for the big part of the St. Louis Exposition which it will represent. The anniversary of the Louisiana Purchase will open the eyes of the world to the remarkable city of Pittsburg and the great state of Pennsylvania."

The power plant that will be installed by the Westinghouse company will occupy about 16,000 square feet in the west end of Machinery Hall, in close proximity to the boiler house, and will consist of four 2,000-kilowatt generators, direct-connected to vertical compound Westinghouse engines. The generators are three-phase, and are wound for 6,600 volts at 25 cycles. In addition, exciting current will be furnished by three 100-kilowatt generators, direct-connected to steam engines.

In addition to the 8,000 kilowatts delivered by the Westinghouse plant, the exposition company will receive 8,000 kilowatts from an outside source. To handle this load properly, a gigantic switchboard will be installed in the gallery, extending along the west end of the building. The entire switchboard, bus-bars, switches, etc., will be in duplicate, and will be so arranged as to prevent interruption of service from the disabling of generators or failure of lines.

Lieutenant Carden has cabled Chief Moore of the Department of Machinery that he has arranged for an exhibit of a Niclausse marine boiler of 700 horsepower, which will be installed in the exhibitors' power plant in Machinery Hall. This boiler is similar to those installed in all battleships built by Cramp.

Heinrich Habbig of Düsseldorf, Germany, has arrived in St. Louis, where he will superintend the installation of a Durr boiler from Düsseldorf, Germany, in the exposition power house, which will be located just west of Machinery Hall. This is the first foreign exhibit to be received by the Exposition company.

Interurban Roads in Northern Illinois.

The interurban trolley line from Rockford, Ill., to Janesville, Wis., is completed. The road connects the three towns of Rockford, Beloit, Wis., and Janesville. Cars are now running on a two-hour schedule, but this will be reduced as the ballasting is finished. The year closes with the best record in building interurban lines in the northern Illinois counties in the history of railway building. The line now operated between Rockford and Belvidere; the new line from De Kalb to Sycamore, which is about to start its cars; the Libertyville extension of the Chicago and Milwaukee line, and the Rockford, Beloit and Janesville road are numbered among the accomplishments of the year.

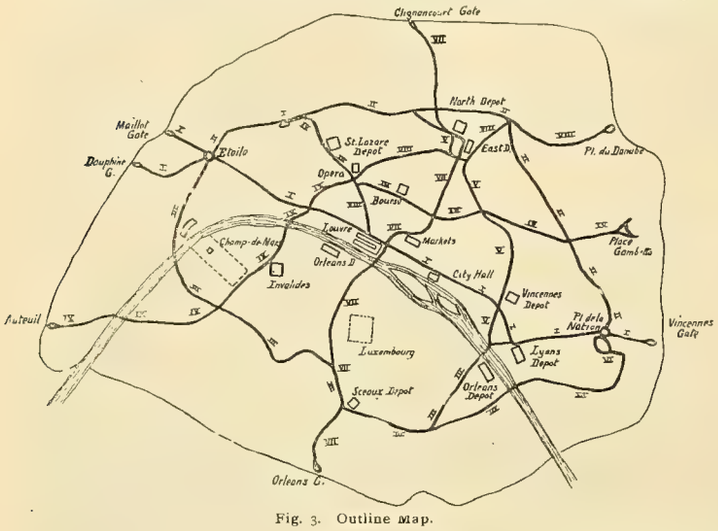


Fig. 3. Outline Map.

METROPOLITAN RAILWAY SYSTEM OF PARIS.

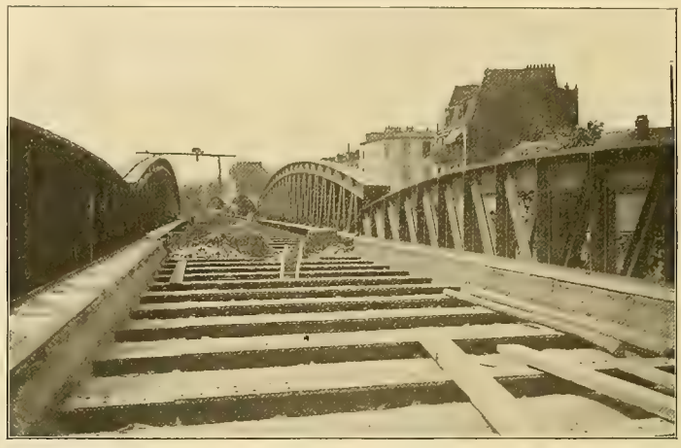


Fig. 4. Elevated Structure.

Electrical Appliances in the Navy.

Of considerable interest to the electrical fraternity is the annual report of the inspector of electrical appliances in the United States Navy, in connection with the report of the Bureau of Equipment. Lieutenant Parmenter acted as inspector until February 26, 1902, upon which date he was relieved by Lieutenant George. The latter is one of the most accomplished electricians in the Navy and is performing the duties of inspector in a highly satisfactory manner. Lieutenant Hudgings served as assistant from October 10, 1901, to April 26, 1902, when he was detailed for duty in connection with wireless telegraphy and is still engaged on that duty.

The sum of $395,432.59 has been expended during the fiscal year upon the installation and repair of electrical appliances on shipboard; and $164,028.53 on the manufacture and repair of electrical apparatus and supplies in navy-yard shops. The total of $559,461.12 was expended during the fiscal year on electrical appliances for all purposes. The demand for electric power for ventilating fans, ammunition hoists, winches, and auxiliary purposes generally, is now so great that when ships are put out of commission for a general overhauling, it is necessary to supply an entire new outfit of electric generators.

The installation of 125-volt generators has commenced. It is the purpose of the Bureau of Equipment to use this voltage for all new generators in the future. In the opinion of the Bureau, efficient electric generators driven by steam turbines, very much lighter and more compact than the present type, will soon be available for use on shipboard.

It is much to be regretted that the school at the Naval Torpedo Station, Newport, R. I., for the instruction of officers in electricity, the need of which was never more apparent, after having been again established, was interrupted during the past summer by the great demand for officers afloat. Unless every effort is made to instruct the personnel of the service in the scientific and technical branches of their profession, the Navy in the future will surely fall below the present standard. The school at the New York navy yard for the instruction of enlisted men in the duties of dynamo tenders and the general care and maintenance of electrical appliances on board ship has done good service during the year.

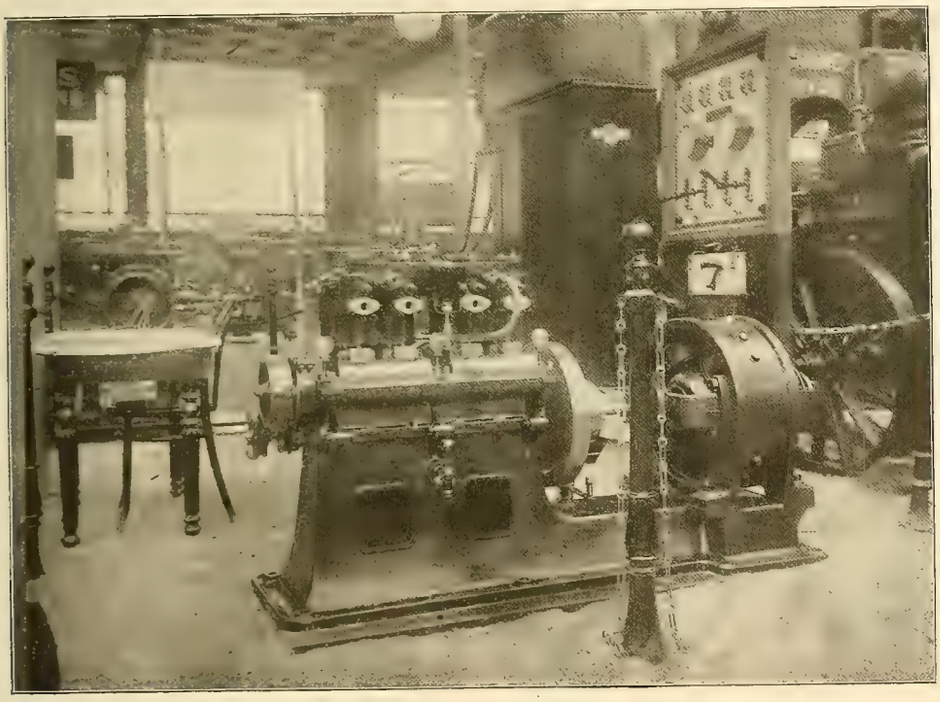
The Bureau of Equipment has renewed its recommendation that Congress be asked to establish a corps of warrant electricians. Reference is made to the reports of the Bureau in years past, in which a full discussion of the necessities of the personnel of the Navy in connection with the care, custody and efficient maintenance of electrical appliances on board ship was made at length.

Cable Between Spain and the Canary Islands.

Consul S. Berliner writes from Teneriffe, under date of October 29th, as follows: "The cable between Teneriffe, on one of the Canary Islands, and Cadiz, Spain, is interrupted; it is supposed that the breakage is about 600 miles from here. This cable was laid in 1883, and for the last eight years breakages have been of frequent occurrence; it sometimes happens that months elapse before communication is restored. The islands are not absolutely isolated, as regards cable communication, because cablegrams can be sent via Senegal, though at a much increased cost—the difference in the London rate is $1 per word; but to do this, messages must be sent overland to Tejitas, which means a delay of at least twenty-four hours."

Dynamo Set with Petrol or Alcohol Engine.

Small petroleum engines are now being used quite extensively in France to drive dynamos, and especially to form a compact generating set, which has many advantages. One of these groups which was exhibited at the last alcohol show in Paris will be noticed in the illustration. The motor is of the Bardon type and runs at high speed; it is direct-coupled to a small alternator. In this case the motor runs with alcohol, or, rather with the 50 per cent. mixture of alcohol and gasoline, which is generally adopted. It is an example of the successful use of alcohol for stationary engines. This practice was first commenced with automobile motors and then extended to the fixed motors, whose construction is similar. The present engine has four cylinders mounted in pairs on the crank-box. The latter is formed in two parts, the lower half being cast with the foundation piece, while the upper half is bolted on and supports the cylinder castings. In front is a hinged cover, which allows an easy inspection of the interior. The engine gives 12 horsepower and runs normally at 980 revolutions per minute. The crank-box is half filled with oil, which also lubricates the main-shaft bearings. The cylinders are cooled by water jackets, and the water is either brought from the mains, or, where it is desired to use the same water over again, it is supplied from a small tank. The circulation in this case is brought about by a small centrifugal pump, worked by a friction pulley from the flywheel. A tank of 25 gallons is sufficient for the cooling.



DYNAMO SET WITH PETROL ENGINE.

The alternator is a four-pole machine, having a bearing on each side. It gives 50 amperes at 150 volts, and on this load its efficiency is about 80 per cent. The petrol engine is well balanced, so that there is very little vibration. The tests which have been made with a group of this kind show that it runs very economically. One test lasted 10 hours and 45 minutes, and the dynamo gave 42 amperes constant load at 149.5 volts, with a speed of 960 revolutions. The total work was 67.2 kilowatt-hours and the consumption of liquid (gasoline was used here) was 64 liters, which figures 0.95 liter per kilowatt-hour. A number of small generating sets like the above are now built by different firms; some are fixed, while others are made portable by mounting on a small carriage. The use of the petrol engine makes it easy to construct a light portable group which is self-contained. The Northern Railroad Company is using one of the small fixed groups to supply the smaller stations with power for the shifting of the trains. This was formerly carried out by hand labor or by horses, and the expense was considerable. By the new system the cars are shifted by an electric capstan. In the smaller stations which have no current supply, the capstans are operated by a battery of accumulators, which are charged at intervals by a special traveling outfit, consisting of a railroad car, containing a dynamo group of the above type and forming a sort of traveling station. In this case a direct-current machine is used, but in other respects the group closely resembles the one above described. The car contains a complete plant, including the 10-horsepower set with water cylinder, pump and gasoline tank, also a switchboard. In this way the car is run into the various stations and the batteries charged, thus giving a supply of power for the capstans without requiring a special dynamo plant at each station. This system, which is now used at a number of stations, is found to work well and is more economical than the old method.

SPACE TELEGRAPHY.

Two Marconi Stories.

The Glace Bay Gazette, published within a stone's throw of the Marconi towers at Tablehead, is accredited with having published the following recently: "Something strange seems to have happened at Tablehead, but that something does not look very encouraging to the promoter of Marconi's schemes. The greater portion of the wires connecting the tower and leading to the operating room have been taken down, coiled up and stored away. One story has it that the other day the powerful current was put on for transmission of a message, and, through some flaw, the wires were burned out. Another statement is that the arrangement of the wires was different from that at Poldhu, by way of experiment, and the new plan has been found faulty and a change is necessary. One thing is certain: Marconi has not met with the success he expected, but he seems confident as ever."

Following this, and possibly in some way connected with it, comes the announcement through the daily press that Mr. Marconi has another invention which he expects will startle the world. He will not formally announce it until the wireless experiments are completed, which he says will be before the end of the year. There is much speculation as to what turn the inventor will next take, but Marconi will make no statement whatever concerning his new invention. News has been received from Glace Bay, according to the report, that a meeting was held in London on December 11th, by the backers of Marconi for the purpose of changing the charter of the English company, with a view to expanding business, enlarging the scope of the field of operation and getting more power.

Naval Investigations and Recommendations.

Considerable space in the annual report of the Bureau of Equipment is given to discussion of the subject of space telegraphy. In October, 1901, Commander Barber, U. S. N., retired, residing in Paris, was, at the request of the Bureau of Equipment, especially detailed for duty in connection with the investigation of this subject on the continent of Europe, where wireless-telegraph appliances have been chiefly developed. Since that date Commander Barber has made numerous valuable reports on this matter, and he is constantly advising the bureau of the latest developments and inventions. There are four systems that have been developed in Europe, which, after investigation, appeared promising, viz., the Slaby-Arco and Braun-Siemens-Halske, manufactured in Berlin, and the Rochefort and Ducretet. The bureau has purchased two sets of each, also certain appliances from other makers which appeared worthy of investigation.

When these outfits were ready for delivery, at the request of the bureau, Lieutenant Hudgins and Chief Electricians Bell and Bean were directed by the Navy Department to proceed to Paris and report to Commander Barber for instruction in the proper methods of operating all these appliances. The knowledge and experience gained by these officers have been of great value in installing the apparatus for testing purposes and instructing navy signalmen in its use, care and maintenance.

It is the intention of the bureau to test these different kinds of apparatus in competition. For this purpose a station has been prepared at the Washington Navy Yard and another at Annapolis, Md., the distance being about 30 miles. Upon the completion of tests entirely overland, it is proposed to install one set of each kind of apparatus on board of a ship and the other set at Annapolis, in order to conduct tests from ship to shore at varying distances. The next step will be to install one set of each apparatus on board of a ship, each ship proceeding to sea for tests at varying distances and outside of any possible land interference. These tests are in progress at the present time by a board of five officers, but it is too early to predict what the result will be.

It is proposed to test other systems of wireless-telegraph apparatus in addition to those mentioned, if satisfactory arrangements can be made for their acquisition, should the department so desire after the tests are completed. Arrangements have been made for obtaining a duplicate set from the De Forest Wireless Telegraph Company. In this connection the bureau regrets that it has been unable to reach any satisfactory arrangement with the Marconi Wireless Telegraph Company for the purchase of its appliances, should it be desired, after testing them. The company has offered a duplicate set for test, to be returned after the trials have been completed. The company requires, however, the payment of a given sum for each set upon delivery and a royalty for each year during the life of the patents. The aggregate cost of a set under such an agreement would be very great, and in addition, it is illegal to obligate the payment of money beyond a single fiscal year.

It is further proposed to establish wireless-telegraph schools for the purpose of instructing officers and men at such stations as Newport, R. I., New York, N. Y., San Francisco, and possibly other naval stations. In order to ascertain the effect of heat, which is said to be injurious to the successful working of wireless apparatus, a station will be established at Key West, Fla.

Most naval powers are far in advance of the United States in the installation of wireless-telegraph appliances on board naval ships. It is the opinion of the bureau, however, that thus far no ground has been lost by reason of the conservative progress of this country in adopting some particular system and supplying it to vessels of the navy. The latter are being prepared, so far as the necessary changes in their masts are concerned, as opportunity affords, and many are ready for the installation of the apparatus, whenever supplied.

The bureau invites the attention of the Navy Department to the paucity of officers now on duty in connection with the subject of wireless telegraphy. In foreign navies commissions of distinguished officers are engaged solely on this important service.

When the transmission of wireless messages is attempted by two or more operating stations at the same time, their interference will probably prevent the reception of a legible message at any receiving station. It is asserted by certain inventors that this interference can be overcome, but these claims do not appear to be substantiated, and it is therefore possible at present for any operator controlling a powerful transmitting apparatus to prevent the reception of a message within its radius of influence.

In consideration of these facts, it therefore becomes important, in the opinion of the bureau, that all wireless transmitting and receiving stations should be brought under the control of the government. It also appears important that this should be done before the vested interests in connection therewith have become too great. The bureau has specially in mind a large wireless station recently established by a foreign company at Cape Cod.

The bureau is officially informed that foreign governments are exercising careful supervision over the location of wireless stations within their respective territorial limits, with a view of having at all times absolute control thereof. In time of war the department will undoubtedly find it necessary to communicate by means of wireless telegraphy with certain receiving stations along the coast. Nothing should be permitted to interfere with the transmission of such messages, nor should it be possible for unauthorized persons to receive them.

The only practical method of insuring this result is to secure government control over all wireless-telegraph stations along the coast. It is suggested that legislation to this end be requested by the Navy Department.

The Netherlands Tramway Company of Bridgeport, Conn., has been incorporated with a capital of $3,500,000, to construct and operate railways and tramways. It is empowered to do business in any foreign country or in any state or territory of the United States, excepting the state of Connecticut. The incorporators are L. B. Grant, Richard McKinirg and C. T. Lark.

Death of John Van Horne.

John Van Horne, a pioneer telegraph man and former vice-president of the Western Union Telegraph Company, died at his home in Pewee Valley, a suburb of Louisville, Ky., on December 13th. Mr. Van Horne was 75 years of age, having been born at Centreville, Hunterdon County, N. J., on April 12, 1827. In 1850 he learned to telegraph, as a student, at Buffalo, N. Y., and served successively as manager at the offices in Ashtabula, Milan and Massillon, Ohio, Adrian, Mich., Sandusky, Ohio, and later at Tuscumbia, Ala. At the last-named office he became acquainted with Dr. Norvin Green, who appointed him his superintendent and afterwards general superintendent of the system. His discretion and vigilance in discharging these duties

JOHN VAN HORNE.

led to his election as president of the Southwestern Telegraph Company, which position he held within the Confederate lines during the Civil War. It was while thus serving, that, as an act of personal honor, he was enabled to save from sequestration some interests of Professor Morse, which not long afterward yielded to him an issue of $450,000 of Western Union stock. On July 1, 1866, when the Western Union, American and Southwestern Telegraph companies were consolidated into the Western Union Telegraph Company, Mr. Van Horne was made general superintendent of the southern division and a member of the board of directors. On October 10, 1878, he was elected vice-president, which position he continued to hold until October 13, 1897, when, at the general meeting of the stockholders, he declined re-election as director and vice-president of the company, after a telegraph service of nearly 50 years, 19 of which were spent as vice-president of the Western Union.

Mr. Van Horne's duties as vice-president placed him in charge of the electrical department, statistics and contracts. The duties of the position were espeially laborious, but he handled them with great skill and firmness, although more than once he had to seek strength and rest by a trip abroad. The supervision of contracts was very exacting work, but Mr. Van Horne did it efficiently and with tact. Mr. Van Horne's knowledge of the business in each department was comprehensive and precise. He had an alert mind and his prudence and sagacity were marked qualities. As a companion he was genial and delightful and highly esteemed by his fellow officers. His chief power, however, in some respects, was with his pen. His letters were often models, and he frequently made use of a natural, but quiet and sunny wit to great advantage. The accompanying portrait, which represents Mr. Van Horne in his prime, is reproduced from the late James D. Reid's "Telegraph in America."

Electrical Protection for Government Vaults.

The secretary of the treasury has sent a letter to the House of Representatives, in which he strongly urges that early action be taken on a report made by the supervising architect of the treasury, covering the cost of and urging the necessity for installation in various cities of the United States electrical protection to vaults in public buildings, in which are kept large sums of money, stamps, etc. The cities and buildings are: Chicago, Ill., temporary postoffice; Cincinnati, Ohio, postoffice and subtreasury; Indianapolis, Ind., postoffice; Louisville, Ky., postoffice; Milwaukee, Wis., postoffice, court-house and custom-house; Minneapolis, Minn., postoffice, etc.; New Orleans, La., sub-treasury, mint and postoffice; Omaha, Neb., court-house, custom-house and postoffice; Peoria, Ill., postoffice; Pittsburg, Pa., postoffice; San Francisco, Cal., postoffice, court-house, etc.; St. Louis, Mo., sub-treasury, postoffice; St. Paul, Minn., postoffice, court-house and custom-house. It is deemed very necessary that some electrical protection should be afforded, such as is usually installed in modern banks and commercial houses, and Congress is asked to provide $30,000 to furnish electrical protection to the buildings named above.

Mr. Barnes of Rochester and His Electrical Comforts.

One of the few American dwelling houses entirely heated by electricity is that of Charles R. Barnes, No. 69 Glasgow Street, Rochester, N. Y. Mr. Barnes is the well-known state electrician of New York, and in his home he has surrounded himself with apparatus that makes it possible for him to study the application of electricity, as well as to keep comfortable and enjoy life. The electric current used is taken from one of the city light circuits, and is carried to the library, where there is a switchboard. This switchboard has five double-throw switches, and these are so arranged as to control the current furnished each heater in the house, making it possible to have a minimum, medium or maximum-current supply where desired.

The heaters are two feet long, 12 inches high and eight inches wide. They are installed in the hall, library, front and rear parlors, the dining room, and in the sleeping rooms. They are mounted on marble slabs, close to the baseboard of the room. Each heater is fused, so that should a short-circuit occur on any of the wires, the fuse would blow, lessening the danger from fire. In the sleeping rooms, it is possible for the occupant to turn off the current after getting in bed by turning a switch on the head of the bedstead, and in the morning the current may be thrown on and the room heated in about 15 minutes.

Naturally, the kitchen is equipped with all modern electrical appliances, and it is possible to cook meals, make tea or coffee aided by the electric current. In the dining room there is an electric chafing dish that may be connected to the socket of one of the chandelier lamps. Electric fans are plentiful, and the arch between the main parlors is rounded out with 50 four-candlepower lamps, operated by a separate switch. Curling-irons and flat-irons are heated electrically.

In this house last year Mr. Barnes had a Christmas tree lighted by about 600 lamps in red, white and blue, and the tree will be a feature of the coming holiday celebration.

An electro-therm is one of the appliances on which Mr. Barnes prides himself. It takes the place of the hot-water bag. It is a flexible electric pad, 14 by 10 inches, and a quarter of an inch thick, made of flexible wires, carefully insulated, and covered with asbestos and flannel. When a hot application is needed, the therm is applied and gives a steady, constant heat.

Seeing at a Distance by Electricity.

The interesting problem of electric vision at a distance has been occupying the attention of scientists for some time. In a recent issue of the Comptes Rendus, J. H. Coblyn, who is experimenting along this line, gives the following:

"The problem of the electric transmission of an image to a distance is based upon the variation of electric resistance experienced by a selenium cell inserted in the circuit. The variable current so produced, which depends upon the brightness of the point explored at the instant under consideration, must be transformed at the receiving station into the variations of intensity of a luminous source. The author proposes to leave the brightness of the source constant, in contradistinction to the gas telephone of M. Lazare Weiller, which acts direct upon the flame; the current transmitted stops more or less the beam emitted by this source, in accordance with the principle discovered by Messrs. Ayrton and Perry. For this it suffices to use the soft-iron oscillograph of M. Blondel and to let the movable piece consist of a hollow tube oscillating in the field.

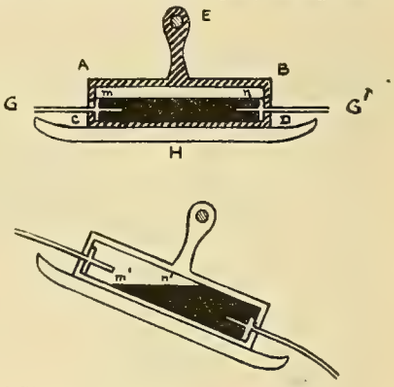
"It remains to 'explore' the image, and the manner in which this is done forms the subject of the present note. Referring to the theory of M. Lazare Weiller, who explores the image by means of parallel bands, it must be pointed out that the original image must be described in a uniform manner, and that no point must be described several times in a tenth of a second, in order to transmit every point with its proper brightness.

"To obtain this result we employ the following system: A diaphragm with a very small hole is placed at the principal common focus of two converging lenses. One of these lenses is placed in front of the image. Thus, those luminous rays of the system are isolated which come from the image in a direction parallel to the general axis of the system. The other lens is in front of a hollow cylinder pierced with helical slits and turning in a direction perpendicular to the optical axis of the system with a velocity of five turns per second.

"Matters are so arranged that the diaphragm and the slits of the cylinder only allow a single ray of a point of the image to pass, that ray being normal to the axis of the system. If the rotation is constant, the point explored is displaced along a series of horizontal bands with a uniform motion. Furthermore, on replacing the diaphragm by the mirror of a tuning fork vibrating vertically, the series of horizontal lines is changed by optical composition into a system of sinusoidal curves, which, by means of a special device, form a kind of rectangular network. This exploration is the most rational, for it decomposes the image into a series of patches having all the same area."

Automatic Circuit-interrupter on Overhead Wires.

A new device has been recently introduced in France in order to avoid the accidents which sometimes occur, owing to the fall of trolley wires or others of high potential. It is the invention of Gaston Bellanger, a prominent engineer, and consists of an automatic interrupter which serves also as a support for the wire. It breaks the current in the wire when it falls on the track. The device was tried not long ago on one of the tramway lines near Bordeaux and operated very successfully. The two sectional views show the support first in its normal position, and, second, when the trolley wire becomes broken and falls. It consists essentially of a box (A) (B) (C) (D), which is supported from a bracket above the track. The supporting rod passes through the lug (E), which allows the box to swing back and forth. The latter is made of an insulating material, preferably porcelain, and is filled with mercury up to the level (m) (n). The trolley wire (G) (G') enters the box through a hole in each end and is fixed by a washer, leaving a portion projecting inside and in contact with the mercury. Fixed to the bottom of the box is a metal plate (H) which has a V-shaped projection on the under side and serves as a guide for the trolley. When the right-hand wire (G'), for instance, becomes broken and falls down, it causes the box to tilt up, and the mercury goes to the lower part, taking the level



AUTOMATIC CIRCUIT INTERRUPTER ON OVERHEAD WIRES.

(m') (n'), as shown in the lower drawing, and uncovering the upper wire. The current is thus interrupted and there is no danger from the hanging wire. This device is adapted not only for trolley wires, but for all high-tension lines where it is desired to avoid accidents due to breakage.

Paper Gear Wheels.

"So remarkable are the number and diversity of uses to which paper has been put recently that one need hardly be surprised at this substance being substituted in many instances for metal in the mechanical arts," says a London trade journal. "Friction-wheels of paper work wonderfully well in the driving of certain high-speed machines, but now spur and bevel wheels are among the latest successes with this remarkable material. . . . One would imagine that paper in any form could hardly be strong enough for such a purpose, but there are facts to prove that it has been found eminently suitable even in respect to tenacity; the behavior of pinions that have been working constantly for two years has sufficed to show that paper pinions are not only strong, but, as might be expected, exceedingly durable. Perhaps their most conspicuous merit is their noiselessness in working with iron or other metallic wheels, and for this reason they are admirably suited for reducing the speeds of electric motors for machine driving. Whatever may be their ultimate strength, it is clear that the elasticity of the material adapts it better for resisting shocks than metal."

Ground was broken recently in Stockton, Cal., for a new electric-railway system, which will form a network of lines throughout Stockton. The local road will also connect with a prospected interurban road soon to be built.

Evolution of Street Cars in Evansville.

The feature of Thanksgiving Day in Evansville, Ind., was a street-car parade, which showed the progress made during the last 30 years in street-railway transportation. The parade was given by the Evansville Electric Railway, the object being to impress upon the people in a unique and forcible manner the improvements in the way of better rolling stock which the company has provided within the last two years, and at the same time to secure an increase in the day's receipts, in which the company was eminently successful. The parade was given on Thanksgiving afternoon and by advertising it rather freely and announcing only one point where the parade might be seen the company succeeded in bringing out, at a conservative estimate, at least 5,000 people.

Heading the procession was Superintendent Cash in a buggy, and he was followed by an old bobtail car 12 feet long, drawn by Old Slick, the veteran mule of the service, who had been brought in from the country for the occasion. Following this were two summer cars, each drawn by mules. Then came the first motor cars used in the service, one of the summer type and the other closed, and both drawing trailers. Two 27-foot winter cars and two new-style 41-foot summer cars followed and the parade was brought up at the rear by the latest acquisition of the company. This is a handsome winter coach, with double-motor equipment, furnished as luxuriously as a steam car and having a capacity for 100 people. The procession was witnessed by an enthusiastic crowd and drew forth much applause. Views of the first and last cars are shown herewith.

Original Mule Car.

Latest Electric Type.

EVOLUTION OF STREET CARS IN EVANSVILLE.

The Evansville Street Railway Company was organized in 1868. There was a great fight on in the City Council about granting the franchise. The company wanted a franchise for 40 years, and it was granted by the margin of one vote. The road now operates over 35 miles of track. Thirty cars run on the regular schedule, 150 men are employed, including the office force and the electricians. The equipments are of the best obtainable and more new cars will be added to the 85 now on hand next summer. Each of the several new long coaches now in use costs $6,000.

Luther Stieringer's Work.

At a meeting of the Franklin Institute of Philadelphia last month a sub-committee of the committee on science and the arts, consisting of W. C. L. Eglin, Thomas Spencer and E. A. Scott, recommended the award of the John Scott legacy premium and medal to Luther Stieringer, the well-known expert in illumination. The report of the sub-committee considers in general terms a series of contributions to the art of electric illumination made by Mr. Stieringer, many of which are subjects of patents. These improvements cover principally systems of electrical distribution and interior wiring. This work was done at a time when no precedent had been established and forms the basis of the present system of fixture wiring and interior distribution, including what is known as the panel system of wiring. The report alludes also to Mr. Stieringer's original work in decorative lighting, the installations for nearly all the large expositions held in this country having been carried out by him personally, or laid out on the lines suggested by his work. The report concludes by recommending the award of the John Scott legacy premium and medal to the applicant "for his invention of insulating joints essential to combination fixtures for gas and electric light, for improvements in interior lighting and for the excellent information and descriptions which he has given in connection with decorative lighting."

Electric Equipment of a San Francisco Hotel.

The Standard Electric Construction Company of San Francisco, which recently secured the contract for the electric work on the St. Francis Hotel in that city, is now engaged on the work. This hotel is being built by the Crocker estate at the junction of Geary and Powell Streets, at a cost of something over $1,000,000. The building is 136 by 160 feet in ground dimensions, is 12 stories high, excluding the basement, mezzanine floor and attic, and will contain over 600 rooms when completed. The electric-lighting and telephone systems will be the most complete and extensive on the coast. The estimated cost of installing both systems is $47,000.

The lighting will be on the straight three-wire system throughout. In all about 10,500 lights will be put in. These will include arc lights for the kitchen, pantry, machine rooms, etc., in the basement. Five hundred Chapman receptacles will be provided for the parlors, bedroom parlors and bedrooms. The main dining room will be lighted by 350 lights in 25-light clusters, the café on the first floor will be similarly lighted by 300 lights, the café in the basement by 150 lights and the various banquet rooms in proportion. In the bedrooms, bedroom parlors, etc., each light will be operated by a separate switch. Double-pole flush push-button switches are used throughout.

The power for operating the lights is fed from the street power mains by two sets of feeders run to a main white-marble switchboard in the basement. The two sets of feeders are so arranged that one may serve as a relay to the other in case of accident. From the main switchboard two sets of feeders will lead to each floor, each set feeding the lights on one-half of the floor. A double-throw system is used to guard against accidents. The size of the building renders it necessary to use some rather large cables on the upper floors. The cables feeding the twelfth floor are 275,000 circular mils stranded. On each floor the feeders lead to marble panel boards, set in plate-glass cases. All the wires are placed in iron-armored conduits, the entire lighting system requiring about 150,000 feet of conduit.

The telephone system of the hotel will be as complete as the lighting system. The system will be both intercommunicating and long-distance. The Bell long-distance small wall and desk telephones will be used. Six hundred telephones will be required for the building. The telephone wires, like the lighting wires, will be enclosed in iron-armored conduit, 30,000 feet of conduit being required for this purpose.

Besides the lighting and telephone systems, the electric work includes five electric elevators, electric fans for lavatories, kitchen, etc., and other minor matters. No call-bell system will be put in the hotel, this being rendered unnecessary by the complete telephone system. The power to feed the entire building will amount to about 4,000 amperes. The installation work will be in charge of A. M. Funke, manager of the construction company.

Bids for Lighting Guayaquil.

Thomas Nast, whose recent death has been announced in the daily press, sent, as United States consul-general in Guayaquil, the capital of Ecuador, on November 12th, a translation of an advertisement by the Municipal Council of that city inviting bids for lighting the city by gas or electricity. The translation of the licitation, as transmitted by Mr. Nast, is not in all respects clear. The parts of it of interest to possible electrical bidders are as follows:

The city to be lighted by gas or electric light, or by both, within limits provided for in the contract; the lights to be located 3.5 meters (3.8 yards) above the surface and one meter (1.09 yards) from the houses' front (portales), and not to be farther apart than 35 meters (38.1 yards); each light to be of 15.4 candlepower (international unit), at the intersection of the streets in the central part of the city, the lights to be of 80 candlepower, located at a height of six meters (6.5 yards); in all cases, the lights used in the streets shall be arc lights; the council guarantees that it will take at least 1,400 lights during 11 hours daily—also 50 lights of 80 candlepower—for which payment will be made monthly; the gas or electric conductors must be laid underground, and of the most modern system and size; switchboards will be located at each section of the electric conductors and opposite each house; the company shall have the free use of the streets, lands and municipal water for all that pertains to the service, and the municipality binds itself to obtain from Congress the free entry of all materials needed for the installation of the service. Sealed offers will be received until February 12, 1903. Address The Secretary, Municipality, Guayaquil, Ecuador.

Yerkes in New York.

Charles T. Yerkes recently arrived in New York city from London, and told much of the underground projects of the world's commercial metropolis. His talk, of course, was mainly about his own system. Among other things Mr. Yerkes said the following: "We are progressing quite to our satisfaction with the London 'tubes.' Our work is a little bit different from the work which is now being carried on in building the New York subway. The people in London, although we are constructing four 'tubes', would hardly know that we are doing any work at all. We have the advantage on account of the nature of the London subsoil, and because we are not bothered by high buildings. The London skyscraper has still to be built. The subsoil of London is a solid blue clay without a pebble in it as big as a pea.

"We are building four tube railways and equipping with electricity the Metropolitan District Railway. The combined trackage of these four roads is 50 miles, and the trackage of the Metropolitan District Railway is 48 miles. The Metropolitan District Railway is what is known as the London Underground. We are changing it from steam to electricity.

"Instead of the third rail, through which to transmit the motive power, we are using four rails. That is to say: There are the regular two rails over which the trains run; then there is the third rail for the transmission of electricity, and a rail between the two-car rails to return the current. The Metropolitan will be equipped and ready for business in 15 months.

"I believe that no underground railway should be run without fireproof cars. All of our rolling stock will be absolutely fireproof. The cars will be constructed of steel, pressed asbestos and fireproof wood, but as little wood as possible. The pressed asbestos will very closely resemble wood. It may be treated like wood is treated, so that you can have asbestos oak, mahogany, ebony, or what not. The ties will be non-inflammable. I do not intend to have any holocausts on our road. The tubes will be all of wrought-iron. We found that wrought-iron was not only cheaper than steel, but would last longer."

Concerning the labor question, which is playing such an important role in the Pennsylvania tunnel franchise grant, Mr. Yerkes said: "We haven't been bothered a great deal. The English labor union is organized altogether on a wrong system. In England the most skilled mechanic in any trade is permitted to do only as much as the least skilled. In other words, the standard of labor in England is that of the poorest workman in any trade. You can readily see that under such a system there is no incentive for a skilled laborer to exert himself. We pay the laborers on the tubes—that is, the diggers—seven pence, or 14 cents, an hour, and we hire every man by the hour. They work eight hours a day, and we have found that the hiring by the hour is the only feasible way to employ these men."

Mr. Yerkes would say nothing at all concerning his controversy with the Morgan interests.

The Champion copper mine in the copper country of Upper Michigan will probably introduce electricity to operate the trams that supply its boilers. If this is done, it is likely to be followed by an electric-tramway system underground.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field Advertising rates are moderate, and will be furnished on application. ¶

CONTENTS OF THIS NUMBER.

PAGE.

Metropolitan Railway System of Paris. By A. De Courcy. Illustrated 439, 440
St. Louis Exposition Power Plant 440
Interurban Roads in Northern Illinois 440
Electrical Appliances in the Navy 440
Cable between Spain and the Canary Islands 440
Dynamo Set with Petrol or Alcohol Engine. Illustrated 441
Two Marconi Stories 441
Naval Investigations and Recommendations in Relation to Space Telegraphy 441
Death of John Van Horne. Portrait 442
Electrical Protection for Government Vaults 442
Mr. Barnes of Rochester and his Electrical Comforts 442
Seeing at a Distance by Electricity 442
Automatic Circuit Interrupter on Overhead Wires. Illustrated 442
Paper Gear Wheels 442
Evolution of Street Cars in Evansville. Illustrated 443
Luther Stieringer's Work 443
Electric Equipment of a San Francisco Hotel 443
Bids for Lighting Guayaquil 443
Yerkes in New York 443
Editorial 444
Revision of Physical Theory. By Henry S. Carhart. (Central Association of Physics Teachers) 445, 446, 447
Electricity and Animal Growth 447
American Pacific Cable Landed at San Francisco 447
Magnetism as an Aid to Traction 447
Underwriters' Electrical Committee Meeting 447
Development of the Telephone Field. Illustrated 448, 449, 450
The Sliding Scale of Rates for the Telephone Company. By Henry S. Herr. (Interstate Independent Telephone Association) 448
Telephone Opposition in Mexico 448
Telephone Situation in Southern Indiana 448
Bell Activity in Los Angeles 448
Telephone News from the Northwest 449
Ohio Telephone Notes 449
Indiana Telephone Items 449
Southern Telephone Developments 449
Stromberg-Carlson Hook-switch. Illustrated 449
Telephone Men 449
General Telephone News 449
Ducretet Loud-speaking Telephone. Illustrated 449
Manufacturers and Dealers 449
Telephone Competition 450
Aldermanic Argument for Municipal Ownership in Chicago 450, 451
The Engineer of the Twentieth Century. By Charles F. Scott. (Engineers' Club of Philadelphia) 451, 452
Electric Flasher in Interior Lighting 452
Regulation of Gas Engines Used for Electric Driving. Illustrated 452
Book Table.—Arnold's "Armature Windings" 452

DEPARTMENTS.

Correspondence 453, 454
New York Notes 453
Southern Developments 453
New England News 453
From the Buckeye State 453
Detroit, Michigan 453, 454
Information from Indiana 454
Northwestern Notations 454
Texas and Mexico 454
Among the Rockies 454
On the Pacific Slope 454
Personal 454
Electric Lighting 455
Electric Railways 455
Automobiles 455
Publications 455
Trade News 455
Business 455
Illustrated Electrical Patent Record 455, 456

DATES AHEAD.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

Northwestern Electrical Association, Pfister House, Milwaukee, Wis., January 21, 22 and 23 1903.

AN exceedingly interesting account of the "Revision of Physical Theory" was prepared by Dr. H. S. Carhart of the University of Michigan and presented as the principal feature of the recent meeting in Chicago of the newly formed Central Association of Physics Teachers. This essay is presented in full in this issue and will be found instructive by persons who follow the fascinating development of scientific theory, as all readers of the Western Electrician may be supposed to do in some degree. Professor Carhart is one of the foremost physicists of the country, and he speaks not only as one having authoritative knowledge, but also as one possessing the gift of clear and graceful expression.

IN THIS age of concentration, rather than diffusion, of electrical generating units, the idea of using self-contained engine-dynamo plants on the cars for supplying the power for railway operation would appear to be a backward step, especially in view of the failure of the exhaustive trials of the Heilman locomotive in France between 1893 and 1897. Yet this is what is announced as the plan proposed for motor cars on the Northeastern Railway system in England. The cars, which are now said to be in course of construction, will be 53 feet long and 13 feet high and will be mounted on two four-wheeled trucks. At one end of the car will be a petroleum engine that will drive two dynamos for generating the electric power. The cars will have a speed of 30 miles an hour. It may be that the local conditions necessitate the use of such a system, but its relatively high cost and low efficiency would seem to stamp it as questionable engineering.

WITH the ardor of a recent convert, Japan carries the idea of being "up-to-date" perhaps a little farther than any other nation. At least that is the impression conveyed by the news that a Philadelphia manufacturer has been commissioned to supply an X-ray outfit for a purpose entirely unique. In explanation of the purpose for which the instruments are to be used, a representative of Japan said that the mikado's mints had been robbed habitually by employes who would surreptitiously swallow the newly minted coins. All sorts of devices to prevent this system of thieving had been tried in vain until the director of the imperial mints, with oriental ingenuity, decided to bring science to play the part of detective. With an X-ray machine to face, the bland, coin-laden Jap, with perhaps a rouleau of gold snugly concealed in his intestinal tract, will doubtless be less imperturbable as he approaches the exit with his unmasticated gains. And thus is another laurel added to the brow of Roentgen!

CO-OPERATION, said Mr. Charles F. Scott, president of the American Institute of Electrical Engineers, in an address at the recent anniversary celebration of the Engineers' Club of Philadelphia, is the great discovery of the nineteenth century. Why not, then, apply it to the profession of engineering itself? Why not have a national Engineering Congress, supported by a union of engineering societies, with a fine central headquarters building, containing a great technical library, ample assembly halls and comfortable parlors, with apartments for all the affiliated societies? All over the country engineering societies and clubs could be similarly associated in the various cities. The suggestion is very interesting, and Mr. Scott supports it in eloquent phrase; but would it not, if put into effect, be carrying centralization a little too far? In times past engineering societies have had their disagreements; and, while cordially co-operating, the various bodies can perhaps best work out their destinies individually. Again, the largeness of the country and its diversity of interests militate against universal recognition of an overwhelming preponderance of engineering authority in one center. The United States is not Great Britain or France, and the engineer in Chicago, St. Louis, Los Angeles or San Francisco cannot, from the very nature of things, take the same interest in a headquarters project in any eastern city as his Manchester confrere can in a London society or the man in Lyons in a Parisian organization. All this, however, is not to say that the general principle of co-operation among engineering societies is not excellent. We merely record our opinion that in such a large country as the United States, with widely distributed areas of population, it would be difficult to locate anywhere a Hall of Engineering that would command the thorough-going support of the great body of engineers throughout the whole nation. Nevertheless, the project is an alluring one, and although it may be impracticable, one can readily sympathize with Mr. Scott's enthusiasm in relation to it.

THE organization of world's congresses to be held in St. Louis in 1904 in connection with the exposition is not without interest to electrical engineers. International electrical congresses were held at Chicago in 1893 and at Paris in 1900, and while no official action has been taken, such a gathering might well be a feature of the series of congresses at St. Louis. The progress of the science and arts of electricity is so rapid that questions of terminology and standardization, on which international concert is desirable, are continually arising. The director of congresses at St. Louis, Mr. H. J. Rogers, and the advisory board, consisting of Dr. Nicholas M. Butler of New York, Dr. W. R. Harper of Chicago, Dr. Henry S. Pritchett of Boston and Mr. Herbert Putnam of Washington, will do well to take under careful consideration the possibility of an electrical congress as one of the gatherings. The American Institute of Electrical Engineers will no doubt gladly co-operate with the exposition authorities, and the subject should be given thoughtful attention.

MUNICIPAL-OWNERSHIP agitation in Chicago has advanced to the stage where two bills have been drafted for the consideration, first, of the City Council, and next of the state Legislature. These bills, if enacted into statutes, will provide, respectively, for municipal street railways and municipal lighting plants (both gas and electric) for Illinois cities. A synopsis of the street-railway bill and an abstract of the argument of Alderman Finn's special committee in support of it are given elsewhere in this issue. The proposed act in relation to municipal lighting plants had not been presented to the council at the time this was written. However, the bill contemplates the sale of gas and electricity to private consumers by the municipalities, which will be a radical departure in this state, if accomplished.

Political maneuvers—the exigencies of the Democratic administration of the city and the Republican administration of the state—are so intermingled with these measures that a sober and exhaustive discussion of them in a technical journal may avail little. The arguments of the committee are simply a specious rehash of the familiar contentions of those who seem to think that public ownership is a panacea for all the economic ills that bodies politic are heir to. They contain many half-truths, but fail to go to the root of the matter, where, in the last analysis, thoughtful students of republican institutions find that municipal ownership is wrong in principle, in that it imposes upon government tasks for which government was not instituted and is not fitted, traversing the familiar axiom that they are governed best who are governed least. Misleading statistics, based on insufficient data or on conditions which have no value as precedents in Chicago or the United States (as, for instance, foreign telegraph tolls in comparison with rates over the thousand-mile wire stretches in this country) indicate erroneous conclusions. But it is an old story; the municipal-ownership idea appears to be popular, and politicians are exploiting it.

It does not follow, of course, that because one is opposed to public ownership on principle he must condone many foolish and wrongful acts of corporations engaged in dispensing what are known as public utilities. Indeed, it is probable that the corporations are in danger from the policy of unenlightened selfishness pursued by so large a proportion of their number; many of them have brought their troubles on themselves and will receive scant sympathy. But this fact does not justify the perpetration of an economic wrong, which has in it the germ of the fallacious principles of socialism. There is a reasonable middle course, by which public-utility corporations may be strictly supervised or controlled by the municipalities granting the franchises; that is, private operation under suitable municipal restriction. It is by some such system as this that existing evils should be corrected.

Revision of Physical Theory.[1]

By Henry S. Carhart.

Physics as a rational body of knowledge is hardy and of slow growth. It has none of the characteristics of the mushroom, but rather those of the oak. It has not grown up in a night nor even in a century. On the contrary, it is the product of many centuries, and it has drawn its nourishment from many lands.

From another point of view, it resembles a coral island, which slowly emerges from the sea, with occasional subsidences and engulfing in the ocean. When it has finally risen from the water and has acquired soil from wind and wave, stately palms crown it and it becomes green with tropical verdure.

The essential element of physics which I wish to emphasize is growth. Not death and decay, but the development of living tissue, enlargement by accretion, assimilation and cellular growth. Now growth and development mean modification, elaboration, flower and fruit, the bare limbs of winter and the grateful foliage of summer. They mean an incessant struggle upward toward the light.

Physics is a living body of truth, a growing science, and as such it exhibits incessant change. It is sometimes profitable and suggestive to take a survey of some of these changes and to note the appearance and sway of physical theories, followed frequently by their disappearance, either gradually or with theatrical suddenness. A mighty magician appears or some new and astounding fact emerges into view; theories are called upon to justify their title, and a readjustment of scientific doctrine becomes imperative. The physicist, who is more intent on ascertaining truth than preserving consistency, holds to a physical theory no longer than he finds it able to furnish support and lend aid. The laws of nature represent the survivals of the fittest theories. Disappearance denotes unfitness to survive. A theory may contain the kernel of a great truth, but overlaid and surrounded with husks and shucks. Time removes these. They may serve a useful purpose in guarding and preserving the kernel till the time arrives for it to germinate, when temperature and soil and sun are favorable. The husk then decays while the inner living principle survives.

It is not difficult to recall instances illustrating the revision which physical theories have undergone in the past. We are all familiar with the famous contest in the scientific world between the corpuscular and the undulatory theory of light. It is not so commonly known that the wave theory was the first to receive the support of eminent men of science. No theory worthy of the name existed prior to the time of Huygens. At a meeting of the French Academy of Sciences in 1678 and in the presence of Astronomers, Roemer and Cassini, Huygens read a remarkable paper on the wave theory of light. Bradley, the astronomer royal of England, had already confirmed Roemer's conclusion from observations on Jupiter's inner satellite that the propagation of light is gradual and not instantaneous. Thus two methods of determining this constant of nature had been discovered—Roemer's, by the eclipses of Jupiter's satellite, and Bradley's by the phenomenon now known as aberration. In 1690 Huygens published his "Traite de la Lumiere." In this he developed the principle relating to the propagation of waves, which continues to be known by his name to this day. It assumes that each point of a wave-front becomes a new center of disturbance for secondary waves, which coalesce into a succeeding wave-front. Huygens definitely assumed the existence of an ether and explained reflection and refraction by methods which are still current in physical literature. He even gave constructions for the path of the ordinary and extraordinary rays in Iceland spar, and showed that both are polarized. But a fatal defect was his assumption of longitudinal vibrations and his inability to give a satisfactory account of rectilinear propagation.

Newton was familiar with the undulatory theory and distinctly recognized its capability of explaining the colors of thin plates. The theory, he says, "is sufficient to explicate all the ordinary phenomena of those plates or bubbles and also of all natural bodies whose parts are like so many fragments of such plates." He nevertheless rejected it in favor of his corpuscular theory, and by his powerful authority biased the minds of physicists for a whole century. The corpuscular doctrine held sway against the arguments of Hooke, Huygens, Young and Fresnel till Foucault devised the crucial experiment to determine whether the velocity of light in water is less or greater than in air. The Newtonian theory required that it be greater; the undulatory theory that it be less. Nature said it is less, and the Newtonian theory retired into the background.

Maxwell, with great penetration and power, laid the foundations of a fundamentally new method of regarding the undulations of light. It remained for the lamented Heinrich Hertz to confirm the Maxwellian theory by a series of the most brilliant experiments of modern times. Since then light has taken its place as an electromagnetic phenomenon, and the rapid extension of the area over which electromagnetic waves of long period may be recognized has finally enabled them to bridge the Atlantic.

It must not be inferred, however, that the undulatory theory of light has been abandoned or superseded. Electromagnetic theory of light is only a modification of the wave theory; it describes something of the mechanism of wave motion in the ether, and classifies the energy in light as electromagnetic in character. It is now possible to produce waves in the ether indefinitely longer than those affecting the eye, as light, and to recognize them by appropriate receiving apparatus. Modern discovery consists not so much in the discovery of long ether waves as in the recognition of their existence and the means of detecting them. The wireless messages of Marconi, wonderful as they are, are but feeble imitations of those incessantly pouring in upon us from the sun. These have dashed the earth with gorgeous colors and dotted the oceans with the greenest of isles. Their swift-winged messages have brought to man some knowledge of other worlds and other suns than ours.

A scarcely less instructive change of physical theory took place during the past century regarding the nature of heat. Able men had not been lacking who had suggested a theory dimly resembling the one held at the present time, but the materialistic doctrine of heat was still generally held by both physicists and chemists along with its congener, phlogiston. Descartes, Bacon, Hobbes and Boyle all suggested that heat and motion were intimately associated. Indeed, Newton himself asked, "Is not heat conveyed by the vibration of a much subtler medium than air?" Unfortunately, the great Cambridge philosopher decided in favor of the materialistic theory; the adoption of phlogiston followed, and then the bald doctrine of material caloric after Newton had long been in his grave.

You are all familiar with the first staggering blow at the doctrine of caloric, delivered by Count Rumford in 1798. His noble contribution to the science of thermodynamics counts for so much that we are disinclined to believe he was a Tory in North Woburn (especially that the Revolutionary War is now over, and England ungrudgingly acknowledges that we were right), and we are almost ready to forgive his desertion of wife and child when he fled to England to become a somewhat inactive enemy of the land of his birth. We must not forget, either, that Rumford was instrumental in founding the Royal Institution in London. That establishment for research, in Albemarle Street, has been prolific in great discoveries. The mere mention of such names as Davy, Faraday, Rayleigh and Dewar is sufficient to call up a long line of the most splendid contributions to science which have been freely given to the world by this same institution for research.

Rumford's strong argument, derived from the continuous production of heat in boring cannon, was to the effect that whatever could be obtained in an apparently inexhaustible quantity when a blunt plunger was turned against friction in a bronze cannon could not be material. The youthful Davy, then only 20 years of age, clinched the argument by showing that ice could be melted by friction against ice. Davy, with a modesty becoming his youth, hesitated to draw the logical deduction from his experiment, which it abundantly justified, till some 12 years later. The caloric theory survived, strange to say, for more than half a century after the experiments of Rumford and Davy had condemned and disproved it. As late as 1856 it received the preference over the dynamic theory in an article on "Heat" in the Encyclopedia Britannica.

When, however, the doctrine of the conservation of energy emerged into the view of those having clear scientific vision, it was perceived that heat is neither material nor is it the mere motion of material particles; not "a mode of motion," but the energy of that motion. Heat is energy convertible into all other forms of energy and the final form which all energy assumes in the process of dissipation. Hence the great work of Joule and Rowland in determining "the mechanical equivalent of heat," one of the most important constants of nature which the mind of man has evolved as a corollary from the doctrine of the conservation of energy. May I take occasion in passing to remark that since heat is energy and not a material, it is unscientific to apply to it the word "temperature." Much that has been written on the subject of the application of thermodynamics to the very modern subject of physical chemistry contains expressions based on the antiquated concepts of the caloric theory. Not a few writers, including Nernst and his school, speak of a quantity of heat falling from one temperature to another or of raising a quantity of heat from one temperature to a higher one, as if heat were a substance called "caloric." It is indeed time that eighteenth-century conceptions about heat were eliminated from our treatises and textbooks.

The mention of physical chemistry brings to mind many changes that have taken place in physical concepts within the past two decades. Just 20 years ago Helmholtz said to the writer, as the latter was about to leave his laboratory, that the most promising field of labor was then on the border-land between physics and chemistry. Subsequent events show that Helmholtz was at that time at work in this field, and at this distance of time his words seem prophetic.

The old formal scholastic distinction between physics and chemistry has disappeared. It is no longer true in any sense that physics is concerned with the molecule, while chemistry has to do with the atomic constitution of matter. So far afield have we gone from this old hard-and-fast division that the modern physicist does not pause at atoms even. He has now to deal with corpuscles or electrons, whose mass is perhaps little in excess of 0.001 of an atom of hydrogen. The brilliant work of Professor J. J. Thomson in this field has given rise to new concepts of matter, and has taught us that there is more in an exhausted receiver than we have hitherto dreamed of in our philosophy.

Knowledge of the properties of matter has been enormously extended in two directions, the one in high vacua and the other at low temperatures. The revolutionary discoveries of Sir William Crookes, beginning about 1875, on electric discharges in high vacua, have opened a new world of the most bewitching interest. We now have Lenard rays, Roentgen rays, Becquerel rays and radio-active substances emitting radiations of most pernicious activity. It has thus been ascertained that mankind has been living in the midst of a multitude of unsurpassed wonders and of properties that no one suspected.

The expression "fixed gases" has not yet faded from our memories. I well remember the wide reputation gained by my old professor of chemistry in college because of his success in liquefying carbon dioxide a short time previously. The solidification of this substance is now a common lecture-room experiment, and the "fixed gases" then known have all followed in the train of carbon dioxide. Every gaseous body but one definitely known to the chemist has now been reduced to the solid state. For the last dozen years Professor Dewar has been engaged at the Royal Institution in London on these low-temperature experiments. Ten years ago I saw him turn a spigot, and out of it flowed liquid oxygen mixed with solid carbon dioxide, from which it was separated by passing the extremely cold liquid through an ordinary filter paper. Even then he was able to liquefy air under atmospheric pressure by means of the low temperature obtained by the evaporation of liquid oxygen in an exhausted receiver. Hydrogen has followed, not to the point of liquefaction only, but to the state of a clear ice-like solid at a temperature only 13 degrees above the zero of the absolute scale, or at a temperature of 260 degrees below the zero of the Centigrade scale. Its density in the liquid form is only one-fourteenth that of water, and the only solid that will float on it is pith. Its specific heat, on the other hand, is five times that of water, and its coefficient of expansion is 10 times that of a gas. It does not conduct electricity, strange to say, in either the liquid or the solid state. It is, therefore, non-metallic, and it is also slightly diamagnetic. The study of the properties and chemical relations of hydrogen led great physicists like Faraday, Dumas, Daniell, Graham and Andrews to entertain the view that in either the liquid or the solid state it would exhibit metallic properties. The case of hydrogen shows, as Dewar says, that "No theoretical forecast, however apparently justified by analogy, can be finally accepted as true until confirmed by actual experiment."

Another revision of physical concepts, which still remains within the realm of theory, is the modern doctrine of osmotic pressure and the related doctrine of electrolytic dissociation. The theory of the solution of a solid in a liquid solvent remained in a chaotic state up to a period 15 years ago, when Van't Hoff showed that when sugar is dissolved in water the dissolved particles follow the laws of Boyle and Gay-Lussac for gases; in other words, we may apply to the sugar in solution the gas equation $PV = RT$, and may demonstrate that if P is the osmotic pressure and V the volume containing a gramme-molecule of the sugar, R has the same value as in the case of a gas; that is, about 83,000,000. Such a remarkable result can scarcely be a coincidence. Whether great molecular mobility is given to a substance by causing it to assume the gaseous form or by dissolving it in a proper solvent, it follows in both cases the same laws as regards the relations between volume, pressure and temperature.

I have stated the principle too broadly, because substances in solution which conduct electricity and undergo electrolysis invariably exhibit a larger osmotic pressure than they should to conform to the gas law. This increase is accounted for by the dissociation into electrically charged ions which the substance undergoes in solution, an ion exerting the same osmotic pressure as a molecule. Van't Hoff expressed the relations between gas pressure and osmotic pressure as follows: "The pressure which gas exerts at a given temperature, if a definite number of molecules is contained in a definite volume, is equal to the osmotic pressure which is produced by most substances under the same conditions if they are dissolved in any given liquid." But the "most substances" of Van't Hoff, Arrhenius showed, do not include many aqueous solutions in the sense that these latter exert a much greater osmotic pressure than is required by the gas law. Hence, Arrhenius made a distinction between active and inactive molecules in solution, the active molecules including those whose ions are independent of one another in their movements. The remaining molecules, not dissociated into independent ions, are inactive. He then proceeds to show that Van't Hoff's law holds not only for most, but for all, substances, even for those which had hitherto been

1. Paper read before the Central Association of Physics Teachers at Chicago, November 28, 1902. Dr. Carhart is professor of physics at the University of Michigan.

regarded as exceptions; that is, electrolytes in aqueous solution.

A corollary of this law is that the active molecules alone conduct electrolytically, the inactive molecules taking no part in the process. In other words, conductivity is a property of the charged ions into which the dissolved substance is dissociated.

The theory of electric conductivity in electrolytes has undergone modifications in successive steps or stages. Very soon after the electrolysis of a compound liquid had been effected, Grothuss, then only 20 years of age, proposed the theory of electric conductivity in liquids which bears his name; it was in a paper published at Rome in 1805, bearing the title "Memoir on the Decomposition of Water and of Other Bodies, Which It Holds in Solution, by the Aid of Galvanic Electricity." The theory involves alternate separation and recombination of molecules. To accomplish this segregation of oxygen and hydrogen, for example, a definite electromotive force must be applied to the solution by means of the electrodes. A smaller potential difference than that required to effect the segregation would not produce any electrolysis nor the flow of a current. But it was afterward shown, as Clausius pointed out in 1857, that even the weakest electromotive force produces a current through an electrolyte and that it follows Ohm's law. Hence the modification of the Grothuss theory, proposed by Clausius, that the ions of a substance in solution are not permanently united with one another, but a few of them are always present in a temporarily uncombined state, and wandering about till they again combine with other partners. This temporary dissociation Clausius conceived to be due to the agitation of heat, and he gave cogent chemical reasons in support of his hypothesis. These free ions are then present in a solution to conduct a current when the potential difference is below the value required for actual visible decomposition.

When the voltameter is composed of metallic electrodes immersed in a salt solution of the same metal, copper electrodes in copper-sulphate solution, for example, the current is simply proportional to the potential difference between the electrodes, no sudden change in its value is observed, and the metal is simply transported across from one electrode to the other. If, however, at least one of the products of the electrolysis is a gas, which occurs when the anode is platinum, then the appearance of the liberated gas when the potential difference reaches a well-defined value, is a signal for a rapid increase of the current and of the visible decomposition. Since work must be done against atmospheric pressure when a gas is liberated, the electromotive force must have a corresponding determinable value before the required work can be accomplished.

From an electrical point of view, the Clausius modification of the theory of Grothuss appeared to answer the requirements. But the study of the conductivity of electrolytes, by Kohlrausch especially, showed that the molecular conductivity, or the conductivity of a gramme molecule of the substance in a solution placed between plate electrodes one centimeter apart, depends on the dilution; the greater the dilution, the greater the molecular conductivity. This fact demanded an advance on the theory of Clausius. The advance step consisted in assuming that the dissociation, which Clausius conceived to be casual and indeterminate in amount, is permanent and occurs when the substance is dissolved. Hence the more dilute the solution, the larger the proportion of molecules which undergo dissociation and become active in the sense in which Arrhenius used the word. At extreme or infinite dilution, all the molecules in the solution are dissociated into ions, some positively charged and the rest negatively. The current through an electrolyte consists of the sum of the positive and negative charges actually carried through the solution by the migration of the positive ions toward the cathode and the negative ions toward the anode.

The theory of electric conductivity through solutions is intimately connected with the theory of a voltaic cell. It has thus come about that the modern dissociation theory has led to an entirely new view of the mechanism in a primary cell, and especially the origin of its electromotive force. A heated controversy was kept up for three generations over the origin and seat of the electromotive force in a voltaic cell. I know of no other dispute so persistent and long sustained, unless it be a Kentucky family feud. Volta's theory that the origin of the electromotive force is at the contact of the two metals had able supporters, especially in Germany, where the names of Poggendorff, Fechner and Ohm were names to conjure with. On the other hand, Fabroni, Wollaston, Ritter, Becquerel, De La Rive and the great Faraday held that the source of voltaic electricity is chemical action. Then came the doctrine of the conservation of energy and the immediate conclusion that mere contact of metals could not give rise to the supply of electric energy which a cell is able to furnish. It will be observed that when Helmholtz, then only 26 years of age, presented his paper on "Die Erhaltung der Kraft," or, as we now express it, "The Conservation of Energy," for publication in Poggendorff's Annalen, it was rejected by this same Poggendorff, who had persistently held to the contact theory. Whether Poggendorff was then the responsible editor of the journal, I am unable to say. He lived for 30 years after this time.

Helmholtz's paper was read before the Physical Society of Berlin in 1847, and was published the same year in pamphlet form. It attracted little attention for six years, when, strange to relate, it was vigorously attacked by Clausius, who lived long enough, however, to see his error and to recognize the greatness of Helmholtz.

After the introduction of the principle of the conservation of energy, Thomson applied it to the voltaic cell and calculated the electromotive force on the basis that the electric energy evolved equals the chemical energy transformed. From the point of view of energy, a voltaic cell is a device for the direct conversion of potential chemical energy into the energy of an electric current. The question arose whether all the chemical energy transformed in a voltaic cell is thus converted into electrical energy? Thomson and Helmholtz, at first, answered the question in the affirmative, and the principle of equating the two forms of energy was thereafter known as the Thomson principle. According to this view, it is a simple matter to calculate the electromotive force of any given combination from the heats of formation of the compounds undergoing chemical change. The quantity of electricity transported through the cell when one gramme equivalent of zinc enters into solution and a gramme equivalent of other substances undergoes a concurrent change may be calculated from Faraday's laws of electrolysis. It is 96,540 coulombs. This quantity multiplied by the electromotive force of the cell, equals the electrical energy given out while one gramme equivalent of zinc goes into solution. If this product is placed equal to the algebraic sum of the heats of formation of all the chemical changes involved in the cell, the electromotive force is readily obtained from the equation. Thus the heat of formation of a gramme equivalent of zinc sulphate, according to Berthelot, is 121,000 calories; of copper sulphate, 95,700 calories. The difference is 25,300 calories. Then the reaction in a Daniell cell may be written

$$Zn + CuSO_4 = ZnSO_4 + Cu + 25{,}300 \text{ calories.}$$

Further, Eq $= 25{,}300 \times 4.19$ joules, where q equals 96,540 coulombs. From this equation, E is 1.098 volts, the electromotive force of the cell. The value of the electromotive force of the Daniell cell calculated in this way agrees very closely with the observed value. It was soon found, however, that other cells did not show such good agreement with the theory. In some the electromotive force is smaller than the calculated value and in others it is larger. Finally, Willard Gibbs in America and Helmholtz in Germany independently expressed the true relationship between the chemical energy transformed and the electrical energy given out. The Gibbs-Helmholtz equation may be conveniently written as follows:

$$E = \frac{H}{q} + T\frac{dE}{dT},$$

in which H is the sum of all the heats of formation expressed in mechanical measure, q is the quantity of electricity required to transport one chemical equivalent of any substance (96,540 coulombs), T is the absolute temperature, and $\frac{dE}{dT}$ the temperature coefficient of the electromotive force of the cell. It is obvious from this equation that E is smaller than the electromotive force calculated from thermal data alone, whenever the temperature coefficient is negative; and it is larger when the temperature coefficient is positive. In the former case only a portion of the transformed chemical energy appears as the energy of the current; the remainder heats the cell. In the latter case, the energy given out by the cell is in excess of the chemical energy transformed, or the cell converts some of its heat into electrical energy, and so cools in action.

The Gibbs-Helmholtz equation represents our most assured knowledge of the relation between the chemical, electrical and thermal quantities involved in a voltaic cell, and it has been fully established by experiment.

It has also been demonstrated that the temperature coefficient of a voltaic cell is equal to the sum of all the thermo-electromotive forces, taken with their proper sign, at all contacts of dissimilar substances in the cell. For example, the thermo-electromotive force between zinc and a solution of zinc sulphate is directed from the solution to the metal. The same is true of copper and copper sulphate, while the thermo-electromotive force between equidense solutions of the sulphates of zinc and copper is practically zero. If, therefore, a Daniell cell be so constructed that one side or electrode may be heated independently of the other, it will have a positive coefficient if the positive electrode and the solution about it be heated, and a negative coefficient if the negative side alone be heated. This follows from the fact that the direction of the electromotive force of the cell as a whole is from the zinc to the copper through the cell. Hence the thermo-electromotive force at the copper electrode is in the same direction as that of the cell, while that at the zinc electrode is in the opposite direction. These two thermo-electromotive forces are very nearly equal to each other, and the temperature coefficient of the Daniell cell as a whole is therefore very small. The same method applies to other cells.

It thus appears that the heat generated or absorbed, corresponding with the sign of the temperature coefficient, may be localized in the cell. For example, in the Daniell cell, the passage of a current generates heat at the zinc electrode, where the current flows against the thermo-electromotive force at the surface of the zinc; at the same time heat is absorbed at the copper electrode because the thermal electromotive force there is in the same direction as the current. A difference of temperature is thus established between the two sides of the cell which in a given time is proportional to the first power of the current. These statements have been fully established experimentally. If the quantities of heat generated on the one side and absorbed on the other are equal to each other, then the temperature coefficient of the cell is zero and the chemical energy transformed equals the electrical energy given out.

The Gibbs-Helmholtz equation, modified as described, is a fairly complete expression of the voltaic cell from an energy point of view. It needs only the further addition of expressing the heat of formation of the chemical compounds involved as a function of the density of the solutions.

The Nernst theory of a voltaic cell is based, first of all, on the theory of osmotic pressure developed by Van't Hoff. To this theory it adds the assumption that metals exhibit a tendency to go into the ionic state when immersed in an electrolyte. A supposed analogy is found in the tendency of liquids to evaporate, the evaporation in a closed space continuing until the vapor pressure is equal to the tendency of the liquid to pass into vapor. In the same way the osmotic pressure of a solution saturated with metallic ions may be looked upon as a measure of the "solution pressure" of the metal in contact with it. This "solution pressure" of Nernst is supposed to measure the tendency of a metal to pass into free ions in an electrolyte. If now a metallic ion passes from a solution pressure P into the state of a free ion under an osmotic pressure p, then Nernst conceives that the work done is the same as when a gas passes from the one pressure to the other. The well-known formula for the work in the case of a gas is RT logarithm $\frac{P}{p}$. This is the work done at one electrode which a gramme equivalent of metal passes into solution. Substituting the value of the gas constant R, and passing to common logarithms, we get

$$E = 0.0002\ 1 \log \frac{P}{p}$$

This expression applies to metals whose valence is one. If the valence is n, and if we take into consideration both electrodes, we have

$$E = 0.0002\ T\left(\frac{1}{n}\log\frac{P}{p} - \frac{1}{n'}\frac{P''}{p'}\right)$$

as the equation for the electromotive force due to solution pressure and osmotic pressure only. If two electrolytes are employed, a small effect may be produced at the contact of the two.

It will be observed that both the Gibbs-Helmholtz and the Nernst formulas involve the doctrine that the seat of the electromotive force of a voltaic cell is at the contact of dissimilar substances in the cell. Neither is, however, a contact theory, but both reason from the theorems of thermodynamics. The two formulas represent two ways of approaching the problem. They are not antagonistic, but complementary rather. Nernst's formula gives a somewhat more detailed insight into the mechanism of a cell, but it involves a number of hypotheses which the most ardent admirer of the theory can hardly claim to have been established by experiment. The Gibbs-Helmholtz formula, even when including the localization of the heat effects, rests on a secure basis of experimental facts.

The Nernst formula gives no definite account of the temperature coefficient of a cell, nor of the relation of this coefficient to the electrical energy evolved. The thermodynamic method of Gibbs and Helmholtz furnishes the most secure foundation for the investigation of a cell from the point of view of energy changes, without the assumption of any hypotheses, and without exposing to view the exact mechanism beyond the application to the problem of thermo-electromotive forces.

"And what shall I more say? For the time would fail me to tell of Gideon and of Barak, and of Samson, and of Jephthah; of David also, and of Solomon and of the prophets." I will only recall to your minds that the superficial distinctions between electricity developed by friction, by voltaic cells, by heat, and by electromagnetic induction have all gradually disappeared, since a condenser may be charged or a current be set flowing by electric pressure, however produced. All the phenomena formerly produced by electrostatic machines are now produced by induction coils or by alternating currents of high potential. In fact, many new phenomena have been added by the high-frequency discharges obtained by alternating currents. Lightning has, so to speak, been analyzed into the "steady strain" and the "impulsive rush" discharges of Sir Oliver Lodge, with attendant oscillations along a well-worn track till the energy is dissipated in heat. Hence the interesting resonance effects which bring out a striking analogy between stationary waves in sound and stationary waves or surges of electricity.

Again, in magnetism, the crude theory of a magnetic fluid, adhering like a liquid drop to the poles of a magnet, has given place since the time of the immortal Faraday to the conception of magnetic induction and lines of force. These lend themselves

to experimental investigation to such an extent that to-day we may design a magnetic circuit to the minutest detail with nearly or quite the same approach to accuracy that is possible with an electric circuit. The law of the magnetic circuit, thanks to Rowland and others, has now taken its place alongside the law of the electric circuit as established by Ohm.

Note also how our friends and fellow workers, the mathematicians, have been obliged to give up their favorite "action at a distance" doctrine. Faraday and Maxwell taught them that no action takes place at a distance without the agency of an intervening medium. As soon as the cannon-ball theory of light and radiant heat had been relegated into a decent oblivion, the necessity arose for a revision of all the physical theories of action involving the law of inverse squares. In fact, this law fails except under ideal conditions, and especially in the case of gravitation. Indeed, gravitational astronomy has not kept abreast of modern physical astronomy as represented by such eminent workers as Pickering of Cambridge and Campbell of Mt. Hamilton. Great renown awaits the physical astronomer who will demonstrate beyond doubt whether gravitation acts through the medium of the ether, and whether it involves the element of time in transmission.

Finally, a lesson for the present may be drawn from the history of theory in the past. Theories are only helps or scaffolds. They are necessary working devices, which aid in the advance of the edifice, and finally disappear like the staging. Use them only as props and temporary expedients, not until the whole edifice is finished, but until some grand arch is completed, some minaret or tower emerges against the clear sky, or the light streams in through some noble window.

It is often darkest just before the dawn. Sometimes we emerge into the bright light with a suddenness that blinds before the eye adjusts itself to the new illumination. One dreary day in April I took the train in Switzerland over the St. Gotthard route. We entered the north end of the tunnel with a clouded sky and snowflakes swirling through the air. Ten minutes passed in the darkness, a thousand feet beneath the village of Andermatt, 15, 17, and then the train ran out on the Italian side of the great divide—into a burst of sunshine and clear sky and white-capped Alpine peaks and tempered winds and the pale green of olive groves. So sudden was the transformation that an involuntary exclamation of surprise ran through the train. The experiences of the past 20 years warn us that we must be prepared for similar surprises in the illumination that physical science is shedding on the world of nature. It seems to us that we are no longer walking by the light of the moon, but that the sun has already risen in its splendor. What shall the noonday be?

Electricity and Animal Growth.

Maurice Springer, in a paper read before the Paris Academy of Medicine, considered the energy of growth in animal organisms, particularly the human subject. This line of investigation is the subject of an article in the Revue Scientifique, translated in abstract by the Literary Digest, from which the following is taken:

"What is the exact form of the energy that produces the molecular work resulting in growth? If we are to believe Mr. Springer, it is electrical. He goes on to show that osmotic pressure or that due to liquid attractions is a very important factor in the exchange and addition of molecules constituting growth. We condense his further remarks:

"The study of osmotic pressure shows that this pressure is stronger as the degree of electrolytic dissociation is higher. Living organisms are generators of electricity. The protoplasm of the ovule brings its contingent of electric energy from the organism whence it comes, and cellular fermentation at its maximum activity, during periods of rapid growth, determines a correlative production of heat and organic electricity. On the other hand, the muscular system is an important purveyor of electricity; the movements of the heart produce a notable quantity. The electric energy thus produced may be measured by the galvanometer and electrometer. Part escapes analysis, for the currents are short-circuited, but we know that there is a certain correlation between the vigor of an organism and its electric reaction. Experiment shows that electric energy is an exciter of growth. By electrifying animals and children, Mr. Springer has caused a notable increase in development and an augmentation of weight. The activity of protoplasm, the movements of plants, and the action of the oxydases are accompanied by the production of electricity, and, on the other hand, if we remove plants from the action of atmospheric electricity by surrounding them with a metallic network, their growth is retarded. We may look forward to the time when, just as we now measure calorific, mechanical, luminous, or electric energy, we may be able to measure the energy of growth. With the aid of these new ideas we may then stimulate the production and utilization of this form of energy and obtain races or individuals of different heights."

The Rouge River Electric Light and Power Company of Rockford, Mich., has increased its capital stock from $12,000 to $16,000.

American Pacific Cable Landed at San Francisco.

An attempt was made to lay the shore end of the American Pacific cable on December 12th and resulted in several accidents. A strong tide was running and was the chief cause of the trouble. Twenty-five thousand people had gathered to witness the operations. The cable steamer Silvertown lay at anchor off the beach all the morning, awaiting for the seas, which were breaking heavily ashore, to moderate. At 11 o'clock the life-saving crews from the South Side, Baker's Beach and Golden Gate stations appeared on the scene with their boats to assist in landing the cable. Shortly after their appearance a signal was given from the Silvertown for the Golden Gate crew to come out through the surf and take a hawser ashore. The boat, drawn by the horses of the station, galloped down into the surf, and the men of the crew climbed into their places. A favorable wave rolled up on the shelving sand and the boat was shot from its carriage into the water. There was a cheer from the crowd which scared the horses. The team broke away from the driver, and, with the boat carriage dragging after it, plunged into the crowd of men and children. After knocking down several persons the runaway team was captured. Fortunately no serious accident occurred. After several attempts the live-saving crew succeeded in getting ashore a hawser to which was attached the cable. A wait of 4½ hours was had for even water before attempting to draw the cable ashore. The hawser bellied down so that it was impossible to draw it ashore through the strong tide. Just before the attempt was abandoned for the day a number of men took hold of the hawser for a final pull. The hawser broke and bowled over the cable-company officers like tenpins. Darkness coming on, the Silvertown returned to its anchorage in the bay, abandoning any further attempt that day. When the great hawser broke, the cable company's officials, who were assembled to carry out the ceremony, seemed to be the most ill-fated of any of the assembled throng. Clarence Mackay, president of the company, was struck on the chin and knocked down, and several others in the party were more or less roughly jolted.

On December 14th success marked the efforts of the workers, and the eastern end of the cable was made fast with interesting ceremonies. A gathering of perhaps 30,000 people assembled to witness the attempt and was very enthusiastic in its expressions of praise for the successful beginning of a difficult undertaking. This time a section of the cable was spliced on board a steam lighter, and the shore end made fast from that craft. No accident of any kind occurred.

"In memory of John W. Mackay, I christen the Pacific cable. May it always carry messages of happiness." With these words Lucille Gage, 11-year-old daughter of Governor Gage, named the cable, and, breaking a bottle of champagne over the shore end, opened a new era in the commercial development of the Pacific Coast. The "christening" occurred at exactly 9:55 a. m. While the cable was being spliced on board the steam lighter, Mayor Schmitz delivered a short speech congratulating Mr. Mackay on the successful beginning of the work. He also spoke of the importance of the undertaking and the benefit to the world at large that would result from its completion. Clarence Mackay, president of the Pacific Commercial Cable Company, thanked the mayor and those present. Governor Gage, on behalf of the state of California, paid a tribute to the late John W. Mackay. The formal exercises closed with cheers for the cable and all those taking part in its landing.

Refreshment tents were erected on the beach, and while the cable was being spliced Mr. Mackay served champagne and other refreshments to a large number of specially invited guests. Mr. Mackay also sent the following telegram to President Roosevelt: "I have the honor to inform you that the end of the Honolulu cable was successfully brought to shore this morning."

When the splicing was completed late in the afternoon horses were hitched to the end, and the cable was drawn through the conduit to the cable station. At the same time the steamer Newsboy steamed out to sea five miles and anchored the cable with balloon buoys. It was picked up by the cable steamer Silvertown and taken aboard. The splicing to the main body was completed that night, and the Silvertown headed for Honolulu at a seven-knot speed. The first message over the cable was sent from shore to Chief Engineer Benest on the Silvertown, congratulating him on the successful landing. Several tests were made as the cable was being paid out by the Newsboy, and it was found to be in perfect condition. A portion of the cable was cut up into small bits for souvenirs and distributed by President Mackay among his special guests, estimated at about 3,000. During the ceremonies an artillery band from the Presidio played.

At night Mr. Mackay concluded a day full of interest to all America, and especially to the Pacific Coast, by tendering a banquet to the officials of the Commercial Pacific Cable Company and of the Postal Telegraph-cable Company. At 10 p. m. a message was received from the Silvertown saying that all was going well. At this writing the Silvertown is far out on the Pacific on her way to Honolulu paying out the cable that will be the great American connecting link, or a part of it, between the United States and Asia.

Magnetism as an Aid to Traction.

A device has been patented to do away with the use of sand in the starting and stopping of electric cars and steam locomotives. This apparatus employs magnetism to supplant the sand. The patents on this invention have been granted to A. A. Honey, at one time superintendent of telegraph of the Northern Pacific Railway.

The scheme makes use of magnetism to give the motor (steam, electric, or whatever it may be) a better grip upon the rails and so to increase its tractive moment. Up to the present invention, nothing has been placed upon the market which would satisfactorily take the place of sand, universally employed with all forms of motors used for drawing cars over rail tracks. As applied to an ordinary four-wheel truck, the device employs two small idler wheels, one traveling on each rail close to and immentioned iron core, the driving wheel, the idler wheels are mechanically attached to the axles of the driving or motor wheels by means of an iron core which meets the axle in a loose journal, setting close to the hub of the wheel on the inside. On this iron core is wound sufficient magnet wire to give the desired strength to the magnet on the passing of a predetermined current. As may be imagined, the magnetic circuit is made up of the abovementioned iron core, the driving wheels, the idler wheel and the section of rail included between the two wheels. Of course, the two magnetic circuits (one on each rail) are in no way connected, excepting that they are created by current from the same leads. The number of turns of wire wound on each core will vary with the horsepower of the tractor. This may be made more clear by saying that in the case of a street car, four magnets being used on the double-truck car, the strength of the four magnets will be sufficient to give the wheels grip enough on the rails to insure the motors developing their full horsepower capacity before these wheels slip. In the case of the steam engine, the electromagnets will be wound so as to give a strength sufficient to allow considerable overload on the engine before the wheels slide on the rails. With the motor it would not do to attempt to do too much work for fear of burning it out; but in the steam engine, only a certain horsepower will be developed anyway, and that will be made full use of.

One peculiar difference between the use of magnetism and sand for increasing the tractive moment, is that, with sand, when the wheel slips, the motor loses a great deal of its power, while with magnetism, that power does not drop away in nearly the same ratio, since the tendency of the magnetic lines is to cause the contact to be all the closer when slipping occurs than before. The device will at all times be under the control of the motorman or engineer, and under ordinary conditions will not add to work of propelling the car or train, owing to the fact that the idler wheels are held a slight distance above the rails by springs. In case of an accident on a steep grade, whereby the supply current to a car's motors is cut off, the car can be kept under control by switching the motors into circuit with the magnets. The motors will, of course, be operating as generators, and the current supplied by them will be more than sufficient for the magnets. The patents on the invention are controlled by the Magnetic Equipment Company of Chicago. In the case of a steam locomotive, current for the electromagnets may be generated by a dynamo driven by a small steam turbine, the set to be placed on the front of the boiler, back of the headlight. Of course, in the case of electrically lighted trains, other sources of current are available.

Underwriters' Electrical Committee Meeting.

The annual convention of the electrical committee of the Underwriters' National Electric Association was held in New York city on December 10th and 11th. The meeting considered several amendments to the National Electrical Code, which were proposed by different interested organizations. Much important business was transacted. Official announcement of changes will be made later by Secretary C. M. Goddard of Boston. The attendance at the convention was about 200 and included committees and representatives from the American Institute of Electrical Engineers and Electrical Contractors' Association, city electricians, and also representatives from the National Architects' Association and other societies. These visiting delegates had full privileges of the floor and showed an active interest in the matters under consideration.

The Western Union Telegraph Company has reported its earnings for the quarter and half-year ending December 31st (partly estimated). Compared with the actual returns for corresponding periods in 1901, the figures are as follows: Net revenue for quarter to December 31, 1902, $2,100,000; for quarter ended December 31, 1901, $1,858,318; for half-year ending December 31, 1902, $4,347,174; for half-year ended December 31, 1901, $3,807,635.

DEVELOPMENT OF THE TELEPHONE FIELD.

The Sliding Scale of Rates for the Telephone Company.[1]

By Henry S. Herr.

The flat-rate system incorporated into many of the franchises granted to different Independent companies by city and town councils, has been the direct cause of more poor service, poor construction and poor maintenance than any other cause that I can think of at the present time. None of the Independent companies was aware when it began business that to maintain a telephone system would cost more per telephone to care for 500 than for a lesser number. Therefore, the companies soon found themselves paying out more money for maintenance and operating than they were receiving. A very popular price among promoters, and a catchy price for the public, is a rate of $1 per telephone, this being considered an adequate amount in telephone systems under most favorable conditions for from 300 to 500 subscribers. That is not a sufficient amount to conduct the business and maintain the plant when the number is more.

A large number of telephone exchanges that in the beginning, when their subscribers were few in number, gave excellent service, are now giving very poor service, because expenditures consume all the receipts, and there is nothing left for repairs or maintenance. And unless financial relief comes by means of advanced receipts, a very short time will put them out of business.

The eagerness of the Independent telephone people to right the wrong done the public in charging exorbitant rates by the company holding the original patent upon the telephone was the prime cause in promoting Independent or opposition telephone companies. The new companies, like the hardware or grocerymen, counted that the more service they could sell, the greater would be their profit, prices always being the same. One hundred barrels of sugar, or 100 barrels of nails can be sold by the merchant for less money per barrel than one, two or three barrels, and still the merchant would make greater profit on his investment by selling the large number at the same price than by selling the small number at the same price. And thus the pioneers of Independent telephony, when they turned their attention to the telephone business, thought if they could sell the service of a thousand telephones, they could make the rate the same, or even less, than if they sold the service of only one-quarter or half that number. The comparison between sugar, nails and telephone business is not a fair one. When a barrel of sugar is sold, that is the end of it; when a telephone service is sold, it is only the beginning. Forever after there are wires to be taken care of, trouble to chase, lightning and electric currents that burn up the instruments to be switched off, and the more telephones you have the longer distances are necessary to reach the subscribers, and many other things must be done. When nails and sugar are sold, the merchant receives all his cost and profits; when a telephone is placed, only a small portion of the cost is paid in the service, and years are required to balance accounts. But to give telephone service to one thousand subscribers, a central apparatus must be provided at a cost of no less than one hundred times as much as the central apparatus will cost to give service to one hundred subscribers. Ten exchanges of one hundred subscribers at $1 and $2 a month will bring a handsome return to the owners, where one, with one thousand subscribers at a cost of $1 and $2 per month, will be a positive loss without any provision for maintenance. Still, in each case, a thousand subscribers are served. But this is sufficient to show cause for this paper.

By the sliding scale of rates for telephone companies is meant a scale of rates based upon the number of connections given subscribers in any one system. The importance of such a rate is well understood by the older companies, as shown by the sliding scale of rates as used by the American Bell Telephone Company at the advent of Independent telephone companies.

The value of the telephone to the users is in the number of subscribers who can be reached in any one system, and it is no more than just that the telephone company should receive a proportionate share of the value that the telephone is, to those using it, whether for business or pleasure. And it is also fair to the users of the telephone that they should not be required to pay more than is necessary for good maintenance and good service with a fair profit to those who have invested their money in the telephone system. This equality can only be accomplished by the sliding scale of rates. If cost of future maintenance was always known, it would be an easy matter to incorporate rates in telephone franchises. But as this is not the case, it remains a question whether or no it is wise to do so. I am of the opinion that there will be no difficulty along this line if telephone companies will do a fair and honorable business and make their rates proportionate to the service rendered, with a fair dividend for money invested. By maintaining reasonable charges, there would be no danger of competition, unless it should be by someone trying to break a weaker company, in order to obtain entire control and produce a monopoly in such a manner as to exclude others forever, and then return to the prices charged during the life of the fundamental telephone patent.

What the sliding scale of rates should be necessarily varies with the conditions under which the company must operate. In small companies, where it is not necessary to use tall poles or aerial cable, or conduit work, placing the cables and wires underground, the rate can be less than in cities where all this is required. But no company can do business more successfully under the most favorable conditions in an exchange not to exceed 500 at a rate averaging less than $1.50 per month, for all telephones. This is usually accomplished by charging $1 for residence telephones, and $2 for business telephones. Above that number, it will be necessary to advance the rate a certain small percentage as the number of subscribers is increased.

A number of telephone companies in the state of Iowa have been asked if, in their experience, they found the average cost of operating, including all expenses per instrument, increased or diminished with the number of telephones installed, and what would be the number approximately at which a $2 rate for business, and a $1 rate for residence on a full-metallic system would be profitable.

The manager of the Des Moines Mutual Telephone Company placed the number at 400 or 500. The Waterloo Telephone Company, Dr. Bennett, manager, placed the number at 400 or 500. The Fort Dodge Telephone Company made the maximum number at 800. The Home Telephone Company of Oskaloosa, at 250. In Iowa City a citizens' committee was appointed by the Commercial Club to investigate the proposed increase of rates by the Johnson County Telephone Company. After thoroughly investigating they reported that it was unprofitable for the company to do business at a $1 and a $2 rate with 600 telephones in operation, one-half of which were business telephones, and the other half residence telephones. The members of this committee publicly announced that they were opposed to a raise of telephone rates when they were first placed upon the committee. But, after their investigation, they were convinced of the necessity of raising the rate to $1.50 and $2.50 until the number reached 1,000 subscribers; thereafter, 25 cents additional; same rate to be maintained until the number reached 1,500, when another 25 cents should be added. This is a fair concession by the committee appointed for Iowa City.

The Interstate Independent Telephone Association should take some action to show its disapproval of the conduct of many Independent telephone promoters in making a flat rate for an unlimited number for service for all time to come, when asking for franchises. This is untenable, because the cost of telephone construction and maintenance vary too much in different cities of the United States, particularly the maintenance, which will average 50 per cent. more in some cities than in others, and it is unwise to place the cost of maintenance at less than 10 per cent. in any case. More than this, the association should do all in its power to enlighten town and city councils on this subject, so that they will scrutinize more carefully the franchise asked for by telephone-company promoters, since such promoters generally organize these companies by issuing stock and bonds, and then construct the cheapest plant possible, taking their profit and leaving the stockholder and bondholder to take care of the situation, who soon find, to their disappointment, that they were caught in an unprofitable investment, and the council is in the awkward position of having required conditions of their telephone company which cannot be carried out, excepting at a great loss and final bankruptcy. City councils are generally selected from the best men of the city, from various trades and business. They want to do the fair thing in such matters, but how can they, when they do not understand the business? It is our duty, as an association, to agitate this question, and furnish proof of the correctness of our position, so that the value of telephone properties may not be destroyed, and many men financially ruined by injurious or unwise legislation, either by the city councils or by state legislatures.

Legislation on this subject is sure to come, and we need not fear it, if we do our duty in this matter. Every business man wants every other to succeed, and the business men will come to our support, if they understand the situation. They all want first-class telephone service, and that, like good goods, cannot be bought at the price of shoddy. Above all, be honest with your people. Make your statements plain and truthful, and you will have a hearing which will bring you success.

1. Paper read before the Interstate Independent Telephone Association at Chicago on December 10, 1902. The author is an exchange operator in Ottumwa, Iowa.

Telephone Opposition in Mexico.

M. G. Ribson, general manager of the Mexican Gas and Electric Light Company of the City of Mexico, has applied to the municipal authorities of that city for a franchise to establish and operate an extensive system of telephones there. The franchise will doubtless be granted. Mr. Ribson is said to be acting as the representative of a syndicate of American capitalists which proposes to enter the Mexico field in competition with the existing Mexican Telephone Company.

Telephone Situation in Southern Indiana.

Concerning the telephone warfare in Evansville and Southern Indiana, about which much has been printed in the Western Electrician, Leland Hume, secretary of the Cumberland Telephone and Telegraph Company (Bell), writes as follows: "In so far as this company's rights to do business in Evansville are concerned, we have the same beyond question. When Mr. Haynes, president of the Luce and Ohio Township Telephone Company, makes the statement that there is not a town of any importance within a radius of 75 miles of Evansville, except Boonville, Ind., which has not an Independent telephone company, he makes a statement that at least shows his absolute ignorance of the situation. There are a great many places of importance within 75 miles of Evansville that are served only, and satisfactorily, by the Cumberland Telephone and Telegraph Company. Among the number are the following: Mount Vernon, Ind.; Boonville, Ind.; Tell City, Ind.; Cannellton, Ind.; Newberg, Ind.; Oakland City, Ind.; Mount Carmel, Ill.; Shawneetown, Ill.; Equality, Ill.; Carmi, Ill.; Harrisburg, Ill.; Eldorado, Ill.; Uniontown, Ky.; Corydon, Ky.; Cloverport, Ky.; Hawesville, Ky.; Calhoun, Ky.; Central City, Ky.; Greenville, Ky.; Earlington, Ky.; Madisonville, Ky.; Dawson Springs, Ky.; Princeton, Ky., and Dixon, Ky., etc. The statement can be made and verified, if necessary, that a majority, a considerable majority, of the so-called Independent companies that can be found at competing points within 75 miles of Evansville have tried to dispose of their properties to this company, some of them several different times."

In a recent statement to the mayor of Evansville Mr. Hume said: "The Cumberland Telephone and Telegraph company, doing business only in the extreme southern counties of the state, has in operation at this time more than 10,000 telephones. With the exception of the city of Evansville, the other large cities of the state are connected with Bell telephone systems, over which we have no voice or control. Now what are the facts with reference to the situation in southern Indiana, where the Cumberland Telephone and Telegraph Company does business? We believe that a searching investigation will not materially change the following estimates:

"In Vanderburgh County the Cumberland Telephone and Telegraph Company operates 2,500 telephones. These telephones are by no means confined to the city of Evansville, but are to be found upon every road leading out from the city, and to the various limits of the county. In Posey County this company has 260, and the local company at new Harmony has 75. In Gibson County this company has 970, and the Princeton Home company has 200, or less, and some farmers' lines connecting in may bring the number up to 350. In Warrick County this company has 530—no home company. In Pike County this company has 550, and the Petersburg Home company has 90, and connecting farmers' lines about 100. In Dubois County this company has 225, and the Dubois County Telephone Company at Huntingburg, counting many farmers' lines that they do not own, but which connect with them, have, perhaps, 750. In Spencer County this company has 1,125; the Rockport company has 250. In Perry County this company has 300; the Troy Home company has about 100. In Crawford County this company has 200, and, as far as we can ascertain, there is no home company—if so, it is too small to figure. In Harrison County this company has 325; no home company in Corydon. In Floyd County, with New Albany as its county seat, this company has 1,700 subscribers, and the New Albany company has about 400. In Washington County this company has 350 subscribers, and the Washington County Home company has 275. In Clark County this company has 1,275. The Clark County Home company has about 100.

"So you will see that out of nearly 100 counties in the state this company operates in 13, supposedly an unlucky number, and yet operates without question five or six times as many telephones as all of its competitors put together, and it is the only company that has anything that approaches a comprehensive long-distance telephone system, and if there is any town or village within the trade area of Evansville that we cannot put your commerce in connection with, it will only be necessary for a customer of the company to indicate the point, and we will build to it."

Bell Activity in Los Angeles.

The Sunset Telephone Company of San Francisco has begun extensive improvements to the equipment of its plant in Los Angeles, Cal. Arrangements are to be made for handling 5,000 additional telephones before next May. A three-story structure, with floor space 75 by 80 feet in dimensions, has been erected in the rear of the company's office building on South Hill street. The lower floor is to be devoted to terminals for all wires. The second floor will be used for long-distance operators and for storage space. The top floor will be used by the local operators. Seventy-five wire men are now engaged in stringing and testing the wire for the new boards, under the direction of J. P. Dunphy, the company's expert.

Telephone News from the Northwest.

The Northwestern Telephone Exchange Company has over 1,000 subscribers in Sioux Falls, S. D., having increased its number by 300 in the past year.

The Zenith Telephone Company secured the contract to furnish telephone service to the city schools of Duluth, Minn., at $25 per instrument for single line and $23 for two-party line connections.

The Twin City Telephone Company has bought the exchange at Cambridge, Minn., of the Minnesota Rural Telephone Company and will improve it.

George J. La Due has bought the local exchange at Mantorville, Minn.

Frank P. Mansfield of Lake Mills, Wis., has been granted a franchise at Jefferson, Wis., for a local telephone exchange.

The local exchange at Hutchinson, Minn., has 254 subscribers and applications are waiting for 15 more connections which cannot be filled owing to delays in deliveries of material from the factory.

The Great Northern Railway Company is installing telephones at various stations from Larimore, N. D., westward, and the work is being rushed. It is believed to be the start of a telephone system which may supplant the telegraph.

The Southwestern Minnesota Telephone Company of Pipestone, Minn., has concluded to place $25,000 worth of stock on the market to raise funds for further extensions. The company now has a total of 15 exchanges in operation with 1,500 subscribers, 350 miles of long-distance lines, 42 toll stations and 194 miles of farmers' lines.

The Maple Leaf Telephone Company has been incorporated at North Branch, Minn., with a capital stock of $50,000.

The West Salem Telephone Company of West Salem, Wis., has moved its headquarters to La Crosse, Wis., and has changed its name to the La Crosse County Telephone Company.

The Northwestern Telephone Exchange Company has 1,000 subscribers in Sioux Falls, S. D., which gives one telephone for every 15 inhabitants. The calls on the system will average about 15,000 a day.

R.

Ohio Telephone Notes.

Representatives of the Federal Telephone Company held a meeting at the office of President F. S. Dickson in Cleveland a few days ago and thoroughly discussed the situation. Mr. Dickson made a report of his inspection of all the plants owned by the company. He also showed that more working capital is needed to put the company in position to realize upon the investments in these plants. Mr. Everett and Mr. Moore were present and promised to use every means to obtain the requisite amount of capital as soon as the railway matters are cleared up, as they will be in a very short time.

A meeting of the creditors of the Columbia Telephone Manufacturing Company was held at Ottawa a few days ago and the Security Trust Company of Toledo was appointed trustee in bankruptcy. Watts & Moore and Krauss & Freeman of Ottawa and Smith & Beckwith of Toledo were chosen as attorneys for the bankrupt, and it is safe to say that its interests ought to be well represented with this array of legal aid.

The Mutual Telephone Company has notified its patrons at Huntington, W. Va., that there will be an increase of 40 per cent. in the rates on January 1st. There is said to be considerable opposition to the advance.

The plant of the Home Telephone Company of Toledo has been turned over to the owners by the Central Construction Company, by which it was built. Robert E. Hamblin is secretary and treasurer of the company. Coupons on the bonds due January 1st will be paid December 15th.

Samuel B. Rawson of Elyria, Ohio, has been elected chairman of the board of directors of the Independent Union Telephone Company of Buffalo, N. Y., which recently increased its capital stock from $200,000 to $1,000,000 for the purpose of securing funds for connecting its properties in the eastern, western and southern portions of the state.

O. M. C.

Indiana Telephone Items.

The Nine-mile Telephone Association of Allen County has filed articles of incorporation. It is capitalized at $10,000. It will erect and conduct a general telephone system in Allen and other counties. The incorporators are F. T. Kenerk of Fort Wayne, T. P. Harbor of Sheldon, J. R. King of Nine-mile, and George Cloverdale of Allen County.

The Board of Safety of Indianapolis has advertised for bids for telephone service in the police and fire departments for the year 1903. The New Company (Independent) received the contract last year. In the office of the board and in both fire and police headquarters both Bell and Independent telephones are used, but at the different houses connection is made with only one. There is considerable rivalry between the two local companies—the New and the Bell—and the bids for this service are usually placed at a low figure. The contract amounts to upwards of $1,000 a year.

The proposition to debar from membership in the Interstate Independent Telephone Association all companies granting concessions or accepting favors from the Bell Telephone Company is not meeting with favor in a number of Indiana cities. Certain cities want but one system and want that system open to connection with all outside exchanges whether conducted by Bell or Independent companies.

The Sterling Electric Company of Lafayette has contracted to erect a telephone plant at Durbin, in the Province of Natal, South Africa.

F.

Southern Telephone Developments.

The Columbus Telephone Company of Whiteville, Columbus County, N. C., has given notice of an increase of capital stock from $10,000 to $20,000.

The Bell Telephone Company is seeking a franchise to establish a long-distance exchange at Sumter, S. C., and also a local exchange after October 1, 1903, when the exclusive franchise of the Sumter Telephone Company expires.

It is said that a number of business men will organize a telephone company and put in an exchange at Ashland City, Tenn., and that a number of outside lines will be constructed.

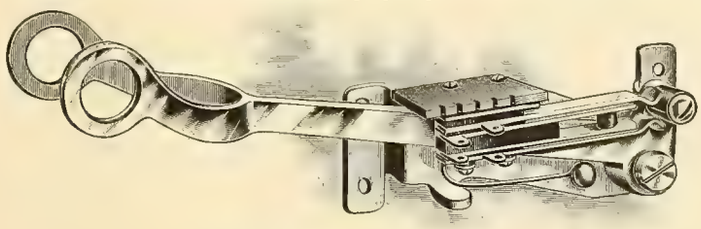
The Providence Telephone Company, a rural concern of Davenport, N. C., is building lines to a number of neighboring villages.

The Duplin Telephone Company, Warsaw, N. C., has begun work on a line from Clinton to Magnolia, N. C., to connect with the Bell company.

L.

Stromberg-Carlson Hook-switch.

The accompanying illustration shows a view of a new telephone hook-switch, recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company of Chicago. The hook is of the long-lever type and mounted on a heavy brass frame fastened with bolt and nut. The hook lever forms no part of the circuit, but all contacts are made by the springs mounted upon the lug on the side of the frame, as shown. The downward movement of the hook causes a hard-rubber insulated pin, attached to the lever, to be drawn in between the springs, thus disengaging the springs and breaking contact, and making contact when the hook is released as in the cut. A stop is provided at the lower edge of the frame, to prevent the downward movement of the lever, below the proper point.



STROMBERG-CARLSON HOOK-SWITCH.

The springs are made of German silver of good length, and all contacts are of pure platinum; pure hard-rubber strips are used to insulate the springs from each other and the frame. At the top of the lug, upon which the springs are mounted, is fastened a strip of hard fiber with the front edge slotted, through which the wires are brought down to the springs, thus keeping them separated and reducing the chances of short-circuiting to a minimum.

TELEPHONE MEN.

W. W. Davenport has become manager of the local telephone exchange at Clarinda, Iowa.

S. P. Grace has recently been appointed chief engineer of the Central District and Printing Telegraph Company, with headquarters at Pittsburg.

Senator O. E. Harrison of Greenville, Ohio, was a recent visitor in Chicago. It is understood that Mr. Harrison is interested in promoting an entirely new telephone proposition.

GENERAL TELEPHONE NEWS.

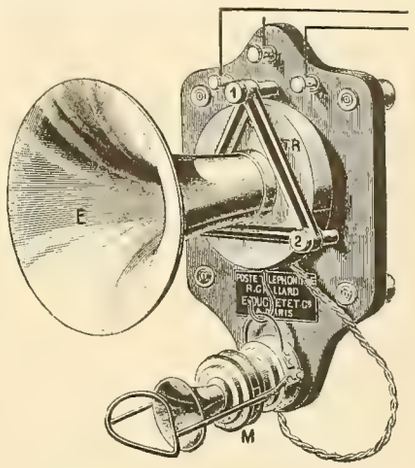
The Columbia Telephone Company of Hudson, N. Y., has been incorporated with a capital of $50,000. The first board of directors includes the following-named gentlemen: Benjamin F. Case, J. H. Bidwell and E. C. Getty.

The records thus far compiled show that the Rocky Mountain Bell Telephone Company has 13,000 instruments on the whole system, 3,360 of which are in Salt Lake City. There is wire enough used in its service to stretch nearly half way around the earth. On the toll lines alone the mileage is 13,460.

What is said to be the first underground telephone-cable system to be installed in the state of South Dakota is now being placed by the Capital City Telephone Company of Pierre. W. S. Rowe, general manager, is quite busy making these extensive improvements. He is reconstructing the exchange and cabling all the central portion of the city. He is also installing an entire new central-office equipment, entirely of the manufacture of the Eureka Electric Company of Chicago. Mr. Rowe states that it is his firm determination that the service of the exchange at Pierre shall be the best in the state.

Ducretet Loud-speaking Telephone.

Mr. Ducretet, the well-known Paris engineer, has lately brought out a new form of loud-speaking telephone which promises to be useful. The microphone transmitter used with this telephone is exceptionally sensitive. It has been recently invented by Lieutenant Gaillard of the French Navy, and it is on shipboard that the new loud-speaking instrument will be of especial value. The cut shows the appearance of the telephone; the receiver and transmitter are mounted together so as to form a small and compact system. The details of the apparatus have not as yet been made public on account of the patent questions. When the transmitter is spoken into in the ordinary tone of conversation, the voice can be heard at the receiver end at a distance of 15 or 20 feet from the instrument. In other cases when the ear is held close to the receiver trumpet, the smallest sounds may be heard, such as the voice in a whisper or the ticking of a watch. As constructed at present this form of telephone is especially designed for short lines and private systems, for connection between offices, on shipboard, etc., and has the special advantage in that the person called is not obliged to approach the transmitter; only the person who is speaking is obliged to use the instrument. There is no call bell, as the sound of the voice is sufficient to call persons at a considerable distance, say within an ordinary room or office. This makes the instrument more compact and also cheaper. The new telephone has been found to operate very well when in the neighborhood of lines carrying heavy currents, and there seem to be no appreciable effects from induction. Mr. Ducretet is at present devising a new type which is to be used on main telephone lines; for this purpose the instrument needs to be somewhat modified. If the loud-speaking telephone could be adopted on the city lines it would be a great improvement, especially in Paris, where the transmission is not always clear. In order to test the difference between the two systems, the Paris correspondent of the Western Electrician made connection with Mr. Ducretet's laboratory from one of the city telephone stations located in the branch postoffices. These telephones use the Ader system of microphone. In the first case Mr. Ducretet used the ordinary microphone and then connected the loud-speaking instrument. In the latter case the voice was heard with remarkable loudness and clearness, leaving no doubt as to the superiority of the new system.



DUCRETET LOUD-SPEAKING TELEPHONE.

MANUFACTURERS AND DEALERS.

It is reported that the International Telephone Manufacturing Company is having a large call for its new generator-call telephones, especially for country party-line and long-distance toll-line use. This instrument is said to embody in the construction of the parts many new features of importance to the durability and efficiency of a telephone plant.

The Chicago Pay Station Company of Chicago transacted a number of deals during the recent telephone convention and it believes the outlook for future business is very bright. This company, in addition to its line of pay-station apparatus, has placed on the market a fine time stamp. With this new device an accurate account can be kept of the time consumed in toll messages, which should be a good thing for the exchanges that recently adopted the five-minute schedule.

Telephone Competition.

In a contribution to the Cleveland journal known as Finance F. S. Dickson, president of the Federal and Cuyahoga Telephone companies of Cleveland, gives the Independent side of the question of competition in telephone service in effective fashion. The article reads as follows:

A delegation from the Erie City Council recently made a report of competing telephone service, claiming to have visited a number of cities in Michigan, Ohio, Pennsylvania, and New York. Among other cities visited and to which the committee paid special attention in their report was Cleveland. The committee may be quite accurate when they stated that they visited Cleveland, but they certainly did not call upon any of the officials of the competing telephone company, nor did they apparently attempt to verify in any way the facts and figures with which they had been supplied from other sources. They evidently relied upon their imagination for their facts and the Bell company for their figures.

In the report which this committee submitted to the Erie City Council they stated that "in Cleveland there is the Bell company doing business with long-distance facilities, and the Cuyahoga Telephone Company doing a local business." Had the committee been seriously in search of information they might easily have ascertained from the Cuyahoga Telephone Company, or, indeed, from any of its subscribers, that the Independent system was connected with the long-distance United States Telephone Company, which owns more than 13,000 miles of copper wire, 5,000 miles of iron wire, 3,000 miles of pole line and has more than 110,000 poles set.

Over 218,000 telephones are connected to-day with the United States system, extending through Ohio, Michigan, Indiana, Pennsylvania, Kentucky and West Virginia, and this is what the Erie councilmanic committee call "doing a local business." Furthermore, within the next few weeks extensions of other Independent lines will connect the United States wires with Philadelphia and Baltimore, giving long-distance service with the large cities of New York from Buffalo to Albany, as well as with the principal cities of New Jersey. A few miles only remain to be built to connect Cleveland with St. Louis, and by the time the Independent companies are ready for work in Chicago and Kansas City, long-distance wires will connect with the United States system. Furthermore, a few miles of construction will connect Cleveland with the Independent system in Louisville, Ky.

It would also be well to remind the Erie councilmen that they might easily have tested this question of Independent long-distance facilities in Cleveland by simply going to any Independent telephone in their own city of Erie, and asking for connection with Cleveland. They would have been given it promptly and courteously over the United States Telephone Company's long-distance line.

Now there is a fact that should be made clear to telephone users. A telephone is cheap or dear according to the extent and character of the service. The subscriber pays for the number of telephones with which he may be connected. At a given rate per year the real cost of the service is large or small, according to the number of telephones in the system. Before the days of Independent companies, the invariable policy of the Bell people was to get the highest possible rate per telephone and not unduly to increase the number, because after a certain point is reached in the telephone business any increase in the number of telephones means a decrease in the net profits. When the Cuyahoga Telephone Company began construction work in Cleveland in 1898, the Bell company had 4,600 telephones in service and the rate for main-line business telephones was $120 a year. That was an annual charge of over 2½ cents for each telephone which the subscriber could call.

On July 1, 1902, as the direct result of competition, the Bell company had 11,694 main and party-line telephones, and had at the same time reduced its rates for a business telephone from $120 to $84. This means that the business man was then paying the Bell company seven mills for each available telephone.

The Cuyahoga Telephone Company had on July 1, 1902, 8,480 main-line telephones, and its rate for unlimited business service was $48. That is, a subscriber was paying about 5½ mills for each available telephone.

If a subscriber in Cleveland takes both telephones and pays the highest rate ($84 and $48, or a total of $132 a year), he finds a total of 20,174 telephones subject to his call, at an annual charge of 6½ mills per available telephone.

In other words, the man who now has both telephones finds his charge per telephone reduced from 2½ cents to 6½ mills, a total reduction on the basis of the service rendered of over 70 2-5 per cent.

It must be noted also that the available number of telephones in the city of Cleveland has been increased from 4,600 in 1898 to 20,174 in 1902, an increase of 338 per cent.

This practical reduction in the cost of over 70 per cent., coupled with an increase of available telephones of 338 per cent., the sapient fathers of Erie characterize as a "nuisance."

In 1899, before the Independent company began work in Columbus, the Bell company had in that city a total of only 1,787 telephones, and its charges for unlimited business service varied from $72 to $120, according to location. At the lower rate this amounted to over 4 cents a year per telephone, and, at the high rate, about 6 2-3 cents per telephone. In September, 1902, the Independent company had 5,900 telephones and the Bell company 5,173. The Independent rate was $40 and the Bell company rate had been reduced to $60. On this basis the user of the Independent telephone paid about 6 2-3 mills per available telephone and the user of the Bell company a little over 1⅛ cents.

If a business man in Columbus takes both telephones he pays $100 per year, has access to 11,073 telephones, and pays a little more than 9 mills per telephone. Here again we note a reduction in cost, on the basis of the service rendered, to the user of both telephones, of 86½ per cent, with an increase in the number of available telephones in three years of from 1,787 to 11,073, or nearly 520 per cent.

It is scarcely worth while to multiply instances. Examine the records of the past in any community that has known both monopoly and competition in telephones and we find that competition is the life of this trade as it is of all others. There are still a few cities in the country where the old company yet reigns supreme without competition, and in all of them the rates remain high and the number of available telephones comparatively insignificant.

In a circular on this subject, issued in October last, by an officer of the Central Union Telephone Company, it is stated that "the disadvantages of two telephone systems in a town, considered from the standpoint of both cost and convenience, is so glaringly apparent that we feel sure that no argument on this point is necessary." It is actually painful to be compelled to declared that a statement which the Bell people apparently considered axiomatic, is absolutely without any foundation whatever.

Aldermanic Argument for Municipal Ownership in Chicago.

At the meeting of the City Council of Chicago on December 8th, the special committee on municipal ownership, of which Alderman N. R. Finn is chairman, reported that it had drafted two bills to be submitted to the Legislature. One, in relation to gas and electric-light plants, was not presented to the council on December 8th; the other, to empower the cities of Illinois to own and operate street railways, was attached to the report. At this writing the council has taken no action on the proposed law. A summary of the street-railway bill follows:

Every city in Illinois may own and operate street railways in its own territory, and without its boundaries, also, in contiguous territory, in the county in which it is located. However, any city desiring to proceed under the act must first obtain the consent of a majority of the voters voting on the proposition at an election. Such an election shall be held whenever 10 per cent. of the legal voters demand it by petition. If the voters favor the proposition, the city must take measures to carry it out. Provision is made for a special bond issue to provide funds for the purchase of street-railway property acquired under the act. Before such bonds are issued they must be approved by a majority vote at another election, in which the question of issuing them is submitted to the people. The City Council may lease the right to operate the municipal roads for periods not exceeding 20 years. But no such lease shall be made unless the voters approve at an election. A street-railway commission or commissioner shall manage and control the municipal roads. All its employes shall be subject to the civil-service laws.

In support of the proposed statutes the committee submitted a long argument. An abstract is given.

An investigation into the conditions prevailing in the greatest and most progressive cities in the civilized world demonstrates that Chicago, in common with a great number of other American cities, is 10 years behind the march of events; that instead of being in the vanguard of municipal progress, she occupies an ambulance in the rear.

Chicago has leased certain rights of occupancy in her streets during the last 20 years to street railway corporations, upon terms that have enabled the lessees to capitalize the lease at approximately $70,000,000 over and above the expense of their equipment, without substantial recompense.

Chicago has leased certain other rights of occupancy in her streets to gas companies, which have been capitalized at about $50,000,000 over the cost of equipment, without substantial recompense.

Chicago has similarly leased other rights of occupancy in her streets to electric-light companies, telephone company and elevated-road companies, all of which have been capitalized largely in excess of the actual cost of equipment, and substantially without recompense to the city.

The public demands, as is shown by the recent overwhelming vote in favor of municipal ownership, that this wasteful, wanton prodigality of public resources shall cease.

Among civilized nations the United States occupies the first place in the prosecution of great commercial enterprises based upon private capital, and the last place in the prosecution of enterprises based upon public wealth.

In the United States the Western Union and Postal Telegraph Companies, that have practically for years had a monopoly of the telegraph business, charge from two to seven cents per word transmitted upon their wires. The cost of transmitting a word over the telegraph wires in Great Britain is one cent a word; in France the same; in Germany 1¼ cents; in Belgium two-fifths of a cent; in Switzerland one-half a cent, and in Austria one cent. In other words, the cost of transmitting a word over the wire in the United States is, on an average, from two to five times more than it is in any of these highly civilized countries.

In Switzerland nearly, if not all, of the telephone systems are owned by the municipalities. Many of the municipalities of Norway and Sweden own their own telephone systems. In the Duchy of Luxemburg the telephone systems are owned either by the municipalities or by the state itself. In Holland the telephone business was in private hands until 1899, when the government took possession and reduced rates. Austria began with private exchanges and afterward adopted public ownership. Denmark in 1898 secured control of the telephone business, and in England there is a decided movement from private to public ownership of telephone systems.

The Bell telephone monopoly in the United States charges from $24 to $75 a year in small places for services worth from $6 to $25 per annum, and in large cities from $90 to $240 per annum for services worth from $30 to $100. Telephone charges in the United States are three times the government tariff in England, and more than three times the charges permitted by the government in France.

Municipal-ownership enabling acts, such as Chicago wants this winter, will have distinct effects, which we will briefly discuss.

They will tend to purify the administration of city government; confirm and strengthen and materially extend the civil-service policy; give the city authorities their one supreme safeguard from further forced submission to private-franchise corporations.

Enemies of municipal ownership tell us that if Chicago should undertake to own and operate its public utilities, the result would be greater political corruption and patronage abuses. The opposite would be the case. The uniform experience of every city that has adopted public ownership is that such adoption is immediately followed by greater purity in city government. Of course, this means an efficient civil-service law. The effect of municipal ownership is to broaden and strengthen civil service.

Our city electrician, Mr. Ellicott, tells us that since Chicago began lighting a portion of the streets and public buildings with its own electric-lighting plant there has never been any friction or interference by politicians. Employes of the city's lighting department are hired on merit only, work less hours and receive better pay than similar employes do when working for private lighting companies.

Politicians to-day can more easily procure appointments for their friends on the street-railway lines and in the gas works than they can in the water office or the city electric-light plant.

Municipal-ownership enabling acts will be of supreme value to Chicago, whether or not they result in immediate action by the city under their provisions. The history of former Illinois legislatures is that public-service corporations, coining millions of revenue from their watered capitalizations of Chicago's franchises, have successfully nullified every attempt by honest legislators from this city to curb their power. We have only to recall the Allen bill, the Humphrey bills, the gas-frontage and consolidation acts to realize that the public-service corporations have used the state Legislature as a mere convenience for perpetuating their rule in Chicago.

We are told that it may take some years to practically realize the advantages of municipal ownership in this city. Every great public reform must have a beginning, and the first step, according to the law and constitution, toward Chicago's realization of municipal ownership is to secure enabling acts at the coming Assembly.

With the passage of such enabling acts, the power of the public-service corporations will be immediately curtailed. With such acts in its possession the city government will be in a position to deal with the traction and lighting corporations equitably and reasonably. These corporations have never been in danger, their pleas to the contrary notwithstanding, of having any of their true vested rights confiscated under any scheme of municipal ownership.

Fortified by public-ownership enabling acts, the city will for the first time be in a position to meet these corporations on a business basis. The gradual elimination of private franchises under a comprehensive policy of public ownership may possibly require temporary agreements with the corporations already controlling public utilities before the city is in a position to launch out as the owner and operator of traction and lighting plants. But the mere fact of being legalized by the General Assembly to own and operate public utilities will enable Chicago to demand from all existing public-service corporations better terms of compensation, and better service to the public, for the remaining time that they may be in the field.

Further, the possession of such enabling acts will prevent the necessity of any further franchises to privately owned corporations for long terms. It will

be a judgment of ouster to such corporations; not immediate, perhaps, but inexorably certain as the conditions adjust themselves. It will end forever the ballooning of traction and gas-trust stock and bonds at the expense of Chicago's public. It will not alienate the rights of these corporations to recover the full value of their plants, but it will ignore the millions of watered and fictitious stock values that have been injected into their capitalizations at the public expense.

Municipal ownership will give the people of Chicago cheaper and better street-car service, cheaper gas and electric lighting.

Acts giving the city of Chicago the simple power to furnish transportation and lighting, as it now furnishes water, to the citizens would have the certain effect of reducing the cost of these necessities to the individual and the householder. Besides reducing the cost, it will improve both services.

Municipal ownership will mean the regeneration of the entire street-railway and lighting policy of the city of Chicago on co-operative public lines. It will stop the payment of exorbitant dividends to private stockholders, and apply the profits of such utilities to the public benefit.

Such experience as Chicago has had with municipal ownership is certainly more satisfactory than the experience with private management of public-service industries. The waterworks under the management of the city of Chicago is a success. It supplies water cheaply, and at the same time is a source of profit to the city.

A recent report by Haskins & Sells on municipal lighting in Chicago shows that in some of the earlier years the public plant did not produce light as cheaply as it could have been rented, but in later years, especially during the administration of Mr. Ellicott, there has been a very marked saving over what light could have been secured for from a private company, and that in spite of the fact that since the establishment of the public lighting system the price of purchased light has been reduced nearly 50 per cent. That reduction in the price of light furnished for public purposes by the private corporations must be counted as one of the gains of the public lighting system. For during the 13 years covered by the report, electric light for public purposes is the only commodity sold by a Chicago public-service corporation that has gone down in price. Street-car fares and telephone charges have risen. Telephone rates for first-class service have advanced from $125 to $175 a year. Because of the competition of the public lighting plant, the private company furnishes light to the city cheaper than it does to private consumers. If the city plant could sell light to private citizens, as it ought to be permitted to do by law, the cost could be still further reduced. The city electric-light plant gives its employes shorter hours and pays them higher wages than the private lighting company.

Recently a street-car company asked for a franchise in Buffalo, N. Y., and offered to sell three tickets for 10 cents, or to carry passengers for 3½ cents each; and a company in Cleveland, Ohio, has been fighting in the courts to sustain a franchise under which it contracted to carry passengers for a straight three-cent fare; and in the city of Chicago, at the present time, there is a street-car line running south from Sixty-third Street on Stony Island Avenue, selling tickets for 2½ cents per ride.

About one-quarter of the total population of the city of Chicago lives within two miles of the courthouse, and considerably over three-quarters within five miles of the courthouse. One-quarter of the population of the city of Chicago, therefore, in riding upon street cars, pay five cents for a ride not to exceed two miles, or 2½ cents per mile, and two-thirds of the remaining three-quarters ride not to exceed five miles for five cents. None of these three-quarters of the population ever ride for less than one cent per mile. The remaining one-quarter living over five miles from the courthouse rarely patronize the surface cars of the city, because of the fact that they can reach their homes much more quickly, and without change of cars, upon the elevated roads. Probably not one-tenth of the one-quarter of the population of Chicago which lives over five miles from the courthouse patronize the surface roads in the daily course of their business. They travel either upon the steam cars or the elevated roads.

Municipal-ownership enabling acts will be the first step toward placing the city government of Chicago on the same plane as successful business enterprises under private ownership. It will be the first practical step toward the elimination of boodling and bossism, which are inseparable from private-franchise grants, and toward enlisting the co-operation of every patriotic citizen in the public welfare.

The first and most frequently quoted objection is that the ownership and operation of these great public utilities by municipal corporations would foster and build up a political machine; that every employe and workman engaged in the operation of these great works would be employed by political leaders who for the time being had control of the city or other municipality.

There would be considerable force in this objection if the men engaged in operating these great enterprises could be appointed and discharged by political "bosses" at will.

The answer to this objection is that every municipality which undertakes the ownership and operation of these public utilities must, for its own protection and for the protection of its citizens, inaugurate and enforce a strict civil service for the selection and appointment of its employes. Wherever municipal operation is in force successfully—and that is almost everywhere that it has been adopted—the municipality has instituted a civil-service system which has made as a test of employment efficiency, honesty and sobriety.

The Water Office in Chicago and the Postoffice of the United States have both been managed from their inception without strikes, lockouts, or any disagreement between the government and municipality, respectively, on the one side, and their employes on the other. They have given efficient service and will continue to do so.

The Engineer of the Twentieth Century.[1]

By Charles F. Scott.

It is significant that the response to this toast is assigned to the representative of the Engineers' Society of Western Pennsylvania. That society represents the engineers of Pittsburg, the city above all others pre-eminent in its industrial and engineering works in the country which is assuming the industrial supremacy of the world. The inventions and designs of the engineer underlie Pittsburg's products; under his supervision they are made; and in turn Pittsburg's products are the materials which other engineers employ in buildings and railroads and power plants throughout the whole world. This is the age of steel. Pittsburg furnishes the steel. This is the age of electricity; she produces the largest dynamos. The total tonnage of Pittsburg is double that of London. The tonnage of the Pittsburg harbor, notwithstanding shallow bottoms and low bridges, exceeds that of New York harbor. Industrial Pittsburg is of the engineer, by the engineer, for the engineer—typical of the present, significant of the future. Do you ask me to portray the future? I ask you to look back 50 years to the time when the first railroad bridge across the Allegheny, built under the protest of hack drivers and sympathetic citizens, brought together the track from Ohio and the track to Philadelphia; it brought them together but it did not join them, for the state legislatures had ordained that the gauges of the tracks be different to prevent domestic cars from wandering too far from home. Compare conditions then with those now; note what the engineer has done since some of those present reached middle age. Who will venture to predict what we young men may see before we become old? It is with pride that I see my own city, the Smoky City of the Keystone State, the City of Engineers and of Industry, growing in influence. A week ago a Philadelphia paper quoted a multi-millionaire thus: "Pittsburg instead of Wall Street must be considered hereafter as a potent factor in the continuation of our national prosperity. When money rates go up in Wall Street and wage rates go up in Pittsburg simultaneously it is the industrial thermometer which most truly indicates the real prosperity." Enter engineer; exit speculator.

It is significant, also, that the response to this toast is assigned to the representative of the American Institute of Electrical Engineers. This organization represents the electrical engineers of America, the country above all others pre-eminent in electrical activity, at a time when its applications are making this the age of electricity. For a retrospect of general engineering we appeal to the memory of men past middle life; but the electrical awakening is within the easy memory of us all.

Electrical work is seldom independent; it does not stand alone, complete in itself. Electricity is usually an agent, a means to an end. It is not energy derived from electricity which enables the car to move and the crane to lift a weight. It is the power from the engine which happily can be transmitted by electric wires better than by shafts or ropes or belts. It is because electricity is primarily an agent, a means, that its applications have been so diversified, so extensive and so far-reaching in their effects. It has given to the whole world a new instrument, a new method of doing things. The telegraph, the cable, and the telephone have had a profound effect upon political, commercial and social affairs; the applications of electricity being revolution of old methods as well as evolution of new ones.

The electrical engineer follows the new gospel, the gospel of service. His mission is helpfulness. Through his aid the railway engineer has replaced the horse car by the people's automobile, which for a few cents will carry anybody from city to suburbs more quickly than it was possible by any means at the command of even the millionaire a dozen years ago, and with the added comforts of warmth and light. Through his aid the mechanical engineer has modernized the machine shop by the electric crane and motor-driven tools which increase output and reduce cost. Through his aid the mining engineer lights his mine, drives his fans and pumps and drills, and conveys his product. Through his aid a new realm is opened to the chemist in the field of electrochemistry. Through his aid the engineer of plant life, the farmer of the West, transforms the desert into a garden by motor-driven pumps and the distant waterpower. Through his aid the engineer of human life is given a new sight to penetrate the living body, and a new stimulus to excite the inactive muscle. Through his aid the luxuries of yesterday have become the necessities of to-day, and the "impossible" has become the commonplace.

The great discovery of the nineteenth century was co-operation—the effectiveness of concentration, the efficiency of largeness. Compare the old days of the hand loom in the home, of the shoemaker at his bench, of the individual oil well and coal mine, of the small railroad and of the small factory. Compare these with modern methods, with their unbounded possibilities—possibilities of good and possibilities of evil; of good, because the engineer has provided the means for doing the world's work more efficiently; of evil, because the social, the industrial, the commercial systems have not kept pace with the advance made by the engineer, for they are tainted by injustice and by selfishness.

The tendencies of the nineteenth century projected into the future reveal, in dim outlines at least, the engineer of the twentieth century.

He is to become a greater factor in adjusting and operating the intricate mechanism of a new civilization. He is to deal with large affairs in a large way. He is to be closely related to every department of modern life. He will be advanced to administrative positions, for which his knowledge and his training peculiarly fit him. At the head of the Pennsylvania Railroad, directing its vast affairs in the present and planning to meet the demands of the future, is an engineer surrounded by engineers—President Cassatt. At the head of the interests with which I am connected is a man successful as organizer and manager and financier, a genius in his foresight, an engineer—George Westinghouse. Sound judgment, breadth of view, integrity, character, the ability to understand and to control men as well as matter, to direct human forces as well as physical forces, are essential to the engineer of the future. A recent event which has brought America to pre-eminence is the victory of our navy. A naval battle is a contest between fighting machines, and these are the products of the engineer. All honor, then, to the engineer, so fittingly represented here to-night by Admiral Melville.

Besides the new relations to others there will be new relations to engineers among themselves. All that I have said so far emphasizes what we all know, namely, that the several branches of engineering are intensely interdependent and co-related. Take a single instance of large work, the extension of the Pennsylvania railroad into New York city, the tunnels under the Hudson and East Rivers, the terminal facilities and the electrical equipment, and endeavor to name an important branch of engineering which is not essential to this undertaking.

The work of the future demands co-operation, not clannishness; unity, not jealousy. Engineers must be specialists, therefore they must work together. The several branches of the profession have their individual interests; they have a larger common interest. As we marvel at what the engineer has done, as we attempt to picture what he may do, we realize the far-reaching responsibilities which confront us. Shall we rise to meet them? We gave to the world the steam engine, the steam vessel, the railroad, the telegraph and cable machinery, industrial processes, the electrical central station, the fundamental requisites which underlie co-operation. Is it not time that we, too, apply to ourselves the great lesson of the last century? What organization stands before the world as representative of the engineering profession? Has the engineer been accorded the recognition and reward which are his due? A noted lawyer recently addressed the annual banquet of a local engineers' society containing members of national and international reputation. His remarks were based upon the idea that all engineers were coordinate with a common chain man, and they would have been positively insulting but for his air of blissful ignorance. A few years ago a gentleman of eminence in addressing the American Society of Mechanical Engineers advised its members not to join in a machinists' strike. In what way do engineers present themselves to other professions? In what way do engineers co-operate to advance their own profession by mutual helpful means and by undertaking methods which advance the efficiency and the usefulness of engineering work? There are national organizations of various kinds, the civil, the mining, the mechanical and the electrical engineers, the architects, the naval architects and marine engineers, the engineers in the army and the navy and there are the chemists, the electrochemists, and others. In general each knows that other societies exist, and they are mutually respectful, but there is some suspicion here and there that the others are a little too exclusive, or that they are a bit jealous. These are the murmurings of littleness, not of largeness.

The several engineering professions, like the constituent states, have their representative bodies, their legislatures, but why not an engineering congress as well? Why not a national representative body to stand for the profession of engineering, to promote a harmonious co-operation which will strengthen each and elevate all?

An incident of the past year is an auspicious omen. Four great societies have co-operated; they have worked together; they have taken a step which will bring recognition to the deserving individual and credit to the engineering profession; they have

1. An address delivered at the banquet commemorating the twenty-fifth anniversary of the Engineers' Club of Philadelphia, on December 6, 1902.

founded a medal, and at a magnificent dinner they have announced the award of the first John Fritz medal to the venerable man who has just spoken, John Fritz himself. But not less significant than even the medal is the discovery that the societies can work together, and by doing so they can accomplish worthy ends.

In the vision of the future may we not discern a reflection of the John Fritz medal in the larger life of the twentieth-century engineer? Methinks I see the outlines of the medal taking the form of a magnificent building, the capitol of American engineering. Into this home in the metropolis are gathered the great engineering societies from their scattered lodgings. Here is a great technical library; here are ample assembly halls and comfortable parlors; here are the headquarters of a score of lesser societies, affiliated in their work but restricted in their scope. I see all over the country innumerable local societies and engineering clubs, no longer isolated but joined together into one great combination. I see them affiliated with the national bodies, sometimes as local chapters, all together constituting a great union. There is individual freedom but general co-operation. The engineering congress, representing all the engineering professions and supported by the great union of engineering societies, gives to engineers a rank consistent with the importance of their work; it increases the efficiency of the inter-relations among engineers. An eminent body, it is powerful in advancing the common interests of engineers, and it represents the engineering profession in its relation to other professions, to pure science, to education, to legislation, to public improvements and to the general welfare.

Years ago engineers were individuals of trivial consequence compared with men in the learned professions. Now, technical professions are of recognized importance. But even yet the national societies of the profession which has made the nineteenth century an era in the world's history, which has provided the means for the production of unmeasured wealth and which promises yet greater things for the future, have not even a home of their own. Within the present week the Society of Mechanical Engineers, which has a little house of its own, found it so very little that it was forced to hold its meetings in a large room in a near-by tavern. There were present men through whose work hundreds of millions have been added to the wealth of this country, and their present efforts are to increase the efficiency of the future. Is this right? Is it just?

But may not the fault lie somewhat with the engineers themselves? Have they fully recognized their own strength and importance? Have they shown a disposition to act together; to do large work in a large way? Have they given promise that they would use well the enlarged facilities to increase the efficiency of engineering work?

The men who are mastering the powers of nature will yet rise in the strength of united effort to meet the increasing responsibilities of the coming years. For it is theirs to build the foundation of the new civilization; it is theirs to establish material prosperity—the underlying condition for broader, fuller and higher life.

The end of engineering is usefulness, the characteristic of America is activity, the modern method is co-operation. As engineers of the twentieth century, let us be useful, let us be active, let us co-operate.

Electric Flasher in Interior Lighting.

An interesting installation of an electric-light flasher for interior work is seen in the bar-room of the Brevoort Hotel, Chicago. Sign flashers have been in general use for quite a time for outdoor work, but the present installation is somewhat out of the ordinary. The bar-room of the hotel is small and the bar, which is in the form of an ellipse, occupies the center of the room. With the exception of a few lamps placed in niches in the walls, the entire illumination of the room comes from lamps in the ceiling or near the ceiling. On this account the feasibility of using a flasher is evident.

Two hundred and eighty-eight lamps are operated by the flasher, these being divided into four color groups of 72 each. The lamp-bulbs are red, green, yellow and white. These four colors are used alternately, each burning alone for a period of 24 seconds, and in unison with one other color during a period of six seconds. This last statement will be more clear when explained specifically. The red lamps being on and the green to follow, the latter will be thrown in circuit six seconds before the former go out. Is this way the room is always illuminated. Another feature of the present installation, which, by the way, contains only 16-candlepower lamps, is that the load carried at any time at which the circuit is to be broken is never more than six amperes, or in lamps, 12 16-candlepower lamps. This means that the 72 lamps in any one color are operated on six different circuits, so that the mechanism of any one circuit throws but 12 lamps in or out. In this way the switches which are of the ordinary knife type, last considerably longer, since they do not suffer from arcing.

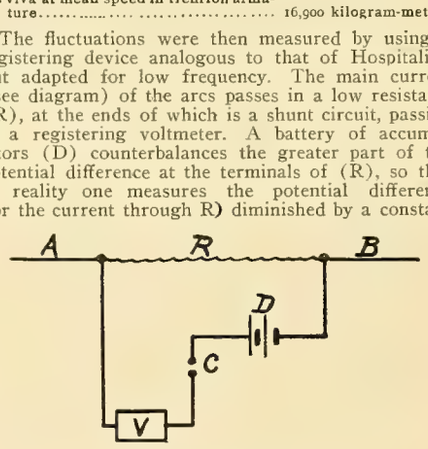
The mechanism is extremely simple and operates with an expenditure of but little power, the motor being such as is used for an ordinary 12-inch fan. No movable part enters into the electric circuit, excepting, of course, the knife-switch, which, when in service, is closed and held closed until the determined moment, when it is released and opens by means of a spring, which holds it open and at a sufficient distance from the jaws of the switch to insure safety from arcing and to prevent the possibility of "drawing" an arc on opening. Without any knowledge of electricity or electrical apparatus, one can change the flasher to obtain any combination he desires, providing that the load on any one circuit be never more than six lamps. The Brevoort Hotel apparatus was installed by the Reynolds Electric Flasher Manufacturing Company of Chicago.

Regulation of Gas Engines Used for Electric Driving.

At a recent meeting of the Société Internationale des Electriciens in Paris, France, Mr. Lauriol read an interesting paper describing a method devised by Mr. Gerard for correcting the fluctuations of current in dynamos driven by gas engines. The Paris municipal plant of Buttes Chaumont contains a Charron gas engine of the one-cylinder, four-cycle type, giving 30 kilowatts at 150 revolutions. It is belted to two direct-current dynamos of 1,500 volts and 10 amperes, each of which supplies a circuit of arcs in series. One of these dynamos is a Henrion series-excited machine, and the other is a Gramme machine with separate exciter on the end of the shaft, the dynamo being excited in shunt at 100 to 130 volts. The gas engine is regulated by reducing the gas admission, there being one explosion every two revolutions. The variations of speed during a revolution at full load reach about 1.5 per cent. on each side of the mean, or three per cent. total difference. When the set is in working order, a constant and marked fluctuation of the light is observed synchronous with the cycle of the motor, namely, once every two revolutions. Different types of arc lamps act differently, but the effect is always marked. The fluctuation depends on the dynamo used. When the engine and the two dynamos are working, the variations are strong in the Gramme circuit and but slight in the other. Mr. Gerard, chief engineer, attributed the difference to the fact that the Henrion machine had more inertia than the Gramme, and the belt transmission did not allow it to follow exactly the variations of motor speed. In fact, a summary calculation gives the following figures:

Motor work during one cycle	3,000 kilogram-meters.
Vis viva at mean speed in flywheel	91,000 kilogram-meters.
Vis viva at mean speed in Gramme armature	2,600 kilogram-meters.
Vis viva at mean speed in Henrion armature	16,900 kilogram-meters.

The fluctuations were then measured by using a registering device analogous to that of Hospitalier, but adapted for low frequency. The main current (see diagram) of the arcs passes in a low resistance (R), at the ends of which is a shunt circuit, passing to a registering voltmeter. A battery of accumulators (D) counterbalances the greater part of the potential difference at the terminals of (R), so that in reality one measures the potential difference (or the current through R) diminished by a constant



REGULATION OF GAS ENGINES USED FOR ELECTRIC DRIVING.—REGISTERING DEVICE.

quantity. In this way readings over a great scale of variations are obtained. A commutator (C), worked by the engine shaft through gearing, closes the circuit (AVC) during a constant period, equal to a small fraction of the motor cycle, and at intervals of time equal to 84/85 of the duration of a cycle. At the end of 85 cycles is found, therefore, a traced curve representing the variations during a cycle, supposing, as in all similar tests, that the 85 cycles are more or less alike. The needle of the galvanometer, starting from zero, receives a series of impulses, in the interval of which the controlling force tends to bring it back. At the end of a few seconds, for a constant value of current, it executes a regular series of oscillations, and a study of the apparatus permits of finding the relation of the position of the needle and the value of the current.

With the Gramme machine the current is periodically variable, increasing rapidly and decreasing slowly. (i) being the maximum variation and (I) the value of the main current, $\left(\frac{i}{I}\right)$ represents, then, the ratio of fluctuation. To correct the variations, Mr. Gerard inserted a rheostat in the exciter circuit, worked by the main shaft of the dynamos; the resistance is then periodically varied and therefore the current of the circuit. By working the main dynamo at constant speed and making the exciting current change slowly, the characteristic at no load is found, and thus is determined the value of the resistances to obtain a given value of field. By regulating the rheostat so as to vary the field in inverse ratio to the speed, one should have a constant electromotive force on the main circuit. The rheostat calculated after these data produced no appreciable effect on the oscillation, and Mr. Gerard tried, experimentally, whether in preserving the principle and modifying the dimensions of the rheostat a better result could be obtained. He was finally successful, and the fluctuations of the light were practically suppressed, which corresponded to a reduction of two-thirds on the current variation. But it was necessary first to give the rheostat a resistance 15 times the theoretical value, and second, in place of making the maximum of resistance conincide with the maximum speed, it was given an advance of about one-eighth cycle.

After giving the theory of the apparatus and showing why the resistances had to be modified, Mr. Lauriol states that the original rheostat had 24 points, but subsequent experiment showed that six points were sufficient in practice, and even four may work. This arrangement worked very well for different values of current. The gas engine thus operated the two dynamos; the Henrion, not provided with an automatic rheostat, worked at a constant load of 10 amperes at 1,500 volts, and the Gramme, with the automatic rheostat, fed a variable number of arcs, giving potentials from 1,000 to 1,800 volts with a constant current of 10 amperes. The resistance absorbs but little energy, and such an appliance is simple and cheap; the resistance may be of simple iron wire, run at a distance from the machine, and connected to it by copper wires. The following numerical data were obtained:

Power of dynamo	15	kilowatts.
Irregularity of speed, ratio $\frac{\text{max.} - \text{min.}}{\text{mean}}$	0.04	
Resistance of automatic rheostat	19	ohms.
Mean current through rheostat	4	amperes.
Power (mean of RI^2), absorbed by the rheostat, about $\frac{19 \times 4^2}{2}$	150	watts.
Ratio of power absorbed to total power	1-100	

As to the fluctuation of light, the Henrion machine gave constantly a percentage of three for the arcs and 1½ for the incandescent. The Gramme machine, without the regulating rheostat, gave at first 10 and two per cent., respectively, but with the rheostat it now gives but 3.5 and 0.5. There may be other methods of regulating the fluctuations of voltage due to gas engines, but the above is to be recommended, at least for certain motor speeds in the neighborhood of one cycle in three-fourths second.

BOOK TABLE.

ARMATURE WINDINGS OF DIRECT-CURRENT DYNAMOS. Extension and Application of a General Winding Rule. By E. Arnold. Translated from the original German by Francis B. DeGress. 1902. New York: D. Van Nostrand Company. Pp. (six by nine inches), vi., 124, with 146 illustrations. Price, $2.

In his work as lecturer upon electrotechnics at the Riga Polytechnic School, Professor Arnold found it difficult to present to the students in a brief and simple manner the various methods of winding armatures for direct-current machines, so as to enable them to solve independently any assumed problem in winding. In endeavoring to establish rules for the various windings, he found that all so-called closed-coil windings could be embraced under a general rule which applied equally well to ring, drum and disk armatures. This book is an exposition of this rule. Beginning with an introductory chapter on "Methods of Connecting Inductors for Obtaining Direct Currents," the author then discusses a great variety of bipolar and multipolar ring, drum and disk armature windings of the closed-coil type. This part of the treatise takes up nearly the entire book, the last 10 pages being devoted to brief mention of open-coil windings, including the Brush ring armature, the Thomson-Houston winding, and the Ferranti-Thomson disk armature. Many of the designs shown in the book are of historic interest only, while, on the other hand, several designs for connections have never been published before. The work fills a unique field, covered, as a rule, unsatisfactorily by the best text-books on electrotechnics, and will be found valuable to the student and designing engineer.

Secretary Root, in accordance with the provisions of the river and harbor law, has prescribed the conditions under which the Michigan and Lake Superior Power Company may divert water from the St. Mary's River into its power canal at Sault Ste. Marie for waterpower purposes. These conditions, which were formulated by Judge Advocate-general Davis, after full consultation with General Gillespie, chief of engineers, proposed diversion of water shall not injuriously affect navigation in the waters affected, nor impair or diminish the water levels or any natural increase thereof, in Lake Superior, in the United States ship canal and locks or their tributaries. The necessary papers were drawn up at the War Department, and have been signed by representatives of the waterpower company.

CORRESPONDENCE

New York Notes.

New York, December 15.—Because of the fact that all the motor cars of the Manhattan Railway Company are not provided with scrapers for the third rail, considerable delay to traffic was incurred last Thursday on account of the accumulation of a thin sheet of ice on the contact rail. A sleet storm was in progress a good part of the day, and towards evening the system was in a pretty bad way. The company is at present busy equipping its cars with scrapers, but the storm came a little too soon. In explanation of the delay to traffic, which caused considerable unfavorable comment by the traveling public, occurring again on Friday, the company gave out the following statement:

"The tie-up was due to the fact that all the motor cars have not been equipped with the new device for clearing the third or live rail of snow or ice, but the work is being rushed as rapidly as possible, and when it is completed there will be no further blocks of the third-rail system. There are 1,150 cars to be fitted with the new device, four to a car, and as there is only one firm which supplies this apparatus, work is necessarily delayed. The apparatus consists of a combination steel brush which scrapes the coating of ice from the rail and a spray which ejects oil upon the rail. The oil is sprayed upon the rail first, and then the brush spreads it evenly and scrapes off the ice. The oil is a special preparation, and loosens the ice so that the brush removes it easily. The steel brush is applied with pressure upon the rail and acts as a conductor in the event of the shoe failing to work. Some of the cars are already fitted with this apparatus, and that is the reason the Second and Third Avenue lines were not entirely blocked. If all the trains had been fitted with this device there would have been no delay on these lines. The entire tie-up of the Sixth Avenue line was due to the running alternately of steam and motor trains. The electric trains were sent out at such long intervals that the third rail had time to freeze again before a motor car equipped with the new device came along."

The Board of Directors of the Interborough Rapid Transit Company has called a meeting of the holders of stock-trust certificates for January 16th to ratify the proposed lease of the Manhattan Railway system by the Interborough company.

A protest has been submitted to the Board of Estimates against the granting to the New York Central and Hudson River Railroad Company any additional rights by the city that should in any way burden the taxpayer. The protest asserts that the proposed new plans of the railroad company will necessitate the building of a number of bridges by the city and will also bring other expenses upon the city. It is further stated that if other companies pay for the privilege of constructing subways under the streets of the city, the New York Central should do likewise. The protest asks that the board refuse to consider any plan from the railroad company that will not at least free the city from any expenditure whatsoever.

Rev. George L. Lose, a student in Drew Theological Seminary, Madison, N. J., was "electrocuted" on Wednesday in his room in the school dormitory through a shock received from an incandescent lighting circuit. The shock killed Mr. Lose instantly. It was a peculiar and probably unprecedented accident. Dr. Lose, who was 26 years of age, was sitting in the dormitory with his feet on a radiator for warmth. He was reading, leaning back in his chair. The light from an incandescent lamp swinging above his head did not suit him. He leaned back to change the position of the lamp, keeping his feet, which were covered with light slippers, on the radiator. Just above the bulb there was a portion of the wire exposed. His hand came in contact with the exposed wire and he was hurled to the floor dead.

The Queensborough Light and Power Company, which has a plant in Astoria, has absorbed the stock of the Hempstead Gas and Electric Light Company, and it will take possession of that company's plant at Rockaway Beach.

The Rosemont Electric Transmitter Company was incorporated yesterday. The capital of the company is placed at $250,000. The directors include Herman Schwarz, Julius Rosenberger and A. H. Schwarz.

The Lewis Manufacturing Company has just been incorporated. The purpose of the corporation is the manufacture of electrical and mechanical appliances. The company's capitalization is $60,000. The incorporators are R. H. Jaeger, L. L. Lewis and J. W. Webster. O.

Southern Developments.

Charlotte, N. C., December 13.—Engineers are making preliminary surveys near Columbus, Ga., for developing a big waterpower. A 54-foot dam will be erected to furnish power for electric cars, electric lights, etc.

It is understood that considerable stock in the local gas and electric light plants at Bristol, Tenn., has been secured by Col. A. H. Leftivich of Baltimore, representing Baltimore capital.

A movement is on foot to build an electric railway between Columbia and Saluda, S. C., a distance of 35 miles.

The Virginia Passenger and Power Company of Richmond, Va., has announced that it will respond to all fire alarms along its line with a wagon equipped with "hose jumpers" and a repair outfit, to obviate the usual delays caused by fires. L.

New England News.

Boston, December 12.—During the "below-zero" weather of Tuesday morning the Boston Elevated Railway Company used oil to keep the track switches from freezing. The salt and water mixture, which is generally used, froze about as fast as it was applied.

A majority of over 25,000 Boston voters cast their ballots in favor of accepting the Washington Street subway bill, at the municipal election, Tuesday. This insures the building of that much-needed addition to the city's transportation facilities. The opposition of the so-called labor element, due to the non-recognition of the labor unions in the employment features of the bill, proved futile.

The Worcester and Northern Street Railway Company is being organized and the capital stock of $150,000 has been subscribed. It proposes to build and operate an electric railway between the Jefferson (Mass.) terminus of the Worcester and Holden Street Railway and Westminster, Mass., where it will connect with the Fitchburg, Westminster and Gardner Street Railway. It will apply for a location up Mount Wachusett, where it will use cable on the grades that are too steep for electricity.

The Boston Suburban Electric Companies' stockholders have elected the following-named trustees: Horace B. Parker, R. E. Townsend, Frederick H. Lewis, William H. Coolidge, and Charles M. Baker. The last named succeeds George M. Morse, but the others were re-elected. The company's statement for a portion of the year ended September 30, 1902, shows: Income, $65,977; expenses, $2,762; dividends, $58,734; surplus, $4,480. The company assumed control of its railway properties on January 1, 1902, of the Waltham company during last spring, and of the Norumbega Park company during last summer.

The Hartford and Norwich Street Railway Company will ask that an act of incorporation be granted it by the next Connecticut Legislature. If the charter is granted, the company will build an electric railway between Hartford and Norwich, Conn., via Franklin, Lebanon, Columbia, Andover, Coventry, Bolton and Manchester. At the latter place it will connect with the Hartford, Manchester and Rockville Tramway Company's road. The proposed road will run through several communities which now have no electric railways. B.

From the Buckeye State.

Cleveland, Ohio, December 13.—At a meeting of the directors of the Cleveland, Elyria and Western and the Cleveland and Southern, held a few days ago, a plan was agreed upon for the merging of the two companies. The plan provides that the new company shall be known as the Cleveland and Southwestern, and that it shall have a capital stock of $5,000,000, with a bond issue of $3,000,000. The stock will be divided into $3,000,000 worth of common and $2,000,000 of preferred. The basis of division is that the stockholders of the Cleveland, Elyria and Western shall receive 60 per cent. of the preferred and 100 per cent. of the common. The stockholders of the Cleveland and Southern will receive $500,000 of the preferred stock and the same amount in bonds. After the exchange is made the new company will have $900,000 in bonds and $300,000 in preferred stock remaining. A portion of this will be used to purchase the light plant at Norwalk.

The Fremont Yaryan Company, Fremont, has completed its hot-water plant, and it is said that it will also install an electric-lighting plant.

The committee from the labor associations, which has been going over the books of the two Cleveland street-railway companies, has about completed its work, and is making up its report to be made public within a short time. While nothing of importance has been given to the public, it is known that the report will say that the cost of carrying a passenger in that city is about three cents, and that it will recommend a somewhat lower fare than at present, perhaps six or seven tickets for a quarter, instead of 11 for 50 cents, as at present.

The Cincinnati, Dayton and Fort Wayne Railway Company of Dayton has been incorporated with a capital stock of $1,000,000, for the purpose of building an electric road from Cincinnati to Toledo and Fort Wayne, Ind. The incorporators are Dr. Samuel F. George, C. E. Gebhart and others. The line will keep well to the western part of the state, and the portion to Fort Wayne will leave the state line in Van Wert County. Dr. George is a prominent Dayton citizen and a promoter of some note.

Forty Cincinnati capitalists made a trip over the Dayton, Springfield and Urbana, the Columbus, London and Springfield and the Central Market Street Railway lines a few days ago for the purpose of making a thorough inspection of the property. The distance of these lines from Columbus to Dayton is 77½ miles, and the Central Market controls 31 miles of track in Columbus. These gentlemen found one of the finest electric roads in the world, built on the steam-road standard, with overhead equipment second to none and cars about the same as any first-class railroad coach. All the cars are 62 feet in length, except those which are operated in trains, and they are 50 feet long. Fred J. Green and H. M. Jenks of the Appleyard syndicate accompanied the party and acted as escort.

The Portsmouth Street Railway Company has made a contract with the Westinghouse company for power machinery to operate the Hanging Rock extension of the road.

The Fostoria Glass Specialty Company's plant at Fostoria was destroyed by fire a few days ago, causing a loss of between $40,000 and $50,000. The insurance is only $17,000, it is said. The company manufactured all kinds of glass articles used in electrical work and was owned by the Fostoria Incandescent Lamp Company and the Fostoria Bulb and Bottle Company. The fires in the kilns have been kept up to save the goods in process of burning.

It was announced in Cleveland this week by George McCulloch of Indianapolis, that the Union Traction Company had purchased the Fort Wayne street-railway system which was owned by a Cleveland syndicate, but the price has not been made public and nothing can be learned in regard to it. Dan P. Ellis is president of the Fort Wayne company and H. P. McIntosh is secretary, but they will give no particulars of the deal, more than that it has been made.

Many of the electric railways of northern Ohio were well-nigh tied up by the sleet and ice Friday. The Lake Shore was entirely idle for some time, and other roads, including the city lines of Cleveland, could not operate on schedule time. Telegraph and telephone lines were also down, and this added to the danger of attempting to run the cars. The cold weather was accompanied by a blizzard which caused much suffering to the men who attempted to make repairs and get things into working order.

The Maumee Valley Railway and Light Company of Toledo has been incorporated with a capital stock of $1,000,000 for the purpose of taking over the properties of the Toledo and Maumee Valley Railway Company and the Toledo and Waterville Railway Company, both of which are operated in the Maumee Valley. President Lang of the Toledo Railways and Light Company says the new company was formed only for the purpose of uniting the management of the two lines which belong to the same parties, the Everett-Moore syndicate.

The stockholders of the Havana and Jaimanitas Railway Company of Cuba held a meeting at the Hollenden Hotel, Cleveland, a few days ago to discuss matters pertaining to the building of lines in Cuba. Secretary York said after the meeting that it had been decided to begin the work of construction at once and push the lines to completion as soon as possible. O. M. C.

Detroit, Mich.

Detroit, December 13.—The Detroit United Railway is busy stringing new feeder cables from power house "B," where a new generator has been installed, to most of the lines of the city. The new power will be necessary for the increased travel of the public during the time before and just after Christmas. The lines to be benefited will be Woodward, Grand River, Third, Fourteenth, Gratiot, Brush, Crosstown, Chene and Trumbell. The heaviest cable is used along Woodward, from the river to Warren Avenue.

As the direct result of the successful operation of the plan of collecting mail in the city of Grand Rapids by street car, the postmaster-general proposes to proceed with the installation of mail boxes on street cars on a much broader scale, with the assumption that it will add greatly to the convenience of the letter-writing public, especially in districts where it is impossible to make frequent collections by the present system

The Detroit, Monroe and Toledo Short Line Company has been incorporated with a capital of $3,000,000, and will extend the present Black-Mulkey line between Monroe, Mich., and Toledo, to Detroit. Mr. Mulkey says $2,000,000 will be spent extending the present line from Monroe to Detroit, and $1,000,000 will be used later for double-tracking. Work on the extension will be pushed as soon as the frost is out of the ground next spring. It has not been decided whether to build directly into Detroit, via Fort Street from Flat Rock or come in via Trenton and Wyandotte, but in any event the road will build in over its own rails, but after reaching the city an arrangement will be made with the Detroit United to use its tracks. The directors of the company held a meeting to-day, at which the following-named officers were elected: President, Matthew Slush; vice-president, Clarence A. Black; second vice-president, A. E. F. White; secretary, C. J. Reilly; treasurer, C. R. Hannan. There was also elected an executive committee to represent the board of directors in order to expedite business. This committee consists of C. J. Reilly, C. R. Hannan and J. M. Mulkey.

Charles A. Chapin has settled all speculation as to what he intends to do with the 12,000 horsepower which his dam in the St. Joseph River at Buchanan, Mich., furnishes. He says this power will be transmitted to South Bend, Ind., to be used for manufacturing purposes. He says no arrangement exists whereby he is to furnish power to operate the Indiana Railway Company's line between Niles and South Bend. Mr. Chapin has erected a $250,000 power house at Buchanan, and the fears of the village that the power was to be transmitted beyond

the town were well founded. In the hopes that the town would become a great manufacturing center, $50,000 was contributed toward the construction of the dam, and interest is still being paid on that sum. C. G. W.

Information from Indiana.

Indianapolis, December 15.—When announcement was made from Philadelphia last week of the incorporation by the Widener-Elkins interests of the Indiana Company, with $1,000,000 capital, as the construction company for the new Indianapolis belt lines and terminal station, it was said that the lease of the Indianapolis Street Railway Company to the terminal company would soon be consummated. The first step toward such a combination will be taken before the close of the year, when the stockholders of the local company will vote on the proposition to lease the lines to the terminal company. The terms of the proposed lease were made public last week. The terminal company offers to lease the property of the local company, guaranteeing dividends on the street-railway stock of one per cent. on January 1st next, and thereafter semi-annually three per cent. for the first year, four per cent. for the second year, five per cent. for the third, and from July, 1906, six per cent.—the term of the lease being 30 years, at which time the local company's franchise expires. There is little doubt that the proposition will be approved, as the control of both companies is vested in the Widener-Elkins people. When the lease is approved, the capital stock of the terminal company will be increased to $5,000,000. Of this, $1,500,000 will be given to stockholders in the street-railway company, in proportion of 30 per cent. of their holdings of street-railway stock, as a part consideration for their approval of the lease. The terminal company will authorize the issue of $5,000,000 of five per cent. bonds, of which $3,000,000 will at once be sold to provide funds for the construction of the terminal station and belt lines. This will make the capitalization of the terminal company $10,000,000, on half of which it must pay five per cent. It not only guarantees the dividends to stockholders of the street-railway company, but it guarantees the interest charges on the street-railway bonds, two issues of $10,000,000 in all, $4,000,000 of five per cent. Citizens' Street Railway consols, guaranteed by the Indianapolis company, and $6,000,000 of the Indianapolis company. After July, 1906, the fixed charges which the traction terminal company will have to meet annually will amount to $1,000,000 or more. In addition, the lessee will pay $30,000 annually to the city, until 1925, and after that time $50,000 annually until the expiration of the franchise, dividends on the $5,000,000 stock of the traction and terminal company and a graduated car tax to the city. The site for the $1,000,000 terminal station has been secured in the very heart of the city, between Illinois Street and Capital Avenue, and will occupy three-quarters of a square. The inner belt line through Ohio, Georgia, Delaware Streets, and Capital Avenue will be constructed at once and the terminal station will be completed within a year. The proposed lease is to go into effect January 1st.

The new Consolidated Traction Company of Indianapolis has filed a map and profile of the route the company will follow in Marion, Hendricks, Boone and Montgomery Counties. Agents are procuring deeds for the right-of-way, and President Hawkins says the construction of the line will begin in a short time. This line will run northwest through Clearmont, Brownsburg, Pillsboro, Ramstown and Crawfordsville.

The new interurban line running between Cambridge City and Milton was opened on the 12th inst., the first car running into Milton on that day. An hourly schedule will be adopted.

The Indiana Appellate Court has sustained the right of the Indianapolis, Greenwood and Franklin interurban line to the $34,000 subsidy voted the company by the town of Pleasant, in Johnson County. A few taxpayers sought to enjoin the collection of the subsidy on the grounds that the road was expected to be a commercial road, since it was organized under the commercial-road law of 1853. The commissioners of Johnson County decided that the road had complied with all the necessary conditions in the carrying of package freight and was entitled to the subsidy, and the Appellate Court affirms the ruling of the commissioners.

In a conference between President McCulloch of the Union Traction Company and his motormen and conductors on Saturday it was agreed that the wage scale for the coming year would show an increase of 10 per cent.

The grade-crossing problem of necessity must be solved in Indianapolis on account of the numerous recent collisions and accidents to street cars and passengers. Some time ago the council passed an ordinance requiring the steam roads to elevate their tracks. They resisted this demand, and took the case to the Supreme Court, where it is now pending. The mayor now proposes to submit the matter of providing for viaducts or grade-crossing devices to a committee of seven citizens, and it is now believed that some such plan will be adopted instead of requiring the steam roads to elevate their tracks. In the meantime, there is a general desire to know how the Supreme Court will hold on the right of a city to compel track elevation.

John G. Brijson of Brazil has secured a 10-year contract to light Greencastle. A new electric-light plant will be erected. It is thought he represents a Boston syndicate.

The Western Indiana Traction Company of Vincennes, has filed incorporation papers, which set forth that the company will construct interurban railways in Knox, Sullivan, Vigo, Posey, Gibson and Vanderburg Counties. The first line will be built from Vincennes to Sullivan, and extensions will be made from that line. The capital stock is $100,000, and Edgar H. DeWolf of Vincennes heads the board of directors. F.

Northwestern Notations.

Minneapolis, September 13.—Fred Glick of Marshalltown represents Marshalltown (Iowa) parties who have bought the electric-light plant at Nevada, Iowa, and Mr. Glick is in charge.

The Electric Light and Power Company of Hastings, Minn., is making extensive improvements to its plant. About 125 transformers will be taken out and replaced by six large ones.

The Menominee Electrical Manufacturing Company of Menominee, Mich., has been reorganized, and the interests of Robert E. Jennings were transferred to new owners.

A private plant to furnish electric light for the new federal building in St. Paul is projected. The estimated cost of the plant is $25,000.

The Lincoln Traction Company of Lincoln, Neb., will make a large extension to its power house and will enlarge its power plant.

Counsel for the Twin City Rapid Transit Company and for the city of St. Paul have been on a tour through the East, taking depositions of electrical men, to be used in the trial against the company for damage to water pipes by electrolysis.

Low water in the Mississippi River has been the cause of the Twin City Rapid Transit Company being short of power to operate its street cars in Minneapolis and St. Paul. The company ordered auxiliary steam plants last spring for August delivery, and they have not yet been received and put in place. A good deal of the equipment has come, but some very important parts are missing, and, despite the efforts of the company, they cannot be secured. The result is that the street-car service in the cities has been miserable. At the busy hours it has been an impossibility for half the crowds to get cars, and office and store help has been late day after day because of the poor service.

The council of Carlton, Minn., has awarded a contract to the Cloquet Electric Company of Cloquet, Minn., to furnish electric lighting. The company will string wires from its plant in Cloquet to Carlton. R.

Texas and Mexico.

Austin, Texas, December 13.—The Metropolitan Street Railway Company of Dallas, which was recently organized by Boston men with a capital stock of $4,500,000 for the purpose of carrying into effect plans for the consolidation and operation of the Dallas Consolidated Electric Street Railway Company and the Dallas Transit Company, is meeting with difficulty in carrying out its plans. It is understood that should the plans for consolidation fail the Metropolitan Street Railway Company will operate its own line separately, although possessing the other two systems.

The City Council of Beaumont is trying to enforce an ordinance requiring the Beaumont Street Railway Company to provide separate accommodations for the white and colored passengers. The enforcement of this provision will work a great hardship on the company, as it will necessitate an increase of its equipment without any addition of business.

It is announced that the syndicate of Baltimore (Md.) capitalists which recently acquired the two street-railway systems in Monterey, Mexico, and obtained a concession from the state and municipal governments to build new lines of railway over the principal streets, not already occupied, will incorporate the new company under the laws of New Jersey with a capital stock of $1,500,000, gold.

A company is being organized to build an interurban electric line between Paris, Texas, and Detroit, Texas, passing through the town of Blossom. The distance is about 30 miles.

C. C. Waller of Houston, who is promoting the building of an interurban electric road between Houston and Galveston, a distance of 50 miles, has applied to the City Council of Houston for a franchise for the proposed road over certain streets of that city. It is understood that Chicago capitalists are the financial backers of the project.

An electric-light and power plant is to be established in the city of Ameca, state of Jalisco, Mexico, by a syndicate of Mexican capitalists. The electric energy will be generated by a waterfall near Ameca.

Otto Scheller, a German electrical engineer, is at Guaymas, Mexico, where he is establishing a system of wireless telegraphy for the Mexican government between that place and points on the peninsula of Lower California.

The Federal District Street Railway Company of the City of Mexico is arranging to build an extension of its system to the town of Texcoco, a distance of 18 miles from the City of Mexico.

An American syndicate has about closed a deal for the purchase of the street-railway system in the city of San Luis Potosi, Mexico. If the transaction is consummated, it is proposed to convert the system from mule to electric power.

Vicente Viegra, a capitalist of Gamazula de Gordiano, state of Jalisco, Mexico, is constructing an electric-light plant at that place. W. D. H.

Among the Rockies.

Salt Lake City, December 12.—The City Council of Florence, Colo., met this week and granted a franchise to Thomas Robinson of that city for building an electric street-car railway in Florence.

A large power and irrigation project has been floated by Senator A. B. Lewis in Beaver County, Utah. It will reclaim 4,000 acres of the best land in the state and develop 800-horsepower for use of mines and street-car and electric lines. An immense storage plant will be put in at Minersville Canyon, and a dam 64 feet high will be built, the reservoir to cover 187 acres. The electrical-power enterprise is independent of the irrigation project. A fall of 164 feet is secured.

Superintendent Heap of the Phœnix (Ariz.) street railway has just installed a new power plant for the company. Part of the machinery is being placed and it is anticipated that the road will be ready for business next month.

The Consolidated Street Railway and Power Company has a proposition under consideration for building its own cars for Salt Lake lines.

A consignment of machinery for the plant of the Boise-Payette River Electric Company arrived this week at Emmett, the terminus of the Idaho Northern Railroad. It was forwarded at once to the site of the plant at Horseshoe Bend, where it will be installed immediately. The consignment of machinery embraced about 150,000 pounds. G.

On the Pacific Slope.

San Francisco, December 10.—Ground was broken this week for the new 2,000-horsepower steam-power electric generating plant of the North Shore railroad in Marin County, Cal. The company will operate electric and steam trains over a portion of its lines. A system of electrically operated signals will prevent any two trains from entering the half-mile sections at the same time.

The Mutual Electric Light Company of San Francisco is now obtaining estimates from steam and electric-machinery manufacturers with a view to equipping an additional electric power house. A steam plant of high efficiency will be installed at the corner of Folsom and Steuart Streets. The initial installation will probably consist of two 1,500-kilowatt, two-phase generators, each direct-connected to a horizontal engine. An improved underground-conduit system will be installed.

The following official statement has been made by the Pacific Light and Power Company of Los Angeles, Cal.: "Our company was organized for the purpose of generating and distributing electric current for light and power. The company has purchased the plant of the San Gabriel Electric Company, consisting of a waterpower generating station at Azusa, with an installation of 1,600 horsepower; a waterpower station in San Antonio Canyon, 40 miles distant from Los Angeles, with an installation of 800 horsepower; transmission lines extending from Azusa, 23 miles, and from San Antonio, 40 miles to Los Angeles, Cal.; and distributing lines throughout Los Angeles and surrounding territory. In addition to this, the company has a 3,000-horsepower steam plant, installed at its station in Los Angeles, Cal. The company is now building a plant on Kern River, distant 105 miles from Los Angeles, where a plant of 10,000 horsepower, with ample reserve, is being constructed. From this plant there will be two separate and distinct transmission lines for the entire distance. The power generated will be used in Los Angeles to supply the system of the Pacific electric railway, as well as of the Pacific Light and Power Company. In addition to this, the company is about to double its steam plant, which is to be held in reserve, to be used in case of accidents, etc." A.

PERSONAL.

Charles H. Pinkham, general manager of the Bay State Electric Light, Heat and Power Company, died in New York city on December 8th. He was 53 years old and was born in Salem, Mass. He was the first president of the Bank of Harlem, which he founded in 1888.

At a recent meeting of the New York Electrical Society the following-named gentlemen were elected to membership: W. A. Belden, J. O. Sinkinson, Thompson D. Harbinson, M. B. Foster, Leon E. Schmielewski, W. C. Andrews, Charles R. Pratt, Harold Melbin, E. B. Conrad and A. Frederick Collins.

Charles W. Wason, president of the Cleveland, Painesville and Eastern Railroad Company of Cleveland, with his wife, will leave Cleveland in a few days for a trip around the world, which will take about six months. The employes in the office presented him a fine gold watch on Friday of last week. Mr. Wason is a prominent electric-railway man and has also been active in Independent telephony. At the New York convention of 1901 he was elected first vice-president of the American Street Railway Association.

ELECTRIC LIGHTING.

The National Electric Light Association states that its membership is now just double what it was at the time of the Cincinnati meeting last May, having added 180 new names to its list of members. Since November 1st the association has gained 45 new members.

The Merchants' Electric Light Company of York, Pa., is considered by the Borough Council of North York for the purpose of furnishing electric light for that thriving borough. Poles will be planted, wires strung and an effort made to set aside the old company.

The bureau of insular affairs of the War Department announces that it is now prepared to give information desired by possible bidders for the Manila street-railway and light and power franchises. The bids as before mentioned in the Western Electrician will be opened in Manila on March 5, 1903. The proposed railway system covers a route 35 miles long. The lighting system is for Manila and suburbs. Construction must begin within six months after awarding the contract and be completed 20 months thereafter.

Bids for lighting the city of Seattle (Wash.) for the next year were opened in that city recently. The Seattle Electric Company submitted a bid as follows: For inclosed arc lamps (66 amperes, 78 volts), each, per annum, $66, and for 30-candlepower incandescent lights, each, per annum, $15. This proposal is for furnishing lights for the entire city, and is contingent upon the acceptance of the whole proposal. This bid for arc lights is $6 less than last year's price. About 250 incandescent lights and 25 arc lamps will be needed in excess to those used last year.

ELECTRIC RAILWAYS.

It is now asserted that arrangements have been perfected for the Berlin (Germany) underground-railway project and that its success is assured. The road will cost 56,000,000 marks, which sum will be raised by a special loan. The line will belong to the municipality, and will be 11 kilometers long, with 15 stations, including the termini. It will run from the north to the south of the German capital under the most busy thoroughfares. The trains, consisting of seven carriages, will run every three minutes. The tunnels throughout will be lined with concrete. The work is expected to be begun next summer, to be completed in six years.

The Chicago Junction Railroad Company of Chicago has been incorporated, with a capital of $50,000. The incorporators and the first board of directors are Frederick R. Babcock, William Raymond, James Miles, John D. Black and Edward W. Everett. The corporation will extend the South Side elevated road to the stock yards, where a loop will be constructed, and to the east along the Lake Shore boulevard line to a connection with the Illinois Central. Work will be begun as soon as material can be brought to the ground. Residents of Englewood, in the southwestern part of the city, are demanding that an extension of the elevated road be built into their section.

Redondo Beach, near Los Angeles, Cal., is soon to be connected with that city by two electric-railway lines. The Redondo Railroad Company has already equipped its line with electricity and will soon begin operations. The second line is being built by the Los Angeles Pacific Railway Company. This latter is a branch from Santa Monica, which is being pushed down along the coast. It is expected to have this branch in operation by Christmas. When these new lines are in operation Los Angeles will have rapid transit by electric lines to all the beach points, including Long Beach, San Pedro, Redondo and Santa Monica, the first three named having been constructed within the last six months.

AUTOMOBILES.

Speaking about his new storage battery for automobiles, Thomas A. Edison is reported to have made this remark recently: "I don't intend to let a battery be put on the market for at least three months, or until I have made a 5,000-mile endurance test, and have discovered all the weak points and rectified them."

PUBLICATIONS.

The Central Electric Company of Chicago is distributing to the trade a new No. 9 D. & W. price list. This price list, which contains half-tone cuts of all D. & W. products, includes much new material not heretofore listed.

In an eight-page bulletin the Mechanical Appliance Company of Milwaukee, Wis., gives the characteristic features of its Watson multipolar motors and generators. Illustrations show various parts of the machines and different adaptations of the motors.

The Emerson Electric Manufacturing Company of St. Louis, Mo., has issued an illustrated bulletin descriptive of its forge and volume blowers with direct-connected alternating-current motors. The motors range in size from one-tenth to one-third horsepower, according to the size of the blower. Another Emerson bulletin describes the company's automatic-start induction motors for single-phase currents in sizes of one-tenth and one-twentieth horsepower.

The report of the twenty-first annual meeting of the American Street Railway Association in Detroit last October, has been issued in book form by Secretary T. C. Penington. The volume contains 341 pages (nine by six inches) of reading matter, including a convenient table of contents. The frontispiece is a fine steel engraving of ex-President H. H. Vreeland of New York. Besides a full account of the proceedings of the convention, the book contains a complete roster of the officers of the association since its organization, lists of the delegates, visitors and exhibitors at the Detroit convention, the constitution and by-laws of the association and a list of members.

TRADE NEWS.

The Chicago Electric Manufacturing Company has been dissolved.

The Klute-Barthold Electric Company of Chicago has been incorporated with a capital of $5,000. The purpose of the corporation is "electric manufacturing." The incorporators are Henry Klute, Emma Klute and E. E. Barthold.

The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has opened an office in Pittsburg, at 319 Frick Building. The office will be in charge of C. C. Bodeau, formerly with the Wagner Electric Manufacturing Company of St. Louis, Mo.

The Dayton Fan and Motor Company of Dayton, Ohio, has made arrangements with the Diehl Manufacturing Company, whereby it has obtained a perpetual license to manufacture fans which embody the principles covered by the Diehl-Bennett patents.

The Reynolds Electric Company of Chicago has certified to a change of name to the Reynolds Electric Flasher Manufacturing Company and to an increase in capital from $2,500 to $15,000.

The Independent Arm and Pin Company, successor to the manufacturing business of the Citizens' Electric Light and Manufacturing Company of Woodstock, Ill., has been incorporated with a capital of $100,000. The company recently opened an office at 1018 Chamber of Commerce, Chicago. Marcellus L. Joslyn is general manager of the firm. The company manufactures crossarms, oak and locust pins and oak brackets. It has factories in Crystal Lake, Ill., Muscoda, Wis., Mize, Miss., and in North Carolina.

BUSINESS.

The Electric Appliance Company of Chicago asserts that it has in Chicago stock for immediate shipment the largest stock of weatherproof wires carried by any house west of the Allegheny Mountains.

The Marshall-Sanders Company announces that it has placed a very complete stock of all its specialties, sockets, switches, cut-outs, plugs and receptacles with Hart & Co., Monadnock Building, Chicago, who can make prompt shipment of everything in this line.

George W. Hoffman of Indianapolis, Ind., manufacturer of the U. S. metal polish paste, states that this has been an exceptional year in his business, which has doubled that of last year. He is shipping this polish and other polishing specialties all over the world.

The Chicago and Alton Railway Company's latest advertising card shows a tramp painfully penning a note to the company, stating that he has found this railway between Chicago, St. Louis and Kansas City the rockiest road he ever walked on, incidentally complimenting, of course, the rock-ballasted track.

The Hemingray Glass Company, Covington, Ky., the well-known producer of glass insulators for telephone, telegraph and electric-light purposes, continues to do an excellent business. Hemingray insulators are used all over the country and the constantly increasing number of new customers proves their popularity.

The Western Electric Company reports very gratifying results from its constant-potential alternating arc lamp. This lamp operates on the repulsion principle, "and," the company says, "the favor with which the central-station managers have received this lamp, as well as the fact that a competing manufacturer has recently copied the details of its mechanism, are tributes to its intrinsic worth."

The Mechanical Boiler Cleaner Company, Chicago, reports an order just received from the Cudahy Packing Company for seven cleaners. This makes 65 cleaners installed in the plants of that company. A duplicate order has also been received for 13 cleaners from the Fort Wayne Gas Company. The Mechanical Boiler Cleaner Company, owning all the Garrigus patents, and, it is said, all patents covering a floating skimmer, is doing a large business. It claims to have the only method of keeping boilers perfectly clean, as its device removes all impurities from the water.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office; December 9, 1902.

715,235. Reversing-switch Controller for Electric Motors. James I. Ayer, Malden, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed February 17, 1902.

The device comprises starting and stopping mechanism and a reversing switch for a motor, a spring-actuated locking device for engaging the switch and holding it against movement, and a retractor actuated by the operation of the mechanism to move the locking device into and out of locking engagement with the switch.

715,236. Booster System. George Baehr, McKeesport, Pa., assignor to the National Tube Company, Pittsburg, Pa. Application filed February 14, 1902.

In the system combined with a motor are automatic means for increasing the amperage and voltage of the current at the motor terminals in proportion to the increase of the load on the motor.

715,254. Protector for Electric Lamps. Frank B. Garretson, Worcester, Mass., assignor to himself and William J. Gindele, Worcester, Mass. Application filed November 29, 1901.

The device consists of spring wires covered by woven-wire cloth.

715,265. Thermo-electric Pile. Albrecht Heil, Frankfort-on-the-Main, Germany, assignor to A. Wolf, Jr., & Co., Frankfort-on-the-Main, Germany. Application filed April 22, 1902.

A thermo-electric element or couple comprises a block, a strap connected to the block extending horizontally, then upward and backward and over the block, and a strip connected to the extended end of the strap.

715,281. Electrolytic Apparatus. Joseph Matthews, Kings Heath, and William Davies, Selby Park, England. Application filed March 29, 1901.

An outer tank or vat has an inner tank or vat of perforated insulating material with a revolving drum mounted therein having a number of radiating arms or rods passing through and supporting an outer circular face of insulating material with electrical connections to the cathode and anode parts of the apparatus.

715,291. System of Control for Electrolytically Propelled Vehicles. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 8, 1899.

Means are provided for controlling the electric circuit in response to changes of pressure in the air-brake system.

715,299. Electric Elevator. Harold Rowntree, Chicago, Ill., assignor to the Burdett-Rowntree Manufacturing Company, Chicago, Ill. Application filed November 29, 1899.

In the elevator are a hoisting motor, an electrically operated main switch, means for controlling the same including a series of push buttons, one arranged at each floor or landing, and a corresponding series of push buttons arranged on the car and each push button adapted to close the circuit of the switch-operating means, and an auxiliary switch actuated coincidentally with the main switch for breaking all the push-button circuits as the motor circuit is completed.

715,313. Process of Forming Electric Conducting Cables. Russell Spaulding, New York, N. Y. Application filed May 3, 1902.

The process consists in braiding a number of fine wires to form a tube, next flattening the tube and finally covering the flattened, braided tube with insulation.

715,327. Rheostat. Frank C. Watson, Philadelphia, Pa., assignor to the Smith-Watson Manufacturing Company, Philadelphia, Pa. Application filed April 2, 1902.

In the rheostat are combined a suitable hollow casing, a resistance inclosed therein, a resistance coil carried by the casing and having its convolutions exposed at one point, a contact member movable over the resistance coil, and suitable terminals for the coil and contact member.

715,329. Rail Chair and Insulator. Walter D. Young, Baltimore, Md., assignor to the National Safety Third Rail Company, New York, N. Y. Application filed October 18, 1901.

The third-rail insulator described comprises a base having outwardly and downwardly extending spike-receiving sections, and parallel inwardly inclined flanges, and an insulator block having its base formed to enter slidably between the flanges.

715,332. Accumulator Electrode. Richard Alexander-Katz, Berlin, Germany. Application filed August 31, 1899.

A number of frames of non-conductive material, each in the form of a wide-meshed grating of even thickness throughout have active material in the interstices of the grating and flush with the surfaces thereof.

715,334. Electric Safe Lock. James M. Allen, St. Louis, Mo., assignor of eleven and one-half twentieths to George H. Price and Isabel H. Nelson, St. Louis, Mo. Application filed June 7, 1901. Renewed May 15, 1902.

An electromagnet is placed in co-operative relation with the bolt. Another electromagnet is used for energizing the magnet from the outside of the safe, and retracting the bolt from its locked position, the electromagnet serving as a temporary handle for the door.

715,343. Accumulator. Frederic N. Blanc, Paris, France. Application filed February 17, 1902.

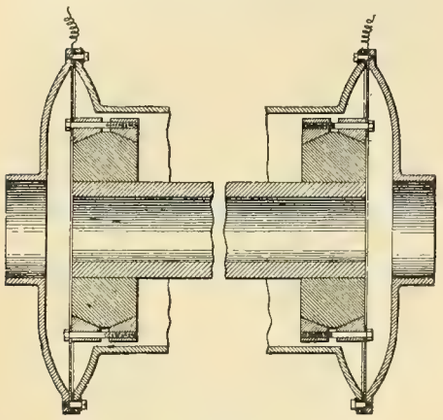
A support for the electrode consists of aluminum electroplated with copper and covered with metallic lead.

715,347. Telegraph. John E. Carney, Montgomery, Ala. Application filed May 27, 1901.

An electromagnet normally short-circuited is adapted when energized to hold a detent adapted to lock the signaling system withdrawn from operative position.

715,375. Insulator. Morton Harloe, Hawley, Pa. Application filed May 9, 1902.

The insulator has a body petticoated and adapted to be secured to a peg, the crown thereof being comprised in three projecting lugs.



NO. 715,509.—ELECTRIC FURNACE.

715,412. Storage Battery. Leonard Paget, New York, N. Y., assignor to Charles Coster, New York, N. Y. Application filed September 8, 1899.

The battery has an absorbent material for the electrolyte consisting of silicated tufa.

715,413. Storage Battery. Leonard Paget, New York, N. Y., assignor to Charles Coster, New York, N. Y. Application filed August 28, 1901.

A multiple-cell storage battery has battery plates extending edgewise from one cell to another with the sole conducting connection between the cells formed by the active material.

715,415. Electric Trolley-wire Hanger. Alexander Palmros, Columbus, Ohio, assignor to the Jeffrey Manufacturing Company, Columbus, Ohio. Original application filed September 24, 1897. Divided and this application filed June 6, 1901.

A casting adapted to be secured to a support and provided with an interior recess, angular in shape, surrounded by an integral wall is provided with a hanger having a head arranged to enter the recess or socket, insulating material between the head of the hanger and the casting, and means carried by the hanger for securing the trolley wire thereto.

715,428. Electrical Controller. Jacob L. Schureman, Jr., Chicago, Ill., assignor of one-half to John W. Hayden, Chicago, Ill. Application filed December 4, 1899.

The controller comprises a circuit-breaking switch and a commutator, a driving shaft, actuating means for operating both the switch and the commutator, and means independent of the switch-operating means for imparting motion to the commutator.

715,434. Electromagnet. Alfred Stromberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill. Application filed January 2, 1902.

The electromagnet includes a swinging armature and a magnetic core portion comprising a main core body and a screw at the end of and projecting beyond the main core body and in threaded engagement therewith and opposed to the armature, whereby the air-gap between the core portion and the armature may be adjusted.

715,455. Sanitary Attachment for Telephone Transmitters. Henry Baethig, Buffalo, N. Y. Application filed May 23, 1902.

Combined with a mouthpiece of a telephone transmitter provided on its front portion with a hook or catch are a sheet support arranged adjacent to the transmitter, and a guide arranged to direct the sheets from the support to the hook or catch.

715,505. Electric Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed November 21, 1901.

The furnace consists of a tube composed of a mixture of dry electrolytes constituting the conducting portion of the furnace, the tube being provided with confronting electric-circuit terminals arranged in pairs at opposite ends of the tube, and the pairs of terminals being symmetrically spaced.

715,506. Electric Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westing house, Pittsburg, Pa. Application filed November 21, 1901.

A carbon tube constitutes the main body of the furnace and has conical ends with flaring carbon terminals adapted to fit the ends, and ring terminals of metal surrounding the carbon terminals.

715,507. Tubular Electric Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed February 7, 1902.,

The furnace has a tube of carbon and is surrounded at intervals along its length by supporting collars of carbon extending at right angles to the tube.

715,508. Electric Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed March 27, 1902.

There are a main stationary tube and an inner rotatable tube of carbon provided with a lining of magnesia or the like, the inner tube being capable of free rotation within the main tube when the furnace is in operation

715,509. End Support and Circuit Terminal for Carbon-tube Furnaces. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed March 28, 1902. Renewed October 28, 1902.

In the furnace are a tubular body having carbon terminals at each end, metallic ring terminals clamped to the carbon terminals, and an insulated diaphragm at each end rigidly connected with the metallic terminals. (See cut.)

715,511. Snap Switch. Henry E. Reeve, Brooklyn, N. Y. Application filed February 12, 1902.

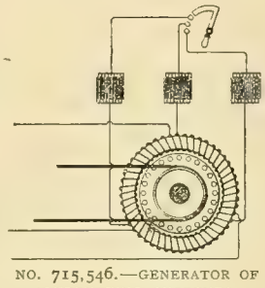
In the switch are combined a movable contact, a latch movable with the same, a reciprocating frame, and a stud movable with the frame for locking the latch in either of two positions and for releasing the latch at the completion of the stroke of the frame.

715,528. Fuse Box. Milton R. Utley, Chicago, Ill., assignor of one-half to Charles F. Slacks, Chicago, Ill. Application filed May 13, 1901.

Combined with the box and the cover therefor is an insulating block or lining mounted upon the cover, a space from the top edge to the bottom edge of the cover being left between the insulating block and the cover for the passage of water.

715,537. Composite System of Electrical Transmission. Frederick Bedell, Ithaca, N. Y. Application filed March 20, 1900.

One claim reads: The combination with a circuit for transmitting electrical energy for lighting, power or similar purposes by means of a maintained alternating current, of sending and receiving communication circuits applied thereto at separate points, impeding devices connected across the mains of the transmitting circuit and joined at an intermediate point to a communication circuit, communication apparatus in the communication circuit and an impedance interposed between the apparatus and the impeding devices.



NO. 715,546.—GENERATOR OF ALTERNATING CURRENTS.

715,545. Generating Alternating Currents. Charles S. Bradley, Avon, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 22, 1896.

An alternating-current generator has a field-magnet circuit including a condenser, a switch for opening and closing the circuit, and a relatively movable co-operating element in inductive relation to the field magnet.

715,546. Generating Alternating Currents. Charles S. Bradley, Avon, N. Y. Original application filed June 22, 1896. Divided and this application filed April 23, 1902.

The method of operating an induction generator whose field magnet is charged by a condenser consists in opening the condenser circuit while the machine is in motion to preserve the condenser charge, and starting the machine by bringing it into motion and then closing the switch. (See cut.)

715,555. Electric Sign. Lucien S. Crandall, Brooklyn, N. Y. Application filed August 30, 1902.

The sign comprises parallel metal plates, means for supporting the plates and for insulating them from one another, lamp sockets in the outer plates in electric contact therewith but insulated from the back plate, devices in the sockets in contact with the back plate, means providing electrical connections to the plates for supplying the current and devices connected to the sockets for designating a letter or numeral by day, the removal of which permits the insertion of electric lamps for designating a letter or numeral, as set forth.

715,625. Process of Obtaining Metallic Aluminum or Other Metals by Electrolysis. Girolamo Taddei, Turin, Italy, assignor to the Societa Italiana di Applicazioni Elettriche, Turin, Italy. Application filed July 17, 1901.

The method consists in separating sodium from its chloride while at a high temperature, by electrolysis, then decomposing the oxide of the metal treated while hot with the chlorine from the first step, whereby a chloride of the metal is formed, and then decomposing the chloride by the hot sodium vapor from the first step, whereby sodium chloride is formed and the metal treated set free, the operation being continuous.

715,626. Apparatus for Obtaining Metals by Electrolysis. Girolamo Taddei, Turin, Italy, assignor to Societa Italiana di Applicazioni Elettriche, Turin, Italy. Application filed December 13, 1901.

An apparatus for the purpose specified in the above patent is described.

715,643. Carbon Guide for Electric Lamps. William J. Deming, Murphysboro, Ill. Application filed July 12, 1902.

A movable insulated guide is slidably mounted upon the side rods and is provided with an aperture for the passage of a carbon therethrough.

715,650. Electrical Massage Apparatus. Oscar A. En Holm, New York, N. Y., assignor of one-half to Homer W. Hedge, New York, N. Y. Application filed March 20, 1902.

Combined with a support comprising a sleeve of insulating material having a closed end are two electrodes rigidly mounted thereon, a circuit-interrupter mounted in the sleeve, and means also mounted in the sleeve for controlling the operation of the circuit-interrupter, the means projecting through one of the electrodes.

715,654. Gravity Electric Battery. Adam M. Friend, Denver, Colo. Application filed June 8, 1901.

A partition is placed horizontally in the jar between the positive and negative elements, and fits its sides to prevent communication between the two compartments around the disk, but permits vertical movement of the disk in the jar for the purpose set forth, the partition being porous and forming a strainer or filter to permit the passage of liquid while straining out the solid particles of matter.

715,677. Electric Roller. Casteran J. Marius, West Hoboken, N. J., assignor to Stephen J. Cox, New York, N. Y. Application filed February 6, 1900.

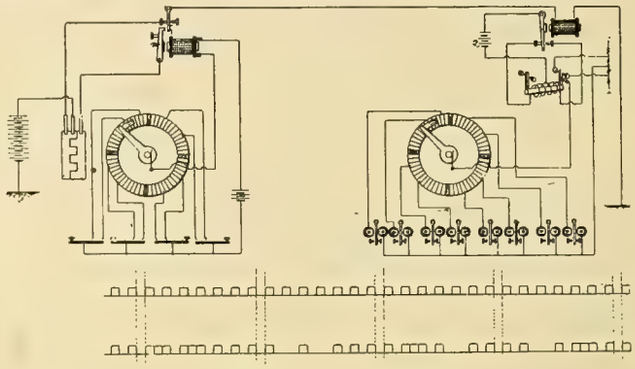
The rotation of the roller in contact with the body is utilized in generating a current of electricity and transmitting the same to the body.

715,683. Electrical Call Bell. William E. McCormick, Chicago, Ill., assignor to the International Telephone Manufacturing Company, Chicago, Ill. Application filed December 16, 1901.

In the bell are combined a ringer frame supporting electromagnetic devices, and an armature plate rigidly secured to the frame at one end and adjustably supported on the frame at its other end.

715,686. Electric Telegraph. Thomas D. Penniman, Baltimore, Md., assignor to the Rowland Telegraphic Company, Baltimore, Md. Application filed January 9, 1902.

An improvement in the transmission of intelligence consists in sending over a circuit a succession of electrical impulses separated by spaces, and substituting spaces for impulses and impulses for spaces in combination, to form the characters of a code. (See cut.)



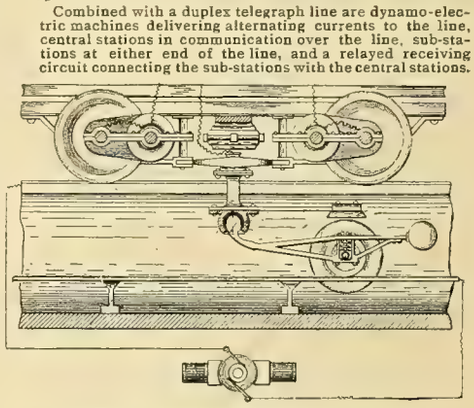
NO. 715,686.—ELECTRIC TELEGRAPH.

715,689. Electrical Switch. Clarence D. Platt, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Application filed August 19, 1902.

An insulating base for an electrical knife-switch has projecting lugs in pairs, with their adjacent faces beveled to form V-shaped grooves.

715,696. System of Telegraphic Distribution. Henrietta H. Rowland, Baltimore, Md., administratrix of Henry Augustus Rowland, deceased, assignor to the Rowland Telegraphic Company, Baltimore, Md. Application filed December 11, 1901.

Combined with a duplex telegraph line are dynamo-electric machines delivering alternating currents to the line, central stations in communication over the line, sub-stations at either end of the line, and a relayed receiving circuit connecting the sub-stations with the central stations.



NO. 715,714.—TROLLEY FOR CONDUIT RAILWAYS.

715,702. System of and Apparatus for Controlling Light Effects. Robert F. Spangenberg, New Orleans, La. Application filed November 18, 1901.

In the apparatus are combined an inclosing casing, an electric light mounted therein, a number of color frames, slidingly mounted in the casing, cords attached to the frames, a rotating shaft, winding drums carrying the ends of the cords mounted on the shaft, and electromagnetically operated mechanism adapted to throw the drums into action to raise the respective frame.

715,714. Trolley for Electric-railway Cars. Louis E. Walkins, Springfield, Mass. Application filed January 9, 1900. Renewed September 20, 1902.

One claim reads: The combination with a slotted conduit, the conductor therein and the truck running on the trackway over the conduit provided with the depending member extended downwardly through the slot in the conduit, of the wheeled trolley in running contact on the conductor and comprising a frame, a portion of which has a ball-and-socket connection with the depending member extended from the truck, and a bar longitudinally and horizontally extended from the member over the trolley. (See cut.)

WESTERN ELECTRICIAN

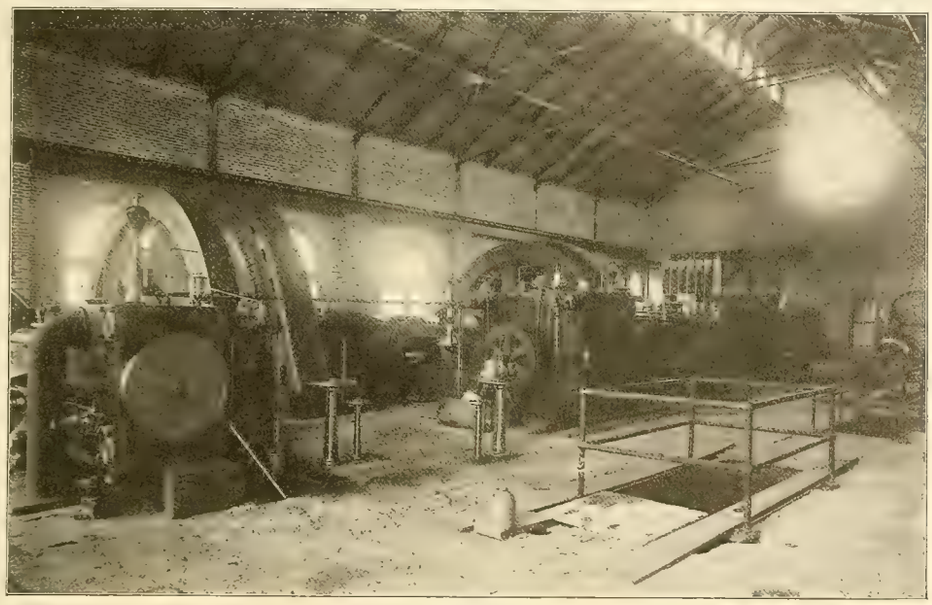
EVERY SATURDAY.

Vol. XXXI. CHICAGO, DECEMBER 27, 1902. No. 26

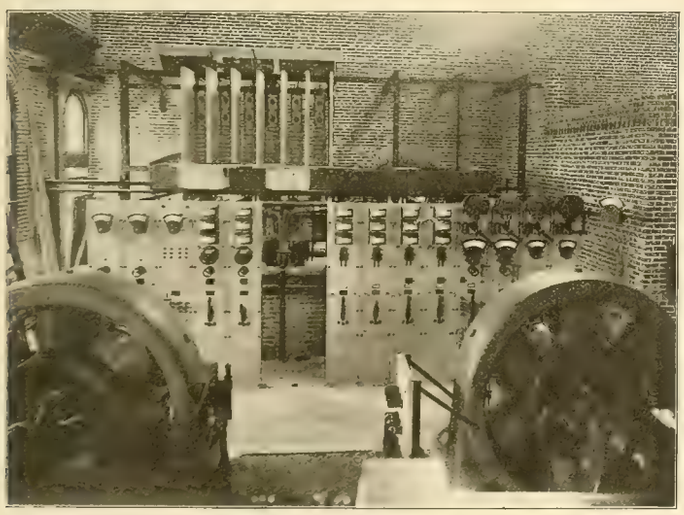
Columbus, Buckeye Lake and Newark Electric Railway.

By O. M. Carter.

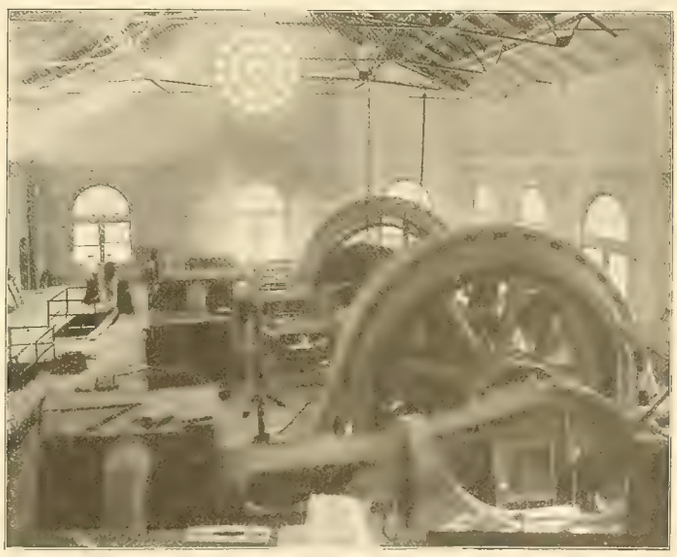
One of the most interesting and picturesque electric railways in the central part of Ohio is that of the Columbus, Buckeye Lake and Newark Traction Company, extending, as it does, through a beautiful stretch of country with a branch to Buckeye Lake, which has a wealth of beautiful natural scenery about it. Central Ohio is a rich agricultural region, with small pieces of woodland on occasional raises and rugged bluffs along the numerous streams encountered. The line leaves the Columbus Union Depot over the loop, and in crossing Alum Creek passes over a substantially built viaduct. After leaving the city, the road swings north to the national pike, which it follows almost due east for 25 miles to Hebron. It is almost a straight line, and so well has the construction work been done that cars have made a speed of a mile a minute for almost the entire distance. From Hebron the main line extends along the bank of an unused canal to Newark, nine miles distant, and a branch extends to Buckeye Lake, which is 2½ miles away. The lake contains 18 square miles, and has been an outing resort for some time. It was some years ago set aside by the state for public-park purposes, and has been fitted up for picnicking, fishing, boating, dancing and other innocent pleasures.



View in Engine Room.



Rotaries and Switchboard.



Alternating-current Generator Units.

COLUMBUS, BUCKEYE LAKE AND NEWARK ELECTRIC RAILWAY.—GENERATING PLANT AT HEBRON.

The population of Columbus is now about 150,000, and Newark is a little city of 22,000 people. On the line, between the termini, are Reynoldsburg, Etna, Kirkersville and Hebron, all thriving villages, and made more so by the road itself. The total population along the line is estimated at something like 250,000 people, and the railway is used very largely by people several miles on either side of it.

The history of Columbus is quite well known to all who are interested in traction matters, but the advent of electric roads has worked wonderful changes for the better in the last few years. The business of both the wholesale and retail merchants has shown a very perceptible increase, and there has never been a greater gain in population in the same length of time. The fact that it is the capital city and in the center of the state makes it a natural center for electric-railway enterprises, and those roads which have it for a terminus are quite fortunate. It has a good interurban union passenger depot, and arrangements have just been completed for a freight depot to be used by all the electric roads entering the city. The Columbus, Buckeye Lake and Newark will have the advantage of using both.

Newark is an active manufacturing town, the county seat of Licking County and the home of the Jewett Car Works, as well as many other enterprises of importance. The fact that the town has five flourishing banks is enough to show what it is in a business and industrial way. The business has increased in a most satisfactory way, however, since the electric line was completed. The annual encampment of the Ohio National Guard is held there, and the famous Indian mounds of that locality attract many students and curiosity seekers.

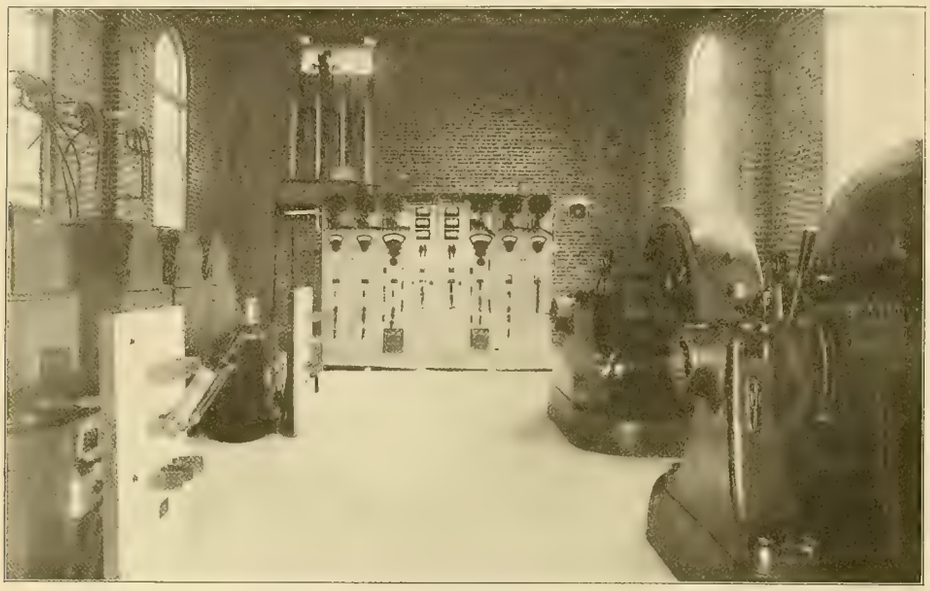
The park at Buckeye Lake has been used for years as a summer resort and place of recreation, but now it will increase its business many fold. Some of its attractions have already been named, but in addition the railroad company has erected a handsome dancing pavilion at a cost of $50,000, and many other improvements have been planned. The company now has about 41 miles of single track betwen Columbus and Newark. In Columbus there are 10,470 feet of single track, all completely paved, in the construction of which nine-inch 107 Trilby rails were used. Newark has 1⅞ miles of track, laid with nine-inch, 90-pound, standard girder rails. The 37 miles of track through the country is composed of 70-pound T-rails, and the switches and frogs are of the steam-railway standard. All rails are laid on standard white-oak ties. Standard six-bolt fishplates are used with the 30-foot T-rails, with one No. 0000 concealed bond for each joint, while with the 60-foot girder rail, a double No. 0000 bond spans the fishplate. The roadbed is made with the usual fill, and six inches of gravel under the ties, and the spaces are filled even with the tops of the ties. It is well ballasted and up to the standard of first-class railroad building. Six steel bridges, from 20 to 156 feet in length, three concrete arch culverts of six-foot span and more than 70 iron or tile culverts of from six inches to three-foot span were required in the construction of the road. All of them are of the best material and workmanship.

Except in the cities and villages, the overhead construction is of the bracket type, with straight, sound and well-set poles, 35 feet long and eight inches at the top, the Richmond Craighead bracket being used. In other places the span construction was used. A No. 0000 grooved trolley wire is employed the entire length of the line, and two No. 0000 copper feed wires are carried on the poles. From the power house at Hebron to the sub-station at Hibernia, 20 miles toward Columbus, a No. 4 copper three-phase transmission line is used.

The power house, built on the canal bank, close to the main track at Hebron, is one of the best built and finest in that part of the country. It is 138 by 118 feet in dimensions, and is built of brick on a striking and rather unusual design. It has a boiler room 40 by 138 feet, an engine room 60 by 138 feet, and coal bins 18 by 138 feet, and is covered by an iron-truss slate roof. The stack is 150 feet high, seven feet inside diameter and is built of radial brick. The machinery proper consists of two 1,250-horsepower, Hamilton-Corliss, cross-compound engines, 26 and 50 by 48-inch, with a speed of 75 revolutions per minute; two 800-kilowatt, 1,300-volt,

three-phase generators, mounted on the shafts of the engines; two 300-kilowatt rotary converters; six 110-kilowatt, air-blast step-up transformers, a 15-panel switchboard, Blake independent condensers, Goubert heaters and other machinery of minor importance. Views in the power house are shown in the accompanying illustrations.

The sub-station at Hibernia, eight miles from Columbus, is a neat little brick building and contains the following equipment: Two 300-kilowatt rotary converters, six 110-kilowatt, air-blast, step-down transformers, seven-panel switchboard and other appliances, all of the latest approved pattern. The electrical equipment in both sub-station and power house is of the General Electric Company's manufacture.



COLUMBUS, BUCKEYE LAKE AND NEWARK ELECTRIC RAILWAY.—INTERIOR OF SUB-STATION AT HIBERNIA.

The rolling stock of the road is of the latest designs in car building and consists of 16 passenger cars, each with toilet room, smoking apartment and water cooler and some with baggage apartments. They are all handsomely upholstered and as finely finished as the parlor cars on a steam road. In detail they are as follows: Four 50-foot Barney & Smith coaches, each equipped with B. and G. trucks, four General Electric 73 (75 horsepower) motors and controllers, Christensen compressor and double-air chambers, Providence fenders and electric headlights; four 62-foot B. & S. combination baggage and passenger cars, with similar equipment; one 60-foot B. & S. parlor car with same equipment, with rich mahogany finish and vestibuled observation platform; five 60-foot Jewett convertible passenger cars, three equipped with two G. E. 73 (75 horsepower) motors each, and the other two to be used as trailers; two 60-foot express cars, each with four G. E. 73 (75 horsepower) motors, with parallel control, and one single-truck snow plow ordered. With this equipment the company is able to handle an enormous passenger business, as well as a good express and freight traffic.

This company now owns the city lines at Newark and the line from Newark to Granville, seven miles, one of the first electric lines built in the state to connect two towns. This latter is to be entirely rebuilt and laid with heavy rails. In all there is 15 miles of the line, and the Jewett Car Works is building four handsome new cars especially for city service. Granville has a population of 3,000 people and is the seat of Dennison University.

Preparations are rapidly being made for the extension of this line from Newark to Zanesville, although this will be done under another corporate name, but with the same persons interested. The right-of-way through the country has all been secured and the surveys completed. Only a few days ago A. E. Appleyard was in Zanesville making arrangements to secure a franchise in that city, with very satisfactory progress reported. This, it is said, will complete the franchise matter, and they will be ready for the construction work. Zanesville is a very prosperous manufacturing town of 35,000 inhabitants and will make an excellent eastern terminus for the Appleyard system. The construction work on this line will be fully up to the standard of the Columbus-Newark road, and through trains will be run when it is completed.

The Columbus, Buckeye Lake and Newark is an Appleyard road, and J. R. Harrigan is the general manager. He is a comparatively young man and yet he has had large experience in the management of electric railways. His most valuable schooling was with the Chippewa Valley electric road, which he took hold of as a mule line, doing an unprofitable business, and left as a fully equipped electric road making money. For a year he was manager of the Dayton, Springfield and Urbana road, and last March he assumed his present position, completing the road and putting it in operation.

The road is operated in a very systematic order and with the precision that governs the running of railroad trains. A rate of about 1½ cents a mile is charged, the rate between Newark and Columbus being 60 cents one way and $1 for a round trip. In addition, the Appleyard roads issue 500 and 1,000-mile books, good over the Columbus, Buckeye Lake and Newark, the Columbus, London and Springfield, Dayton, Springfield and Urbana, Dayton and Lebanon, the Columbus and the Grove City and Southwestern roads. These books will ultimately be good over other lines, either proposed or under construction. The books sell for $6.25 and $12.50, respectively, or at the rate of 1¼ cents per mile. They are made out in the name of the purchaser, but the coupons are accepted from anyone presenting them.

Institute Branch in Cincinnati.

A local branch of the American Institute of Electrical Engineers has been formed at Cincinnati. The movement was inaugurated by F. G. Bolles and the first meeting was held in the officers' dining-room at the works of the Bullock Electric Manufacturing Company on Wednesday evening, December 17th. Eleven members were present, and after forming a temporary organization and discussing the different phases of the subject for some time, R. T. E. Lozier was elected chairman and L. E. Bogen secretary of the permanent organization. It is the intention to discuss papers presented at the New York meeting, as this will be feasible, owing to the fact that the local meeting will be about three weeks later than the one held in New York.

Mr. Bolles handed in 10 new applications for membership and stated that at least 10 more would probably be secured before January 12th, the date of the next Cincinnati meeting.

The new Aurora (Ill.), Rockford and De Kalb railway recently paid the city treasurer of Aurora $10,000, which is the amount due the city for the trolley company's franchise, granted last May. This is the first time that a cash consideration for a franchise has ever been obtained by the town.

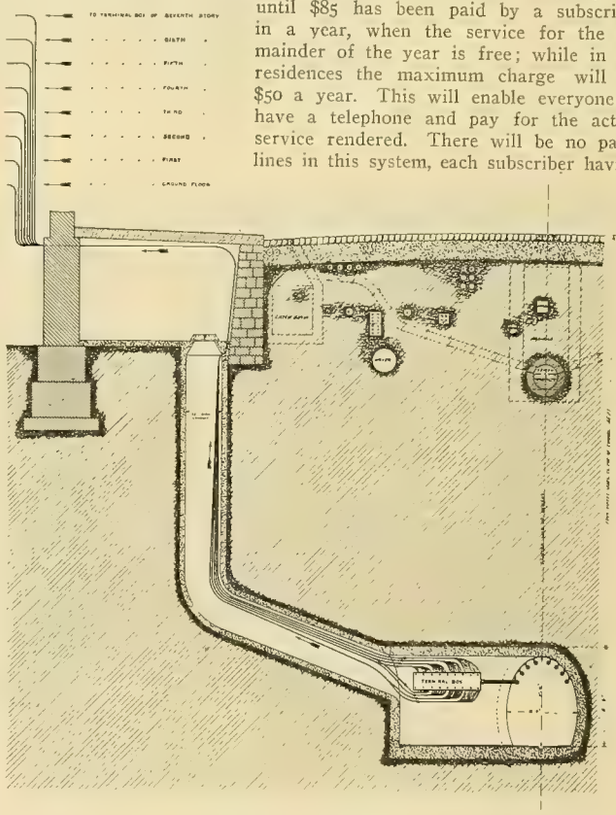
Progress on Telephone Tunnels in Chicago.

The work on the telephone tunnels, building under the streets of Chicago by the Illinois Telephone and Telegraph Company, steadily progresses. The most recent development in that enterprise is a petition by the company asking the city for permission to extend the tunnels to and throughout a large section of the West Side. The petition brought up an interesting point of law, and, says Commissioner of Public Works Blocki, will have to be decided before the city will grant the telephone company any further rights. It is the question as to whether a telephone tunnel is a conduit or not. On this account the West Side petition is, for the present, held in abeyance.

The most recent exposition of what the telephone company has been doing is given in the following extract from an address delivered before the Chicago Academy of Sciences by the company's operating engineer, George W. Jackson: "The Illinois Telephone and Telegraph Company has constructed 14 miles of tunnel under the streets of the business section of Chicago to carry its telephone and telegraph wires. Its plan is to give to the people of Chicago an automatic telephone system at the lowest possible cost. We intend to place in every office, business establishment and residence one or more of our telephones connected with a meter which will accurately register the amount of the service furnished, on the same principle as the gas meter registers the gas used by the consumer.

"The magnitude of this company's exchange will be better realized when it is understood that there are about 150,000 gas meters in Chicago. It costs as much to install a gas meter on the premises as to install a telephone, and there certainly is a demand for a telephone wherever a gas meter is used. Many more telephones would be used if the cost to the subscriber were made low enough.

"The value of the telephone is in the number of subscribers and the efficiency of the service. This company realizes this fact, and will therefore place its telephones with its subscribers the same as the gas company places its meters, making no charge and asking no guarantee from the subscribers, except to pay the company five cents for each outgoing call until $85 has been paid by a subscriber in a year, when the service for the remainder of the year is free; while in the residences the maximum charge will be $50 a year. This will enable everyone to have a telephone and pay for the actual service rendered. There will be no party lines in this system, each subscriber having a metallic-circuit telephone connected with an automatic switchboard.



TELEPHONE TUNNELS IN CHICAGO.—CROSS-SECTION SHOWING CONNECTIONS WITH BUILDINGS.

"It is our intention to bring 200 pairs of cables from the switchboard to a point accessible to the cable and wire shafts built in the different buildings for the purpose of placing wires and cables for the accommodation of the tenants. At this point, a three-foot sub-conduit lateral [shown in the accompanying illustration] will be built, running from the six feet by seven feet six inches lateral conduit to the space between the area wall and the building.

The sub-conduit will be constructed to about 18 inches above the surface of the basement floor, a sealed cover being placed over the conduit. In this three-foot conduit it is our intention to carry a system of 25 or 50 pairs of separate lead-covered cables. These separate 25 and 50 pairs of cables are to run to each floor of the building. From the cables, the wiring for the telephones will be done. With a system of this kind the likelihood of a telephone being out of service for any length of time is reduced to the minimum, as any trouble which might occur in the wiring or cable system would be readily detected. Also by wiring the buildings in the manner described, we are providing for the future growth, thereby preventing unnecessary annoyance to tenants and owners of buildings.

"There is one other annoyance that the public will be saved by our system, and that is the continual tearing up of our streets. This will be beneficial to the public as well as the company, saving a large outlay for maintenance after the conduit system is constructed. This same principle will be carried out in the entire exchange, and a sufficient number of cables will be put in so that the future needs of the system can be met without unnecessary expense or delay."

Third-rail Contact as Affected by Sleet and Ice.

Recent snow and sleet storms in New York city precipitated the Manhattan Railway Company into all kinds of difficulties with its newly installed third-rail system on the elevated roads. Owing to the company's inability or neglect to equip its cars with proper apparatus for keeping the third rail free from ice and snow, its elevated system was, practically speaking, put out of business for a considerable number of hours. The possibility of such interruption of service has raised the question whether some practicable method is not at hand to guarantee at all times and under all conditions of weather, a sure and thoroughly good contact with the third rail. Seeking an answer for this important question, a representative of the Western Electrician consulted officers of the different elevated electric-railway systems of Chicago with the results given.

Mr. H. M. Brinkerhoff, manager of the Metropolitan West Side Elevated Railway Company, said: "Yes; we did have trouble with our third-rail contact, but that is a thing of the past for us now. We feel absolutely certain that no sleet or rainstorm, no matter how severe, can tie up our system. Our scheme employs four steel brushes to a truck, or eight to a car. These brushes are made of steel

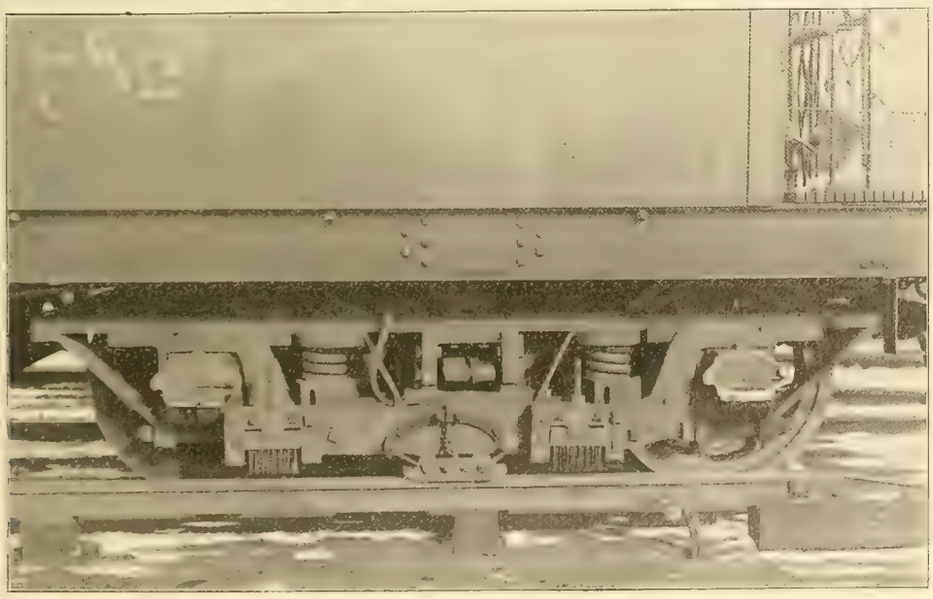


FIG. 1. THIRD RAIL CONTACT SHOE AND STEEL BRUSHES USED ON METROPOLITAN WEST SIDE ROAD IN CHICAGO.

'bristles' and will stand a heavy pressure without becoming damaged. Each contact shoe is protected by two of these brushes, one placed in front of it and one behind it. [This arrangement is shown in Fig. 1.] The motorman or conductor on a car can lower as many of the brushes as he pleases, depending upon the necessity of the occasion. One, two, three or four may be brought into service, and if all four fail in producing the desired affect, a hand scraper is put into service which cannot fail."

This handscraper, as described by Mr. Brinkerhoff, has a long handle, so that it may be operated from the moving car. Each car carries one of these scrapers at all times. A man stands on the front of the car and holds the scraper in contact with the third rail just in front of the contact shoe. Mr. Brinkerhoff positively asserts that there is no coating of ice so hard that this scraper will not thoroughly remove it. In speaking of the hand scraper, he said that it's services had not been required during the last three years, as it was only under the most adverse circumstances that the brushes would fail to take care of the contact.

When asked concerning the most difficult ice to be removed from a rail, the manager of the Metropolitan company described the following conditions: "Suppose," said he, "we have had a night of cold weather, with the temperature down to 18 or 19 degrees above zero, perhaps, and the third rail and all surrounding material has become thoroughly chilled and frosted. Now, suppose that toward morning the weather warms up to about freezing and a rain sets in. The instant the rain strikes the third rail, it is frozen into a solid 'enamel-like' ice, and no steel brush made will remove it thoroughly enough to insure good contact. Then it becomes necessary to resort to the hand scrapers. Don't mistake me, however, and infer that we could not continue service without the hand-scraper. We could do so, but it would not be profitable or satisfactory."

A question was then asked concerning the use of oil, as proposed by the Manhattan Railway Company. Mr. Brinkerhoff spoke as follows: "Yes; we tried oil, and it is fairly successful when one is dealing with sleet, providing the approach of a sleet storm is accurately and positively foretold. On the other hand, if we covered our third rail with oil and the storm did not favor us with its presence, we discovered that Chicago's dust would take its place, and as a result, the contact rail and shoe were soon covered with a gummy paste which acted as bad, if not worse, than ice. A continual sputtering occurred and holes were burned in both the shoe and rail. For this reason we abandoned the use of oil, and I imagine the Manhattan will have to do so likewise."

Garrett T. Seely, engineer of maintenance of way for the South Side Elevated Railroad Company, gave the following in regard to the third-rail problem: "We use steel brushes, the steel bristles being three to four inches long. Four of these brushes are placed on the two trucks of each car, so that the two contact shoes on one side of the car are between the brushes. In this way a contact shoe is always preceded by a rail cleaner. This scheme works all right under ordinary circumstances but fails when a severe test is put upon it such as would result from a heavy sleet storm. I am considerably in doubt as to whether any apparatus has been devised so far that will insure a good and sure contact, under all conditions of weather. Mr. Hopkins (general manager of the company) remarked to me the other day, that if I could invent a successful apparatus for clearing the third rail of sleet and ice, my fortune would be made. Judging from this remark, I take it he is of much the same opinion as myself concerning the existence of an absolutely sure rail cleaner. We have not been in very much trouble but once in the last two years, and that was one day last winter. A heavy sleet storm had continued all night, and the next morning we found quite a bit of difficulty in getting our trains out of the yards. Salt was brought into service and helped us considerably. Once on the road we found no difficulty in keeping the rail fairly well cleared on account of the frequency of the trains."

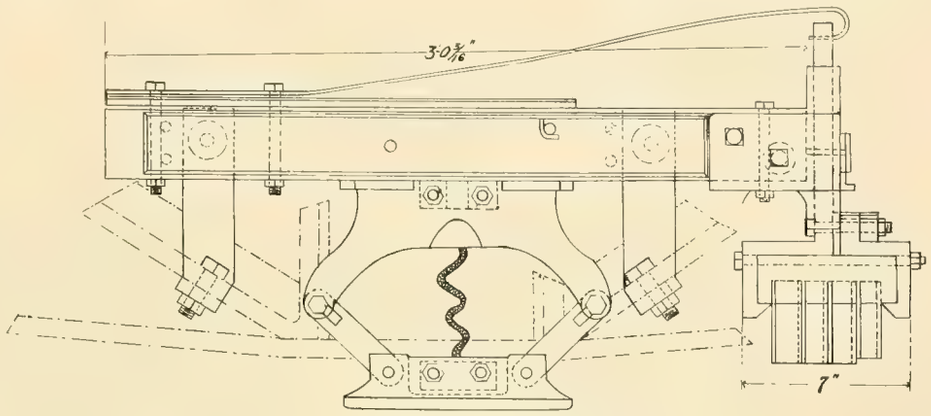


FIG 2. HEDLEY THIRD-RAIL SCRAPER.

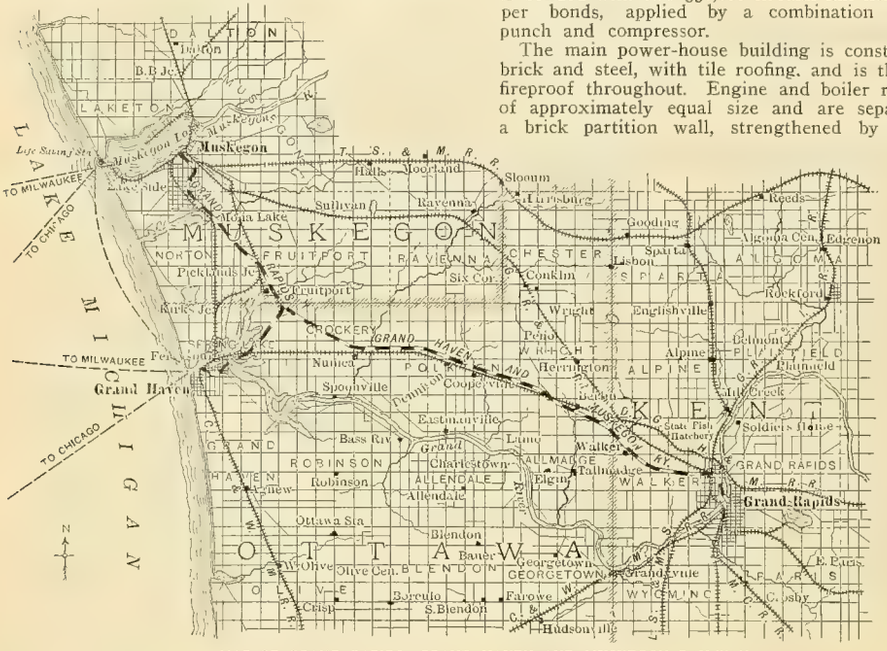
After having heard the remarks made by Mr. Seely, it was with considerable curiosity that the opinion of Frank Hedley, general superintendent of the Northwestern Elevated Railroad Company, and of the Lake Street Railroad Company, was sought. When asked whether his roads would be interfered with by a heavy sleet storm, Mr. Hedley gave the following answer: "No, sir; not by the worst sleet storm that Chicago or any other city ever saw. I will positively state that we can keep our cars in operation, and on schedule time, through any kind of a storm. Further, we do not employ any hand scrapers at all. Our apparatus is entirely automatic, and it keeps the third rail entirely clear of all ice, sleet or snow. The Western Electrician described my patent last May, hence I need not give you any detailed account of its method of operation. The apparatus has successfully taken the Lake Street system through three winters already and the Northwestern through two. On that account, I feel not the slightest hesitancy in making so positive an assertion, for I know that the apparatus will bear it out."

The scraper which Mr. Hedley referred to is shown in Fig. 2. As he says, this apparatus was described last May by the Western Electrician, but, for the purpose of the present discussion, the following details are given here: The scraper is made up of steel plates set into a steel block. These plates are set vertically, as shown in the cut, but they are turned at an angle in the vertical plane, so as to more easily remove obstructions from the rail; that is, the flat surfaces of the plates do not set perpendicular to the direction of motion. The scraper is self-regulating and automatic in its operation, and in its normal position rides upon the third rail. It may be raised, however, at the discretion of the motorman. The scraper is pressed down upon the rail by means of a long spring, as may be seen in the cut. This spring allows the scraper to accommodate itself to any unevenness in the rail. When one set of plates has worn away, the block can be easily and quickly removed and a new one put in its place. The patent on this scraper was granted to Frank Hedley on February 25, 1902.

The above opinions give one a pretty clear idea of the situation in Chicago, where the third-rail system was first put into operation on elevated railroads. Mr. Hedley and Mr. Brinkerhoff have both had much experience in this particular work. Mr. Seely has only been connected with electric railway work for a year, and his opinion was based more particularly on Mr. Hopkins' views and on what had been done on the South Side system since he accepted his position with that company.

Grand Rapids, Grand Haven and Muskegon Railway.

One of the recently completed interurban electric railways in the West is the Grand Rapids, Grand Haven and Muskegon Railway. This road is representative of high-grade construction, embodying the results of much valuable experience obtained during the course of the construction of similar railway properties. The main line is approximately 35 miles in length, and extends from Grand Rapids, the western metropolis of Michigan, to Muskegon, a thriving manufacturing city of 30,000 inhabitants,



MAP OF GRAND RAPIDS, GRAND HAVEN AND MUSKEGON RAILWAY.

situated on the shores of Muskegon Lake and Lake Michigan. A branch line extends eight miles in a southwesterly direction, connecting Grand Haven Junction, on the main line, with the summer resort at Spring Lake and with Ferrysburg and Grand Haven. The latter is a manufacturing city of 5,000 inhabitants, located near the lake shore, and both Grand Haven and Spring Lake are excellent locations for summer residences.

The railway closely approximates the steam railroad, both in territory served and quality of equipment. The road was designed for passenger, express and local freight business. Not the least important item in the acquisition of a passenger business is the improvements which have been undertaken for the purpose of converting Spring Lake into a desirable summer resort. Although the cars of this road will stop at any convenient location for passengers, it has been the endeavor to localize passenger and freight business as far as possible, and to this end nine stations have been erected along the line of the route. These are combination passenger and freight stations, with the exception of those at Walker and Coopersville, which have an independent compartment for the reception of substation machinery.

The permanent way has been located with exceptional care, avoiding all severe grades and sharp curves, and provides a route between the main termini more direct, by one and 17 miles, respectively, than those afforded by the two existing steam roads. No attempt has been made to follow the highways, and the road operates upon a private right-of-way for the entire distance, with the exception of short stretches through some of the larger towns, where the highway is traversed. The main line is single track throughout and sectioned by frequent turnouts. The track proper is constructed of 70-pound standard T-rail, double-bonded, standard cedar ties and gravel ballast. Spring frogs and long-point switches are provided at all turnouts, which are all of the single-curve or through-line type. Grade crossings have been avoided, and all railroad tracks are spanned by steel bridges of special design. The earthwork bridge approaches are extended for some distance back, for the purpose of securing an easy grade for the interurban cars.

Not the least interesting feature of this road is the employment of the third rail instead of the trolley or overhead system of distribution. Through several towns and cities, where third-rail crossings are impracticable, short sections of overhead have been erected, but, outside of termini, these aggregate less than 2,500 feet in length. The third rail used is 65-pound standard T section, and is mounted upon reconstructed granite insulators. These are bolted to every fifth tie, which is of extra length for this purpose. The rail tread is approximately six inches above and 19 inches distant from the outer rail. At all highway intersections the crossing is protected by cattle-guards and the third rail is broken, suitable wood approach blocks being attached to the free ends, to allow passing contact shoes to regain their bearings without undue shock. The two sections of the third rail are connected by two 250,000-circular-mil copper cables, securely bound to the rail web and carried beneath the crossing in a creosoted wood-pipe conduit filled with pitch. This method of insulating the third rail has proven entirely satisfactory, and the leakage therefrom during wet weather is unnoticeable. The bonds used on the track rails are crimped copper-web bonds with solid heads expanded into a reamed hole by a screw compressor, and are entirely concealed underneath the splice plates, two bonds being provided at each joint, in order to avoid pinching by the splice bar. The third rail is bonded with two 350,000-circular-mil flexible copper bonds, applied by a combination hydraulic punch and compressor.

The main power-house building is constructed of brick and steel, with tile roofing, and is thoroughly fireproof throughout. Engine and boiler rooms are of approximately equal size and are separated by a brick partition wall, strengthened by pilasters. The boiler room is provided with a monitor and skylights for purposes of light and ventilation, which, in the engine room, are accomplished by skylights and ventilating hoods in the roof. Floors are entirely of concrete, that of the engine room being arched between supporting beams to provide for a basement for the accommodation of cable work and pumps of the condensing system. Coal is brought in upon an elevated coal siding paralleling the boiler room. The tracks are mounted upon a masonry and steel supporting structure, beneath which are concrete-lined storage bins of 500 tons' capacity. These bins are accessible from the boiler room through openings in the wall directly opposite each stoker.

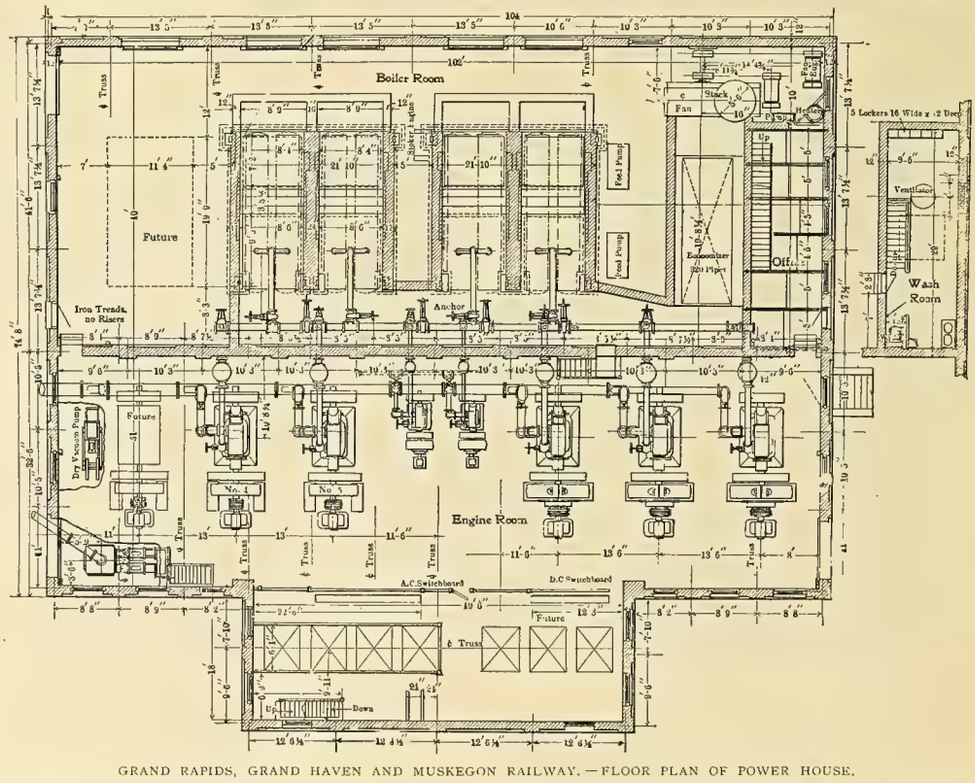
Four 250-horsepower vertical-header Babcock & Wilcox water-tube boilers furnish the steam supply of the plant, at a pressure of 160 pounds, provision having been made for a future battery. The boilers are fitted with Roney mechanical stokers, which are driven by small Westinghouse standard engines located between the boilers, and are supplied with coal by direct shoveling from the storage bins. The waste gases discharge into a brick and steel flue in the rear of the boilers, thence successively through an improved circulating-type economizer, vertical tandem exhaust fans, uptake and a short steel stack, extending about 15 feet above the roof.

Provision has been made in the engine room for six 250-kilowatt main generating units, of which five have already been installed. These units consist of 18 and 30 by 16-inch Westinghouse vertical-compound condensing engines, direct-connected to 250-kilowatt Westinghouse generators, two of which are 390-volt, three-phase alternators and the remaining three double-current machines, furnishing both 650 volts direct and 390 volts alternating current. The grouping of the machines places three units of each kind on each side of the center of the engine room, where are located two 37½-kilowatt exciters, direct-connected to Westinghouse compound engines, running upon the condensing systems.

The electrical equipment other than the generators is entirely contained in a fireproof wing, adjoining the engine room and symmetrical about its transverse center line. In the opening provided by the absence of the dividing wall are located the two main switchboards, which are placed directly upon the wall line, thus preserving the rectangular shape of the engine room. Behind the switchboards is installed all high-tension apparatus. In the basement is the transformer vault, which will eventually contain seven 400-kilowatt Westinghouse oil-cooled transformers, four of which are at present installed, one as a reserve only. These are delta-connected and raise the bus pressure of 390 volts to a line pressure of 16,600 volts for transmission. On the first floor of the transformer room is located the entire high-tension switching apparatus. The high-tension switches are of the Westinghouse pole-fuse type, and are operated from a low wooden insulating platform for security against accidental shock. Above these switches is the lightning protective apparatus, mounted upon heavy marble panels and connected with static interrupters upon the main floor. The transmission wires lead directly from these panels through heavy glass insulating wall tubes to an anchorage outside of, and secured to, the wall and thence to the line. All connections between transformers, switches and arresters are of lead-covered cable, with heavy rubber insulation.

The low-tension board is divided into alternating-current and direct-current sections, erected upon either side of the center line of the transformer wing. One board contains 550-volt direct-current apparatus only, and controls the direct-current side of the double-current generators, the 125-volt exciters and the local feeders, while the other board controls the alternating-current machinery and transformer primaries. The boards are of Westinghouse design and embody the latest types of indicating and recording meters, quick-break switches, circuit-breakers, time-limit relays and synchronizing apparatus. The generating machinery operates in parallel, the units being synchronized by the control of the engine throttle and the indications of a round-dial synchroscope. A complete system of compressed-air piping and storage tanks provides four 62-foot B. and S. combination baggage and B. and S. parlor car; same equipment, with rich efficient means for cleaning the electrical apparatus.

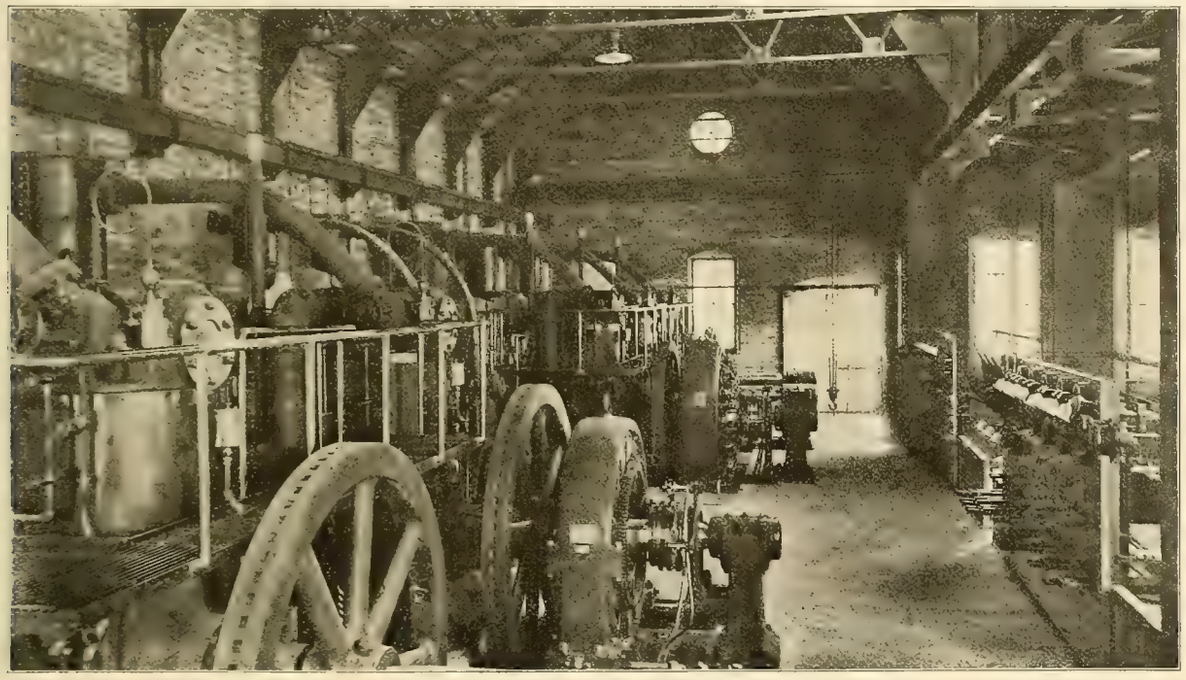
The distribution system is supplied with power from three points, viz., the main station and the two



GRAND RAPIDS, GRAND HAVEN AND MUSKEGON RAILWAY.—FLOOR PLAN OF POWER HOUSE.

sub-stations. The district near the power house is supplied from the direct-current side of the double-current generators, while the sub-station rotaries feed the remainder of the line.

The two sub-stations at Coopersville and Walker are, respectively, 12 and 22 miles distant from the power station at Fruitport. They are combination passenger, freight and sub-stations, and are constructed and equipped along the same general lines as the power station. Each station is provided with a fireproof high-tension tower, in which is isolated all high-tension apparatus in the same consecutive arrangement as that employed at the main station. This arrangement evidently permits the use of a much lower building than would otherwise be possible, and adds largely to its attractiveness. Fifteen thousand-volt current is led into the sub-station towers from the transmission line through heavy glass wall tubes to the high-tension fuse switches, which are mounted upon the wall of the tower, within easy reach of an operator standing upon the elevated high-tension gallery. The current then passes through openings in the concrete floor to a bank of bayonet switches, thence continuing to the transformers resting on the ground floor of the station. The bayonet switches were provided for the purpose of isolating a defective or damaged transformer. The employment of the delta connection of transformers admits of this without



GRAND RAPIDS, GRAND HAVEN AND MUSKEGON RAILWAY.—INTERIOR OF ENGINE ROOM.

disturbing the operation or phase relation of the line, the remaining two transformers being able to carry the increased load for a limited period. Lightning protection is identical with that of the main station and is completely isolated inside the high-tension tower. Each sub-station equipment comprises two 250-kilowatt rotaries, with starting motors, three 200-kilowatt, oil-cooled lowering transformers and a six-panel white marble switchboard.

As in all work of this character and magnitude, the train sheet has been the basis of all determinations for locations of stations, power equipment and line conductors. Owing to the use of the third rail for the major part of the distance, no extra copper feeders were necessary, the rail having ample cross-section to carry the entire current. Where bracket or span-wire overhead construction was necessary, 500,000-circular-mil aerial feeders and No. 0000 B. & S. hard-drawn grooved trolley wires were provided.

The main transmission line is carried upon 30-foot cedar poles, set six to seven feet in the ground, and is provided with a single-braced crossarm, which supports two of the three wires. The third wire, forming the apex of an equilateral triangle, 28 inches upon a side, is supported by a special "ridge-iron" pin, mounted upon the pole top. Proper line insulation is secured by five-inch umbrella-type porcelain insulators. All poles carrying both trolley and high-tension wires are five feet longer than the regular 30-foot high-tension poles, in order to prevent possible contact of the trolley with a live high-tension circuit. Brackets are constructed of two-inch steel pipe, with malleable fittings, upper truss rod and steel span wire carrying a single "round-top" straight-line hanger.

The telephone system has been installed with the greatest care and embodies the most substantial construction. In the open country, telephone wires are carried at a height of 14 feet upon a line of 20-foot poles, where no transmission line runs, and upon the high-tension pole line within the transmission district. The circuit is metallic, of No. 8 B. & S. hard-drawn copper, and at all sidings taps are brought down to waterproof jacks, conveniently located upon the pole for purposes of telephonic connection. Interference from alternating-current induction, in both high-tension and telephone lines, is prevented by transposition of leads at regular intervals, and lightning protection is all concentrated at the stations, none being applied along the line of route on account of the difficulty of maintenance.

The rolling stock comprises 15 52-foot Barney & Smith passenger coaches, three 40-foot express cars and one construction car, furnished with tools, snow-plow and a motor-driven winch. The passenger cars contain 28 double, non-reversible seats, upholstered in red plush, and are finished in white oak and holly, with plate-glass windows, doorlights and bulkheads. A smoking compartment is provided in the front part of the car, which is ventilated by a suction draft induced during motion of the car by the curvature of the front vestibule. Electric heaters are provided throughout. A complete telephone set on every car enables the conductor to obtain instant communication with the despatching station by means of flexible cord and plug which fits into the telephone jacks located at all sidings and stations. Special pole connections are also provided on all cars, so that in the event of accident or disablement at any point on the line, telephonic communication with the despatcher may be had at once from the car.

Passenger cars are equipped with two 150-horse-power Westinghouse No. 50-C. motors, both applied to the rear truck by Gibbs' suspension. Trucks are of the M. C. B. type, built by the Baldwin Locomotive Works, and driving wheels are steel-tired, while those of the leading truck are spoked wheels with chilled treads. Express cars are similarly equipped with two Westinghouse No. 76 motors. The construction car has one No. 76 motor per axle, aggregating 300 horsepower in addition to the winch motor. This equipment enables the car to make emergency runs and perform all kinds of heavy duty such as wrecking, hauling gravel cars, pile-driving and snow-plow work.

All cars are equipped with Westinghouse air brakes, supplied by type-D motor-driven, reciprocating air compressors, placed under the car body and controlled from the vestibule.

Cars are dispatched by telephone from a station located at Fruitport. They operate at an average cross-country speed of 35 miles per hour, with a headway of 30 minutes. Lay-overs of six to 10 minutes at termini and car barns are provided in the schedule, allowing ample time for making reports, inspecting wheels and journals, filling sand boxes, etc. Express service is as yet seriously delayed by the lack of terminal facilities, but it is expected that regular express service will be started in the near future.

The Grand Rapids, Grand Haven and Muskegon commenced operation in the early part of the year and has been uniformly successful in establishing a permanent and lucrative traffic throughout its territory. Although greatly handicapped by the lack of suitable terminal stations, the road at once placed itself upon a dividend-paying basis, thus demonstrating the wisdom of thorough construction. The road was located, designed and constructed throughout by Westinghouse, Church, Kerr & Co., and represents their latest practice in the railway field.

The Elgin, Aurora and Southern Traction Company's books show the following figures for the month of November: Total gross earnings, $33,542; net earnings, $12,469; net income available for dividends, $4,135.

American Association and Physical Society Meetings.

The annual meetings of the American Association for the Advancement of Science and of the American Physical Society will be held jointly in Washington, D. C., from December 29th to January 3d. Sessions of Section B, Physics, of the American Association, will begin on the opening day. On Wednesday, December 31st, the annual business meeting of the American Physical Society will be held, and on that day the programme will consist of papers from members of this society. The meetings will be held in the chemical lecture room of the main building of Columbian University. The headquarters of the American Association will be at The Arlington. Special railroad rates are offered, and a large and successful meeting is anticipated. Dayton C. Miller of the Case School of Applied Science, Cleveland, Ohio, is secretary of Section B of the American Association, and Ernest Merritt of Cornell University, Ithaca, N. Y., is secretary of the American Physical Society.

An advance list of papers to be read shows nearly 50 titles, and this will probably be added to. Among the papers the following are noted: "The Construction of a Sensitive Galvanometer," by C. G. Abbott, Smithsonian Institution, with an introduction by S. P. Langley, Smithsonian Institution; "Results of Comparisons of Magnetic Instruments," by L. A. Bauer, United States Coast and Geodetic Survey; "The Condition Governing the Coherence of Metals When There Is an Electrical Discharge Between Them," by Carl Kinsley, University of Chicago; "A Determination of the Frequency of Alternating Currents by the Automatic Adjustment of the Circuit to Resonance," by Carl Kinsley, University of Chicago; "On Methods of Measuring Radiant Efficiency," by E. L. Nichols and W. W. Coblentz, Cornell University; "The Infra-red Spectrum of the Mercury Arc," by W. C. Geer and W. W. Coblentz, Cornell University; "A High-tension Electrical Coil," by G. Lenox Curtis, New York city; "Experiments Concerning Very Brief Electrical Contacts," by Herschell C. Parker, Columbia University; "The Magnetic and Electric Deviation of the Easily Absorbed Rays from Radium," by E. Rutherford, McGill University; (Title to be announced), by R. H. Thurston, Cornell University; "Induced Radio-activity Excited at the Foot of Waterfalls," by J. C. McLennan, Toronto University; "Radio-activity of Freshly Fallen Snow," by S. J. Allen; "The Damped Ballistic Galvanometer," by O. M. Stewart, University of Missouri; "On the Electrical Conductivity of Solutions in Amyl Amine," by Louis Kahlenberg, University of Wisconsin; "Relations Between Science and the Patent System," by Charles K. Wead, United States Patent Office; "Why Does the E. M. F. of a Daniell Cell Change When the Density of the Solutions Change?" by Henry S. Carhart, University of Michigan; "Absolute Measurement of the E. M. F. of the Cadmium Cell," by Henry S. Carhart and Karl E. Guthe, University of Michigan; "On the Double Refraction of Dielectrics in a Magnetic Field in a Direction at Right Angles to the Lines of Force," by D. B. Brace, University of Nebraska; "A Lecture Room Method of Analysing Irregular Electric Currents," by W. J. Humphreys, University of Virginia; "A Note on Arc and Spark Spectra," by Charles E. St. John, Oberlin College.

Two City Electricians Wanted.

Under date of December 16th a Canadian correspondent of the Western Electrician writes: "The city of Toronto is about to appoint a first-class electrical engineer at a good salary, whose duty it shall be to look after all the electrical companies operating in the city. This is being done on the recommendation of City Engineer Rust."

Alderman Woodson of the Kansas City (Mo.) Common Council has prepared an ordinance, to be submitted to the council, which provides for appointment by the mayor of a city electrician, whose duty it shall be to inspect and pass on all wiring done in the city. The position is to pay $2,000 a year and an additional amount of $1,000 is to be allowed as salary for an assistant who shall be chosen by the city electrician himself. The same ordinance fixes the fees to be charged for inspection as follows. Arc lamps, $1; electric motors, $1; incandescent lamps, one to 10, $1; incandescent lamps, 11 to 25, $1.50; incandescent lamps, 26 to 50, $2; incandescent lamps, 51 to 100, $3; each additional 100 or part of 100, $3. A special committee has passed favorably on the ordinance.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:

510 Marquette Building, - CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Columbus, Buckeye Lake and Newark Electric Railway. By O. M. Carter. Illustrated 457, 458
Institute Branch in Cincinnati 458
Progress on Telephone Tunnels in Chicago. Illustrated. 458, 459
Third-rail Contact as Affected by Sleet and Ice. Illustrated. 459
Grand Rapids, Grand Haven and Muskegon Railway. Illustrated 460, 461
American Association and Physical Society Meetings 461
Two City Electricians Wanted 461
Editorial 462
Braking and Traction Brakes. (American Institute of Electrical Engineers.) 463, 464, 465
Some Brake Tests and Deductions Therefrom. By J. D. Keiley. Illustrated. With Discussion 463, 464, 465
Railroad Car Braking. By R. A. Parke. Illustrated. With Discussion 464, 465
Important if True 465
Frank Hedley Appointed General Superintendent of New York Rapid Transit System. Portrait 465
Development of the Telephone Field. Illustrated 466, 467
New Telephone Patents. Illustrated 466
Telephone Controversy in St. Petersburg 466
Nebraska Independent Telephone Association 466
Cumberland Service Near Evansville 466
Telephone News from the Northwest 466
Ohio Telephone Notes 466
Indiana Telephone Items 466, 467
Michigan Telephone News 467
Southern Telephone Developments 467
New Telephone Ringer 467
General Telephone News 467
New Companies 467
Telephone Men 467
Manufacturers and Dealers 467
Weston Instrument Patents Upheld 467
American Capitalists Plan Lighting System for Paris 467
Space Telegraphy 468
Marconi Sends Messages Across the Atlantic Successfully. 468
Collins' Lecture 468
Developments of De Forest-Smythe System 468
Stone Space-telegraph Patents 468
Globe Direct-current Enclosed-arc Lamp. Illustrated 468
Transportation Building at St. Louis Exposition 468
New Electric-railway Systems. Illustrated 469
Technology School for University of Chicago 470
Consideration of Chicago Municipal-ownership Report Postponed 470
Allgemeine-Union Combination in Germany 470
Book Table.—Bauer's "Magnetic Declination Tables" 470

DEPARTMENTS.

Correspondence 470, 471, 472
New York Notes 470
New England News 470
Southern Developments 470, 471
Detroit, Michigan 471
From the Buckeye State 471
Information from Indiana 471
Northwestern Notations 471
Canadian Intelligence 471, 472
Personal 472
Electric Lighting 472
Electric Railways 472
Power Transmission 472
Societies and Schools 472
Publications 472
Miscellaneous 472, 473
Trade News 473
Business 473
Illustrated Electrical Patent Record 473, 474

DATES AHEAD.

Master mechanics of street-railway companies (meeting for organization), Cleveland, O., January 12, 1903.

Northwestern Electrical Association, Pfister House, Milwaukee, Wis., January 21, 22 and 23 1903.

CHARLES LAMB, in one of his essays, written in the leisurely days of sailing ships, descants in his whimsical fashion on his Now as contrasted with the Now of a correspondent at the Antipodes. Similarly, an editor sometimes experiences regret that his Now anticipates by a space of time varying from a few hours to several days, or weeks perhaps, the Now of the reader. Thus, on the eve of Christendom's great holiday, the desire is strong within us to wish every reader of the Western Electrician a very Merry Christmas, but when these lines are published Christmas will have passed and wishes in relation to it will be in vain. However, there is still ample time to express the hope that all and singular to whom these presents may come may enjoy a Happy New Year, and this we do with a right good will.

Now that the Chicago City Council has the proposed municipal-ownership law in relation to street railways before it, the actions of that body seem to indicate that it does not know what to do next. The subject came up for discussion at the meeting held on Monday of this week. Several substitutes for or amendments to the proposed statute submitted by Alderman Finn's committee were offered, showing that the aldermen were not very enthusiastic over the measure as a whole, although no member of the council had the courage to arise in his place and combat public ownership on principle. Finally, after considerable discussion, further consideration of the subject was deferred until the next meeting, to be held on January 5th. After the vote in favor of municipal ownership at last spring's election in Chicago, it is probable that the aldermen will recommend to the Legislature the passage of the bill providing for the municipal ownership of street railways and possibly of gas and electric-light plants also, but just what form the proposed bill or bills will finally take, and the subsequent action of the Legislature, are matters for conjecture.

FEW more important subjects can engage the attetion of the electric-railway manager than that of braking. With the steady increase in size and weight of motor cars and the great extension of interurban electric railways, it is obvious that the necessity of providing means of keeping the cars under perfect control has grown in corresponding ratio. The American Institute of Electrical Engineers has done well, therefore, to devote a meeting to the discussion of this vital topic. As will be seen by the comprehensive abstract of the proceedings of the meeting in New York last week, presented elsewhere in this issue, two excellent papers were presented. One, written by Mr. J. D. Keiley of Brooklyn, described brake tests on electric cars and gave deductions therefrom, with comparison curves and tables. The other paper was read by Mr. R. A. Parke of Pittsburg and was more fundamental in character, going over the whole subject of railroad-car braking and ending with a brief description of the new, yet old, magnetic brake. These papers brought out a valuable discussion, and the whole forms a useful addition to technical literature. The Institute is deserving of all praise in disseminating knowledge of this useful and timely character.

A STRIKING diversity of opinion is shown to exist among managers and engineers of elevated electric railways in relation to the problem of maintaining third-rail contact in sleet storms. To a representative of the Western Electrician, who recently made some inquiries on the subject, three officers of as many elevated-railway systems in Chicago gave the views which are recorded on another page. Two of them agreed that it was possible to keep third-rail trains moving under all conditions of sleet and ice, but disagreed as to methods. The third, with a shorter term of experience in this particular kind of railroading, thought that under unusually severe conditions transportation service on elevated roads depending on contact-rail operation might be interrupted, and said that a reliable invention to keep the third rail clear of sleet and ice was greatly needed. Thus the preponderance of opinion is in favor of the practicability of steady third-rail operation in all sorts of weather; and we think that the 330,000 passengers who use the elevated roads of Chicago daily will agree that the service is good and free from serious interruptions, winter or summer. In New York, where elevated electric railways are new, much difficulty has been experienced in moving the trains in a recent sleet storm, and there has been a great public outcry; but we believe that with a little patience the traveling public of the eastern metropolis will find the electric service as satisfactory as it has been in Chicago. In this city, if a ballot were taken among the patrons of the South Side "L"—the very road whose representative was in some doubt whether sure contact could be had under all conditions of weather—we have not the slightest doubt that an overwhelming preponderance of the voters would be strenuously opposed to a return to the old steam locomotives. Experience has proved that electric power is better than steam for elevated-railway operation, from the point of view of the passenger as well as the operating company.

INVESTIGATORS in the field of pure and theoretical science have had much to say lately on the electron theory, and one of the latest contributions on this subject is made by W. Sutherland in an English journal. Mr. Sutherland has endeavored to reduce molecular attraction to the electron theory, and his efforts along this line of work are very interesting. A neutral gaseous molecule, containing a positive and a negative electron, is conceived at the outset. Such a molecule will have poles like a magnet, and will exert upon a similar molecule an attractive or a repulsive action, accordingly as unlike or like poles are nearest. However, an attraction tends to increase itself, and a repulse tends to diminish itself, and so it happens that on the whole there is more attraction than repulsion. The molecules attract each other, like magnets, with a force varying inversely as the fourth power of the distance. The author indicates that a strong contrast is shown to the law of gravitation, and the first condition of the electron theory is satisfied by the fact that molecular mass does not enter into the expression for molecular attraction. It may be considered that the two electrons of a molecule, like NaCl, when giving the line spectrum of sodium, revolve around one another in a circle of such size that centrifugal force and electric attraction are in equilibrium. They revolve perhaps entirely within the atom of sodium. The author calculates a theoretical frequency of revolution amounting to 28×10^{14} per second, which is about 10 times as large as that of the visible part of the spectrum.

MARCONI has succeeded in transmitting a wireless message across the Atlantic and is entitled to great praise for this wonderful achievement. This time it is not three dots merely, but a complete dispatch, and, from all accounts, not only one but several messages have been sent. The question that now naturally arises is, Is practicable transatlantic space telegraphy, on commercial lines, now in sight? It is evident that another great step has been taken toward the goal, but such important problems as speed, non-interference and immunity from atmospheric disturbance still remain to be disposed of. Marconi himself has said that space telegraphy is destined to supplement the ocean cables, not to supersede them. He undoubtedly knows more of the possibilities of the wireless system than any other man, but the new telegraphy may be extended far beyond his present conjectures. Certainly, it has shown a constant, if slow, development, and no one can set for it metes and bounds. On the other hand, almost everything done so far has been of an experimental nature. In every case where space telegraphy and the older method have been tried under conditions admitting of a comparison, the latter has done the better work. It may not always be thus, but so far as transatlantic wireless communication goes, the future still remains simply an interrogation point.

While the feature of transoceanic space telegraphy thus looms doubtful on the horizon, the laying of the time-tried cables is proceeding apace, as witness the operations in the Pacific. Even as we write, notice comes that the American cable between San Francisco and Honolulu will be completed on or about January 1st and operated in connection with a system of land lines in the United States. A temporary scare having subsided, cable shareholders are still undismayed.

BRAKING AND TRACTION BRAKES.

At the meeting of the American Institute of Electrical Engineers in New York on Friday evening, December 19th, the general subject for discussion was "Braking and Traction Brakes." About one hundred gentlemen were present, many of whom expressed their views on the topic of the evening. In his introductory remarks President Charles F. Scott said:

"Difficult braking problems are now being encountered in electric traction. The old hand brake of the horse car is inadequate when weights have increased tenfold, and speeds on our streets have increased three or fourfold, thereby increasing the stored energy in the car 100 times. Interurban railways, with their still heavier cars and far greater speeds, make the problem of braking quite similar to that in steam-railway service.

"In electric service in elevated and underground city railways, where stops are frequent and high-schedule speeds are essential, certain new elements have entered into the braking problem. Ordinarily, brakes are for the purpose of facilitating traffic and preventing accident. The new feature of commercial value which has come into the problem is that of quick retardation. The run from one station to the next consists in acceleration, running at a sensibly constant maximum speed, and retardation. To increase schedule speed it is important to lessen the time of retardation as well as that of acceleration. This is a new demand. It presents a new point of view in braking problems which have not previously been of importance in regular service.

"This is illustrated by the marked difference in schedule speed under average conditions, such as prevail on the elevated railways of Greater New York, between a low rate of braking and quick retardation. A change in the rate of retardation from one mile per hour per second to three miles per hour per second increases the schedule speed about 10 per cent. This effects a saving in time to the passengers of 10 per cent., and it reduces the number of trains required for carrying a given number of passengers by 10 per cent.

"We may divide the brakes in ordinary use into two classes: Hand brakes and power brakes. The latter may be again subdivided into air brakes and electric brakes. When the air brake is used on electric cars electricity is an acceptable auxiliary through the agency of the motor-driven pump.

"Electric brakes are of several general types. The motor itself may act as a brake in either of several ways. The motor may be reversed. This is a severe measure, which is seldom applied except in an emergency. The motor may be used as a dynamo for absorbing the energy of motion of the car. The power delivered by the motor or dynamo may be employed usefully by being returned to the line, of charging a storage battery on the car, or by heating rheostats which are used for heating the car, or, on the other hand, it may be wasted in heating rheostats under the car.

"Again, the current from the motor may be used for operating some form of magnetic brake. In this case the car is retarded both by the energy taken by the motor acting as a dynamo and also by the friction produced in the magnetic brake. The brake in this case may consist of two disks, one stationary and the other mounted on the car axle, or it may be track brake, in which there is friction between moving shoes and the track rail.

"Magnetic brakes may be operated independently of the motors by current obtained from the line or from a storage battery.

"These methods indicate various ways in which electricity may be used for braking and make obvious the extreme flexibility of electricity in its application to problems of this kind. The application of the braking effect in proper amount at the proper time and with a reliable method of control places very exacting requirements upon the designer of braking appliances."

Two papers were then read. Mr. Keiley, the author of the first, who is connected with the Brooklyn Rapid Transit Company, was unavoidably absent. His paper was read by W. C. Andrews. Mr. Parke, who is engineer for the Westinghouse Air Brake Company of Pittsburg, was present and read his own paper. Brief abstracts of the papers are here given.

Some Brake Tests and Deductions Therefrom.

BY J. D. KEILEY.

On account of the widely varying conditions of electric-railway operation, and of the fact that the design of equipment and track has been in a period of evolution from horse-car practice to a condition approximating heavy-railroad practice, many branches of the art, especially the subject of braking, have not been developed in the same proportion to their possibilities as has the subject of train braking with locomotive traction. It is apparent that the conditions of electric traction and the service requirements and constructions which have made desirable, and even necessary, great advances in the methods of braking, have also to some extent rendered these advances possible, and have given to investigators of the subject, as well as users of train and car brakes, a new interest and a broader field of activity.

On the braking of elevated and light interurban cars or trains the aspect of the problem has, of course, been changed from the conditions of locomotive traction—slow acceleration to comparatively low maximum speeds, and the braking of light cars with maximum passenger load equal to 60 or 70 per cent. of weight of cars—to the conditions of electric traction with distributed motors. In the latter case the motors are carried on the passenger trucks, with armatures geared directly to axles; here we find rapid acceleration to high maximum speeds, and the braking of cars with maximum passenger loads equal to but 45 or 50 per cent. of the weight of cars. The rapid acceleration and high maximum speeds with very efficient braking make possible high-schedule speeds under conditions of frequent stops. A concurrent condition, in many instances of the first importance, is the relation between effective braking

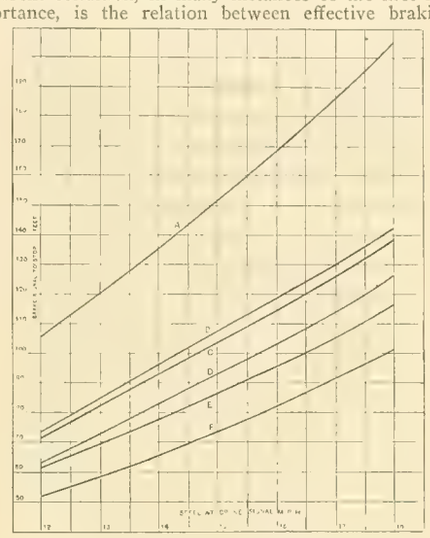


FIG. 1. COMPARISON OF BRAKE TESTS.

and liability to accident. Notwithstanding these changes in mechanical limitations and operating requirements, many small electric-railroad companies, and even many very large systems, have apparently been satisfied with old apparatus and have continued to use the single floating lever (or sway bar), inherited from horse-car practice. Another class of users have, at great expense, equipped their cars with novel and complicated apparatus, to be used in developing greater force for the application of brake shoes to wheel than could be produced with similar dispatch by human muscular effort when applied to brake wheels or crank handles. A third class of users and a large class of investigators have endeavored to effect the retardation of cars by other means than friction between wheel and rail set up by the pressure of brake shoes upon wheels.

A class of braking which is of the first importance on account of the very large number of cars in service, and the magnitude of the accident liability affected by them each year, is the emergency braking of cars of from 15 to 25 tons weight (including passenger load), from speeds which are under 30 miles per hour. This class of brake service is clearly differentiated from what is commonly known as "high-speed" braking, and requires for its accomplishment a different sort of apparatus. Consider, for instance, the case of a double-truck electric car used in city, suburban or interurban runs, or for all three classes of service collectively. This is a very ordinary case, and perhaps the most exacting requirements on the braking apparatus of such a car are those met with in the city or suburban runs, where cars are operated over public highways and unprotected crossings at comparatively high speeds. Under these conditions, emergency stops must often be made, and a braking apparatus is required which is capacitated to stop a car that is moving at a rate varying from 15 to 30 miles per hour, and in the shortest possible distance after the motorman receives notice of the necessity to check the speed.

Such cars are frequently equipped with merely a hand brake and a single floating lever (giving anywhere from 25 per cent. to 40 per cent. excess brake pressure on the rear brake); with a hand brake and some system of equalizing levers; with air or other power brake and equalizing levers; or with some power brake in which, in addition to the friction between wheels and rails, as introduced by a rail shoe depending for its friction either upon a portion of the weight of the car, an entirely separate frictional force is set up by electromagnetic action between the rail shoe and the rail. None of this apparatus, except, perhaps, the last mentioned, exhibits any marked advance over the braking of cars used in locomotive traction in city or suburban service.

This paper will contain a brief statement of certain methods which have been used in the determining for an electric-traction company the relative merits of several types of power brakes.

In designing new or investigating existing brake apparatus, the identity and relative importance of the several consecutive events which occur in the stopping of a car under ordinary conditions should be fully considered. It was thought desirable in the brake tests described below to plot accurately a curve sheet, such as is shown in Fig. 1, where the distances in which a car can be brought to a stop from different speeds at brake signal are shown graphically for the brakes under consideration, as this is the first question usually asked concerning the performance of a brake. A curve sheet was worked up for each braking test.

A considerable number of individual sheets were worked up for each type of brake tested, and from these sheets were determined coefficients or equations of curves of comparison.

Fig. 2 is a diagram showing the method of obtaining accurate measurements of the distance required for stops. Fig. 1 is a comparison chart, showing stops from speeds of 12 to 18 miles per hour, with six different brakes.

The following method was adopted to secure the requisite data for plotting these curves: In all tests the same type of car was used, mounted on similar trucks, and all cars were put in as nearly the same condition as possible and loaded to the same gross weight by an amount equivalent to a heavy passenger load. The cars were run in the same direction over the same section of track on a uniform grade, wind and humidity conditions being as nearly uniform as possible, and great care was taken to determine with accuracy in each case the speed of car at brake signal and the actual distance traversed between brake signal and the stopping of the car. An axle of the

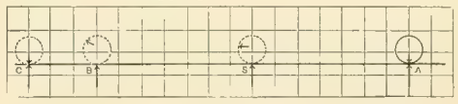


FIG. 2. BRAKE TESTING.

car was fitted with a drum carrying a contact plate which momentarily closed a battery circuit once in each revolution; this circuit energized an electromagnet operating one of two recording pencils, under which a strip of paper was drawn at uniform speed by a very accurately adjusted spring motor. The operating magnet of the other pencil of the two above mentioned was energized by a circuit which was closed every half second by a contact-maker actuated by a carefully adjusted clock movement. It will be readily seen that with this apparatus a record sheet could be obtained that would contain a clear record of wheel revolutions; from this the number of revolutions during any interval or the duration of any particular wheel revolution could be determined with great accuracy.

The method of using this apparatus to obtain the data desired was as follows: When the arrow mark on wheel (see Fig. 2) is in contact with rail, the revolution-counter circuit is closed by contact on axle. Each run started with this mark in contact; at stop the point of contact between wheel and rail was marked on rail, and the car rolled on until the arrow mark on wheel again came in contact with rail, giving the final fractional part of a revolution to be used in getting the total length of run by wheel revolutions, which was subtracted from the length of run by tape measurement to get the distance skidded. In Fig. 2 (A) is the position of wheel at start; (B), position of wheel at stop; (C), position to which wheel was rolled to get last fractional part of a revolution; (S), point at which brake signal was given, determined by record of revolution counter; (AB), tape measurement, total distance run; (AS), computed from revolution recorder; (AB) — (AS), distance to stop = (SB).

The car was placed near the starting point and moved backward or forward until the contact on the axle drum was closed, then the point of contact between the wheel and rail was chalk-marked both on wheel and rail. Then the record paper was put in motion, the car started and brought up to speed very gradually to avoid the possibility of slipping of the wheels. When the desired speed was attained, an electric bell was rung as a signal for an emergency stop. The circuit of this bell traversed the operating magnet of the chronograph pencil, and by drawing this pencil farther than it was ordinarily drawn by the clock circuit, produced a clearly defined record of the exact time at which the signal bell was rung. When the car was brought to a full stop, the bell was rung again in order to make a record of the time elapsed between brake signal and stop. The position of the point of contact of the front wheel was then carefully marked on the track, and the car moved slowly along until the first chalk mark made on the wheel was brought again in contact with the rail, and the rail was marked at this point. A tape measurement was then made between the first and second marks, giving accurately the total length of run; and between the second and third marks, to determine the distance traversed in the final fractional part of a wheel revolution. The distance from start to brake signal determined by the wheel-revolution record on the chronograph chart was calculated; this distance deducted from the total length of run (a tape measurement), gave an accurate measure of the distance from brake-signal to stop. Furthermore, where there was a difference between the total distance run by tape measurement and the total distance indicated by the wheel-revolution chart, such difference only occurred in case of skidding, then the difference was the measure of the distance skidded.

The charts show the relative efficiencies of the various brakes for emergency stops; for instance, at 15¾ miles per hour speed at brake signal the distances from brake signal to stop are: For brake

(A), hand brake, 164 feet; for brake (B), power brake, 115 feet; for brake (C), power brake, 112 feet; for brake (D), power brake, 100 feet; for brake (E), power brake (B) with differential levers, 93 feet; for brake (F), power brake, 80 feet.

The curves show plainly the relative efficiencies of the several brakes in making emergency stops.

To reduce the liability to accident and to effect economy in the use of motive power, it is desirable to secure as high a rate of braking as is consistent with the comfort of passengers; and if we assign a total cost per equipment per year to each type of brake considered, then the most desirable brake will be that for which this total is a minimum. The total cost per equipment per year should include the following items: Cost of maintenance, labor and material, cost of power for operating brakes, interest on investment, cost of accidents per equipment per year.

The cost of maintenance and for power must be estimated from the best data at hand. As to the cost of accidents, a figure was readily obtained for hand brakes. A figure was also obtained for brake (D), for which the record of a number of equipments was accessible. From these amounts, chargeable to hand brakes and brake (D), the amounts which should be applied to the other brakes were estimated by a graphical method, taking into consideration the distances in which stops may be made with the respective brakes. Under the item of cost of power in the original comparison a charge was made against the hand brake, which represents the amount of power necessary for operation with hand brakes in excess of what would be required with a power brake, due to the lower rate of braking with hand brakes; as the same schedule speed can be maintained at a smaller expenditure of energy by using a more effective brake, the time of running with power being reduced and cars allowed to coast a greater distance.

Below is given an approximate comparison table for several power brakes:

	A	B	C	D	E	F
Maintenance of power brakes and extraordinary repairs, chargeable to brakes	.....	58.80	10.95	36.25	.....	29.20
Power	.....	29 20	.....	.....	25	
Interests	.....	15	5	6.50	17.50	11.50
Accidents	.....	58	53	37	30	15
	.....	161	68 95	79 75	72.50	55 70

The totals above, which are, of course, only of approximate accuracy, show that under certain conditions a very considerable amount per annum may be saved by the judicious selection of brakes.

Railroad Car Braking.

BY R. A. PARKE.

[In this paper were given a sketch of the practical development of brakes in railroad service, an analysis of the results of investigation of brake-shoe friction, a definition of the requirements and limitations of brake efficiency in practice, a consideration of the loss of braking efficiency through disturbance of the normal rail pressures by brake retardation and a description of the means of compensating for it. The concluding paragraphs are given in full.]

To enter into the detail of the air-brake apparatus employed to furnish the braking force, in a paper of this character, would unduly extend it and would also be a work of supererogation. The compressed-air supply generally implies a suitable compressor upon the car, or, if operated in trains, one or more upon each train. Storage of the compressed air in sufficient quantity has, however, been satisfactorily accomplished in some cases, and possesses certain advantages. The air is usually stored at a comparatively high pressure (generally 150 pounds) in large reservoirs secured beneath the car, or in any other convenient place. It is delivered through a reducing valve into the "main reservoir" of brake operation, at the desired pressure, where it is handled in the ordinary manner. In such a system a single air compressor of large capacity and high efficiency compresses the air at a station, where it is stored and charged into the car storage reservoirs from time to time. The advantages lie in avoiding the cost of installing and maintaining compressors upon all the cars, and in cheapness of operation. The disadvantages consist of the bulkiness of the storage reservoirs and the time required to stop and charge them, and also the limited distance that may be traversed in the intervals. Where the air is compressed upon the car, the compressor must be accessibly constructed and placed upon the car, and supplied with clean, dry air. It may be operated by steam, by a separate electric motor, or by the car motor, through suitable connection with the car axle, as circumstances render it expedient. Its operations should be so controlled by a governor that it shall cease whenever the maximum storage pressure has been attained in the main reservoir, and shall be renewed when operation of the brakes has reduced the storage pressure to the inferior limit.

Upon the motorman's operating valve, the satisfactory operation of the brake system in large measure depends. It must not only present the means of accurately gauging the force of brake application and of promptly releasing the brakes, but must also define with precision the pressure of the air with which the auxiliary reservoirs are charged, to insure the full efficiency of braking without exceeding it to the injury of wheels and detriment of efficiency, while, at the same time, it must provide a superior pressure, that may vary considerably under different conditions, in the main storage reservoir, to insure prompt release of the brakes and restoration of pressure in the auxiliary reservoirs, without any variation of the working pressure in the latter—an exacting combination of conditions, not easy of realization, but of capital importance.

Of the apparatus for the immediate application of the brakes to the wheels, sufficient has already been said, it having been indicated that, in the single case where the unit invariably consists of a single car, simply an air cylinder in communication with the motorman's valve meets all the requirements, while the conditions of every other case justify nothing short of the efficiency of the quick-acting automatic apparatus, and, where characterized by high speeds and frequent stops, the superior efficiency of the high-speed brake is essential to high efficiency of service.

The application of other forms of power than compressed air to brake service has been practically limited to the vacuum and electricity. The limited pressure and bulky apparatus have restricted the use of the vacuum to comparatively light vehicles, and it is fast becoming a mere historical feature of the development of the art of braking. Electricity has been experimentally applied in various forms of apparatus, but has only recently become recognized as a means of promising utility in practical braking. The simplicity of employing the back torque of the car motors of electric railroads for retarding purposes has appeared very attractive to those unacquainted with the objection to dependence upon that means alone. In combination with other means of retardation, so that excessive heating may be avoided, this means of braking cars has been used with some practical success. But the application of electricity to the purpose of braking that appears to overshadow all others is that of the magnetic brake, which embodies such novel applications of old devices, with results so phenomenal, that the use of electricity as the source of braking force in electric-railroad service at once occupies an interesting position with a very promising future.

The magnetic brake forms part of a combined braking and car-heating system, in the latter of which, the diverters of the ordinary car-starting apparatus are so also used as resistances for grading the current employed for braking purposes that they serve to heat the car. This part of the system is itself of such interest that, while it is a separate purpose, a brief description is excusable.

It appears to be a well-established fact that the heating effect due to the use of the diverters in starting is not alone sufficient for the practical purpose of heating the car, under the usual varying conditions of service; but when, in addition, the heating effect of braking is also diverted to that purpose, the heat supply is abundant. Two systems of diverters are therefore used, one beneath the car, radiating the heat into the external atmosphere, and the other suitably arranged within the car for heating purposes. The two systems may be so combined, according to the temperature and weather, that any desired portion of the generated heat, from none of it to all of it, may be employed for heating the car, and any remaining heat is dissipated. The heat supply is, of course, intermittent, but the heaters are so constructed that they readily absorb the heat as generated, and gradually and continuously supply it to the car for uniform heating. In this manner the cost of the trolley current, ordinarily required for heating purposes—an item of no mean proportions—is entirely obviated.

The brake apparatus itself consists of a combination of a track brake with the ordinary wheel brake. Track brakes have long been known and variously proposed for practical use, but no satisfactory application of these devices appears to have been made. The track brake consists of a system of brake shoes, arranged beneath the car, directly over the rails, which may be forced down upon the rails to produce the retarding friction. There are several serious obstacles to the attainment of satisfactory efficiency from this method of retardation. In the first place, as the weight of the car must be lifted off from the wheels and transferred to the track-brake shoes, it is obvious that the shoes must be so formed that they will guide the car upon the rails as safely and surely as do the wheels. This appears to be impracticable, and, where the track brake has been employed, only so much of the weight of the car is transferred to the brake shoes that there still rests upon the wheels sufficient weight to enable them to guide the car securely. Thus only a portion of the weight of the car is available for rail friction.

Again, it is manifest that the friction of the track-brake shoes is of the same dynamic character as that of the brake shoes upon wheels, which varies inversely with the speed, and is very much inferior to the static friction of the rotating wheels upon the rails, which is the measure of the available friction of brake shoes upon the wheels. While it is undoubtedly true that the large area of contact between the rails and track-brake shoes that may be employed results in a track-brake friction which is much superior to that of the sliding wheels (provided the entire weight is transferred to the track-brake shoes), it is doubtful if the conditions permit the realization of as high a coefficient of friction where brake shoes rub upon the track as where they are applied with the same force to the wheels, and it is certain that a track brake of any construction, working upon this principle, is much inferior to an efficient wheel brake of the "high-speed" type. The combination of a track brake of this kind with a wheel brake is merely an added intricacy, as the efficiency of the track brake is entirely at the expense of the wheel brake, in robbing the latter of the rail friction upon which its effectiveness depends. For these reasons, and for the additional one of constructive complication and cost, no practical application of the track brake has ever been made, within the knowledge of the writer, except in certain cases of street railroads with exceptionally heavy grades, where an independent track-brake system has been installed for emergency use only, in the event that the wheel-brake system should become disabled.

But the magnetic brake introduces an entirely new element, through which the track brake does not interfere with the efficiency of the wheel brake, but both adds to its normal retardation and provides the operating brake force. The track brake shoe is placed between the two pairs of wheels, and, instead of being forced upon the rails through an effort from the car, is drawn to the rails by an electromagnet suspended from the car, thereby not merely adding its friction to the unimpaired friction of the wheel brake, but also actually increases the rail pressure of the wheels to the extent that the supporting springs for the track shoes and magnets are in tension through the descent of the track shoes to the rails. The construction will be better understood by reference to Fig. 3.

In Fig. 3, the magnetic-brake apparatus is shown as applied to a four-wheeled, swiveling truck, the parts of which are in dotted lines, more readily to distinguish the brake apparatus. The electromagnet (a), dividing the track brake shoe (b) into two parts, is secured by pins to the two push rods (c), and suspended at a proper distance above the rails by the adjustable springs (h). The push rods are secured by pins to the lower ends of the brake lever

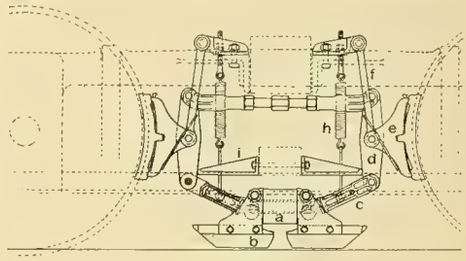


FIG. 3. MAGNETIC BRAKE.

(d), which are connected at their upper ends by the adjustable rod (g), and at an intermediate point are pivoted to the brake-shoe holders, and the hanger links (f), suspended from the truck frame. The push rods (c) are telescopic, as shown in the sectional view of the one at the left, so that a movement of the track shoe toward the right relative to the truck frame, causes the wheel brake shoe at the right to be applied to the wheel and the connection (g) to be moved to the left, thereby applying the wheel-brake shoe at the left, the stop (i) preventing the lower end of the brake lever at the left from following the track brake shoe. A relative movement of the track-brake shoe to the left is obviously accompanied by application of the wheel-brake shoes through corresponding movement of the parts in the reverse order.

The brake-controlling device may be incorporated in the running controller, or may be a separate device, placed by its side and operatively interlocked with it, so that neither can, through carelessness, be caused to interfere with the operation of the other. In the operation of the apparatus, the current is supplied by the motors, running in multiple as generators, and is divided between the electromagnets and the diverter combination, in such ratio as to cause the track brake shoes to be drawn upon the rails with a force proportionate to the braking requirements. The frictional resistance of the rails to the motion of the track shoes causes the wheel brakes to be applied with corresponding force. Thus, to the ordinary retardation of the wheel brakes is added that of the track brake and also the back torque of the motors, which, however, is practically limited to compensation for the rotative energy of the motor and car wheels. The force of application depends primarily upon the current and upon the electromagnets operating the brake shoes. The attractive force of the rails upon the magnets is under the control of the motorman up to a limit of about 150 pounds per square inch of brake-shoe surface in contact with the rails. The strength of the magnet is limited by the sectional area of the rail, acting as armature, and where the weight of the car makes a magnet of greater strength desirable, the track shoe is divided into three parts, instead of two, and wound to form a three-pole magnet, or two electromagnets, with one common pole.

The friction of the track brake shoe may also be adjusted to some extent through the angular inclination of the push rods (c), by which some of the weight of the car may be thrown upon the track shoes, the levers (d) being correspondingly adjusted to reduce the wheel brake-shoe pressure in proportion as the weight is transferred to the track shoe.

It will be observed also that the brake shoes are hung at the inside of the wheels, so that the hanger links may have an angular inclination to correspond with the transfer of weight from the rear to the forward pair of wheels through the influence of the retarding forces.

The incidental features of the magnetic brake are also of interest and great value. The current declines with the speed during a stop, thereby offsetting the increased coefficient of friction at the lower speeds. In bad weather, when the condition of the rails is liable to be accompanied by wheel sliding, the braking force operating the wheel brake is correspondingly reduced, so that the force of application of the wheel brakes is automatically proportioned to the rail friction which rotates the wheels. But, in addition to this valuable feature, if, by chance, the wheels should slide upon the rails, the interruption of wheel rotation is accompanied by the extinguishment of the track-magnet current, through which the pressure of the brake shoes upon the wheel is instantly relaxed and rotation of the wheels is resumed, without injury or serious loss of time.

In operation, the efficiency of the magnetic brake under the various conditions of service is phenomenal, and far exceeds that of any other braking system for the retardation of trains, which, combined with the commercial advantage of dispensing with the use of trolley current or any other means of heating cars, seems to assure it a leading position in electric-railroad operation of the future.

Discussion (in abstract).

C. O. Mailloux: We are indeed to be congratulated upon having had a paper by Mr. Parke on this subject. I regard Mr. Parke as the greatest authority, in this country certainly, and perhaps in the world, on the subject of braking. When an author has been studying a subject like this for as many years as Mr. Parke has done, if he is unable to give one a clue as to what might be a typical brake curve, then you may indeed realize what a difficult problem we have before us. The paper of Mr. Keiley, while it is interesting in the comparison which it gives of results obtained with actual brakes, is of great interest to me on account of the fact that it represents, at least, an attempt to obtain practical brake curves; that is, it shows an interesting mechanism whereby one may be able to obtain data giving the co-ordinate points from which brake curves actually obtained may be plotted out.

Calvert Townley: A test was conducted in Boston about a year ago by the Boston Elevated Railway Company to determine a number of braking and other questions, with reference to their equipment, and the following test was made: They took a train on their elevated structure, composed of three cars, which cars were equipped with motors, brakes and all the other paraphernalia, the three cars being similar, and they ran them up to possibly their maximum rated speed, somewhere between 35 and 40 miles an hour, and then applied the emergency brakes, keeping the current on the motors at the same time, to determine what effect it had, first, on the motors and other car equipment, and, second, on the speed of the car. The actual result was that the train slowed down to 20 miles an hour, approximately, and then maintained a constant speed, showing that, with each motor car equipped, it was not practicable to stop the train by means of brakes. That is a fact which is easily demonstrated by a braking calculation, but at the same time it had not been brought to my mind forcibly and conclusively.

Mr. Parke: In reference to the distance required to stop a car at a speed of 60 miles an hour with the magnetic brake, I may state that there have been no tests made with the magnetic brake, that I am aware of; that is, no definite tests under known conditions have been made—no systematic tests—which would enable one to say how the stops compare with the high-speed brake. I have not as yet, at any rate, received any information in regard to it. It is manifest on the face of it that the stops ought to be better, and much better, than with any wheel brake, because, while with the high-speed brake, even, the brake-shoe pressure is greater during the early portion of the stop when the coefficient of friction is low, thereby compensating, and is reduced toward the end of the stop when the coefficient of the brake-shoe friction arises, the same effect may also be acquired with the magnetic brake. It is a mere question of regulation, and, in addition, you have also all the braking effect of the track brake.

Elias E. Ries: There seems to me to be quite an interesting point which Mr. Parke omitted from mentioning in his paper in referring to the electric magnetic brake. It would appear on the face of it that by the employment of magnetism there would be an increase in the coefficient of friction between the brake shoe and rail, in addition to that due to the attraction of the shoe upon the rail, which is given in the paper as being up to a limit of 150 pounds to the square inch. I ask Mr. Parke if he has noted any such increased effect—the braking or sliding effect, which is probably due to increase of the molecular action or friction between the brake shoe and the rail, on account of the magnetization independently of the pressure? If that be the case, it would seem to me that that is an important point in connection with an electric magnetic brake.

Mr. Parke: I will say in answer to the gentleman that the statement regarding the limit of 150 pounds to the square inch, was that that is the limit of the magnetic attraction of the shoe toward the rail; in other words, that is the force with which the shoe presses upon the rail. There has been, to my knowledge, no attempt to determine whether a different coefficient of friction exists under such conditions from that which will exist from mere pressure, without the presence of electricity and magnetism. There has been no systematic experimenting with this form of brake to determine its exact efficiency, and that could only be done by a knowledge of the efficiency of the wheel brakes by themselves, and then the added effect of the magnetic brake could be measured, and the coefficient of friction determined therefrom. That has not as yet been done.

Mr. Parke: I do not know that there has been any observation whatever of the frictional effect of the magnetic brake. I have not been informed that there has appeared to be any greater friction between the magnetic brake shoe and the rail than would be accounted for by the ordinary coefficient of friction with the pressure that goes upon it.

William Nelson Smith: We have been somewhat interested in the subject of electric braking by what as Mr. Parke has said, is known as the back-torque method; that is, throwing the overhead switch, pulling down the trolley, reversing the reverse switch and throwing the controller clear on, and then noting that the speed of the car was suddenly checked. This, as an emergency operation, has been very well known to people operating electric railways ever since it became the practice to use double reversing switches for two-motor equipments. I have more than once carried a heavily loaded car and trailer down a four per cent. grade, when the old-fashioned hand brake was so bad it could not be worked, carried 200 people in safety down a bad grade without accident, at a slow rate, which it would have been impossible to do with the braking apparatus on the car. After seeing Mr. Sperry's original electric brake at the Atlanta meeting of the American Street Railway Association in 1894, I tried an experiment or two, for my own amusement, on a double-truck street car, about the size of some of the smaller cars used in New York, 21-foot body car, Brill maximum traction trucks, having G-800 motors, one on each truck, and I went through this so-called electric-brake application without applying the hand brakes. I checked the speed of the car, and went through the operation several times, and then looked around to see what was happening underneath the car. I noticed that the rear wheels of the truck would vibrate like the balance wheel of a watch, going first in one direction and then in another. The reasons are well known—that the action of the motors is producing this braking effect; and what Mr. Parke said about the increased braking effect upon the front wheels of the car was all proven by the fact that the rear motor lost its grip. One motor, of course, was bound to overpower the other, but with an empty car it appeared that there was no reason why one motor should have any more weight than the other, and it was hard to see why it was the rear motor which vibrated and went backward, the wheels revolving in opposite directions.

Important—if True.

[From the Chicago Daily News.]

Paris, December 18.—"Our French railway administration will be the first to introduce electrical traction on long-distance lines," said an official of the Paris, Lyons and Mediterranean system to the Daily News correspondent this morning. "While other nationalities have been talking we have been acting," he continued, "with the result that within six months the south express from Paris to the Pyrenees will be run entirely on the automobile principle."

Experiments in this direction have been conducted with the greatest secrecy and with almost unvarying success, except in the case of heavy freight trains, where damage to the apparatus was almost the invariable result. Beginning June 1st the first ordinary express trains between Paris and Lyons—a distance of nearly 400 miles—will be operated solely by the electric current. The distance will be covered in less than five hours—little more than half the present schedule time.

Should this innovation prove a success, the system will at once be extended. "It has certainly proved cheaper," said the above-mentioned official. The electric locomotives are 17 meters (56 feet) in length and are pointed fore and aft. The traction apparatus occupies only 2½ meters (seven feet six inches) and consists of a 220-horsepower generator [!] A single operator is sufficient to control the engine.

At the outset the trains will be composed of two carriages, each seating 50 passengers. Later two more will be added. The details are yet to be studied, but there is no doubt that the system will be a practical success. The splendid working of the electric line between Paris and Versailles is understood to have given impetus to the installation of the system on a larger scale and to such an extent that French officials predict a speedy revolution of traction on all existing lines.

Petitions are being circulated asking the mayor and City Council of Girard, Kan., to call a special election to vote on a proposition to issue $10,000 in bonds to establish a gas plant for the city and also $20,000 for a municipal electric-light plant.

Frank Hedley Appointed General Superintendent of New York Rapid Transit System.

Frank Hedley, who has been prominently connected with the elevated railways in Chicago during the last 10 years, has been tendered and has accepted the position of general superintendent of the Interborough Rapid Transit Company of New York city. This is the company which is to operate the new underground rapid-transit system in New York, in conjunction with the Manhattan elevated system, and the appointment comes to Mr. Hedley as a decided compliment to his ability and past record. He has tendered his resignation as general superintendent of the Lake Street and Northwestern Elevated Railroad Companies of this city, and will enter upon his new duties on January 15th.

FRANK HEDLEY.

Frank Hedley is a son of James Hedley and is of an old English family that was one of the first in the world to be connected with steam-railroad and locomotive engineering. Frank Hedley's granduncle was William Hedley, who was the designer and builder of the first locomotive traction engine that was ever constructed: a model of this engine was exhibited in Chicago at the World's Columbian Exposition in 1893, and this model was, at the close of the fair, turned over to the Field Columbian Museum of this city, and is now on exhibition there.

Mr. Hedley learned the mechanical-engineering profession in England and came to this country in 1882, and engaged with the Erie Railroad at its Jersey City shops as a machinist. He then went with the Manhattan elevated road as a machinist engine inspector for the Third Avenue division, and then was promoted to the position of assistant general foreman in the locomotive department. He remained with the Manhattan company for 5½ years, and was then connected with the Kings County Elevated Railroad in Brooklyn, N. Y., as master mechanic for 3½ years. He became superintendent of motive power and transportation of the Lake Street Elevated Railroad Company of Chicago in June, 1893, and had full charge of the construction of the cars and locomotives and of the operation of the road.

In 1894 and 1895 the construction of the Northwestern elevated and the Union Loop was begun. During all the construction Mr. Hedley was on the consulting engineering staff. In November, 1897, Mr. Hedley had charge of fully equipping and starting up the trains around the Union Loop; he also organized the forces and started the Northwestern Elevated in 1900. He occupies the position of general superintendent with the Lake Street Elevated Railroad Company and the Northwestern Elevated Railroad Company, the latter including the Union Loop. He is also a director of the Lake Street company and has been vice-president of the company.

Mr. Hedley's mechanical genius has always been used for the betterment of the elevated properties and he has taken out several patents for some of his inventions. One patent granted in 1897 covers a railway truck that is particularly adapted for electrically operated railroads. All of the cars and motors on the Northwestern Elevated have been equipped with these trucks, and they have also been adopted for the Lake Street Elevated, being applied on all new equipment. Another of Mr. Hedley's patents is for a device for cleaning the third rail from snow and sleet, which is also in service on the Lake Street and the Northwestern elevated railroads.

In his new position as general superintendent of the Interborough Rapid Transit Company, Mr. Hedley will have full supervision of the operation of the system and will be alone responsible to the vice-president and general manager, E. B. Bryan. During his connection with the elevated-railway interests of Chicago Mr. Hedley has made many business and personal friends, who will regret his departure. Mr. Hedley's family, which resides in Edgewater, Chicago, will follow him East in the spring.

The Calumet and Southeastern Railway Company of Chicago has been incorporated, to operate an electric railway, starting from a point on the Calumet River at Chicago and extending in a southerly direction to the Ohio River. The incorporators who compose the first board of directors are W. S. Dye, B. T. Bacon, Charles S. Barber, F. L. Schulze and R. S. Dutton, all of Chicago. The principal offices of the company will be in Chicago.

DEVELOPMENT OF THE TELEPHONE FIELD.

New Telephone Patents.

An important telephone invention has just been patented by William M. Davis of Chicago and assigned to the Stromberg-Carlson Telephone Manufacturing Company. The invention has for its object the provision of improved circuit arrangements for telephone systems employing primary and secondary windings of transformers, and relates particularly to that class of telephone systems wherein the receiver is included in a local secondary circuit with the secondary winding. In practicing this form of telephony the primary winding has usually been included directly in the main line, as also the transmitter, battery current having been usually supplied to the transmitter and the primary winding over the telephone line. The primary winding has usually been of one-half-ohm re-

FIG. 1. NEW TELEPHONE PATENTS.—DAVIS' TELEPHONE SYSTEM.

sistance, while the receiver contained resistance to the amount of 90 ohms and the secondary winding to the extent of 60 ohms, the secondary circuit having thus vastly more ohmic resistance than the primary winding. In practicing his invention Mr. Davis increases the primary winding preferably to 11 ohms, which causes additional impedance in the circuit including the same.

It is theobject of the invention to counteract or nullify the impedance due to the primary winding, which is accomplished by means of a low-resistance secondary circuit. This secondary circuit includes a secondary winding, which instead of being of high resistance —as, for example, 60 ohms, according to the prior art —is greatly reduced, having, preferably, 10½ ohms. In order to maintain this secondary circuit of as low resistance as possible, the receiver included therein is provided with two coils, each of 50 ohms, connected in parallel in the circuit. The secondary circuit thus in practice has about 35½ ohms resistance. This secondary circuit by being of this low resistance, which is about one-fourth of resistance usually employed in the prior art, serves to counteract impedance due to the primary winding. In order to get the necessary strength of current and pressure in the secondary circuit that would otherwise be impaired by the reduced number of turns and resistance in the secondary winding, the primary winding has its resistance and number of turns increased to maintain or produce the required transformation. Thus are two

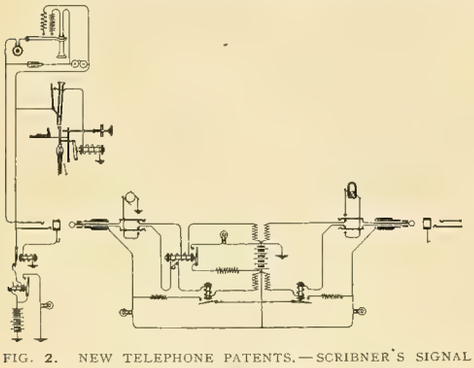


FIG. 2. NEW TELEPHONE PATENTS.—SCRIBNER'S SIGNAL FOR TOLL LINE SYSTEMS.

important departures made from the practice of the prior art—one the reduction of the resistance in the secondary circuit, particularly the secondary winding therein, and the other an increase over accepted practice in the length of wire and number of turns in the primary winding. Fig. 1 illustrates the application of the invention to a common-battery system.

A recently patented invention of Charles E. Scribner of Chicago is a supervisory signal for a telephone-exchange system and is illustrated in Fig. 2. A metallic-circuit telephone line extends from a toll station to a central office where a battery is bridged across the line, one pole of the battery being grounded. There is telephone apparatus in a bridge of the line at the sub-station and a toll box which has a coin-chute and a switch adapted to be actuated by a deposited coin. Mechanism is provided so that the subscriber may control the disposal of the coin. A ground branch from one of the line conductors is controlled by the coin-actuated switch, and a signal-controlling electromagnet is arranged with two differential windings, one in each of the line conductors, whereby the central-office operator may be informed of the presence of a coin in the toll box.

Telephone Controversy in St. Petersburg.

As reported in a previous number of this journal the city administration of St. Petersburg awarded not long ago to the Kellogg Switchboard and Supply Company of Chicago the contract for the erection and installation, with instruments, of a telephone exchange to have a capacity of 40,000 subscribers, the contract price being about $196,000 in American money. The St. Petersburg papers have had much to say in relation to the awarding of this contract, criticizing the city authorities for accepting the push-button telephones said to have been specified in the contract, and also alleging that the contract price was too high. In response to this clamor and to the representations of Russian firms and Russian agents of German, Swedish and American competitors of the Kellogg company, which asserted that a foreign concern had been unduly favored, the city administration, according to the Novoye Vremia, the leading daily of Russia, annulled the contract with the Kellogg company and called for new bids. This action is described as having been taken on November 13th, the date of opening the new bids being fixed for November 19th (these dates are old style). The new specifications called for the push-button telephones of the Kellogg type, but restricted the cost to 372,000 rubles, about $189,000. With this action neither the Kellogg company nor its critics were pleased. The Kellogg people said the city had no legal right to annul its contract; the local people and the representatives of other foreign companies objected that the push-button specifications were still retained and that the time allowed for submitting new bids was too short. According to the Novoye Vremia of November 20th (old style), just received in Chicago, at the meeting of the city authorities on the preceding day, when the new bids were to have been opened, a final protest was made by the representative of the Kellogg company. The St. Petersburg officials withdrew for consultation, and although no official announcement was made, the Novoye Vremia says that it is confident that the original contract with the Kellogg company was finally upheld. As the Russian journal named has excellent sources of information, there seems little reason to doubt that the Kellogg company has at last secured the contract beyond all question.

Nebraska Independent Telephone Association.

The annual meeting of the Independent Telephone Association of Nebraska was held in Lincoln on December 19th and 20th. The convention was well attended and unusual interest was shown by all the members present. The following papers and addresses were given: "Rural Line Development," by A. M. Munn, Nebraska City; "Traffic Contracts With the Bell Company, and the Disadvantages Accruing to the Contracting Independent Company," by J. H. Adamson, Broken Bow; "Inspection and Maintenance," by C. M. McNeill, Beatrice; "Toll Rates and Division of Tolls Between Connecting Companies," by A. E. Gantt, Fall City. The following-named officers were elected: President, I. D. Clark, Papillion; vice-president, J. H. Adamson, Broken Bow; secretary and treasurer, E. C. Hansen, Fairbury, Neb.; executive committee, T. H. Pollock, Plattsmouth; A. E. Gantt, Fall City; A. M. Munn, Nebraska City. The association adjourned to January 18 and 19, 1904. The following manufacturing concerns had exhibits at the convention: American Electric Telephone Company, Swedish-American Telephone Company, Stromberg-Carlson Telephone Manufacturing Company, Ericsson Telephone Company, Eureka Electric Company, Chicago Telephone Supply Company, Kellogg Switchboard and Supply Company.

Cumberland Service Near Evansville.

In relation to the recent interruption of telephone service in and near Evansville, Ind., Mr. Leland Hume, assistant general manager of the Cumberland Telephone and Telegraph Company, writes to the Western Electrician to the effect that any general interruption must have been on lines other than those of his company, and says: "The morning after the heavy windstorm our long-distance service was disabled, but by 10 o'clock of that day satisfactory connections had been established in all directions. This was on account of the fine organization of the company."

The Niagara County Home Telephone Company of Niagara Falls, N. Y., has given a mortgage of $500,000 to the Empire Trust Company of New York. The mortgage calls for the issuance of 100 bonds of $100 each, 280 at $500 each and 50 at $1,000 each.

Te'ephone News from the Northwest.

An impatient house mover in Minneapolis has got into trouble by cutting a telephone wire. He wanted to move a house on Thanksgiving Day, and the men of the telephone repair department were all off duty. He was informed that a man could be got by paying holiday wages, which he declined to do. He then proceeded to cut the wires himself. The Northwestern Telephone Exchange Company then had him arrested on a charge of injuring telephone wires. The penalty for this offense is a fine of $500 or imprisonment in the penitentiary for not more than five years. He pleaded not guilty.

C. C. Gowran, a banker and bond buyer of Grand Forks, N. D., has become associated with the officers of the Twin City Telephone Company in their application for a franchise for a local exchange at Grand Forks. The state law provides that a franchise cannot be granted to any but a resident. The company proposes a long-distance line from the Twin Cities to Grand Forks, thence on to Winnipeg.

The Twin City Telephone Company, operating Independent exchanges in Minneapolis and St. Paul, reports a steady increase in cash collections by months from January of 1901 up to date, including November. The collections for November of 1902 are on a basis of an annual business of $264,041.80, to which figure it has grown from $16,716.60 in January of 1901.

The Northwestern Telephone Exchange Company has bought the lines of the Davis company into Minot, N. D., and will soon complete connections and have long-distance service into that city.

The council of Crookston, Minn., has passed a resolution requiring wires in the business district to be placed underground. The ordinance becomes effective July 1, 1903. No more overhead wires are to be strung without the permission of the council, however.

The reports of telephone companies of Minnesota to the state treasurer show that there are from 125 to 150 new companies in business in the state, which have started within a year.

The Iowa Telephone Company contemplates erecting a modern central-exchange building at Des Moines, to cost $100,000.

The Great Northern Telephone Company of Forest City, Iowa, has been incorporated with $10,000 capital stock, to construct rural lines through the county. Orders have been placed for material and work is to be begun as soon as possible.

The farmers' telephone system, with the exchange at Hudson, Iowa, proposes to extend the lines to Cedar Falls, Iowa. This system has 250 farmers connected. The farmers pay the operator at the exchange, hire a lineman, and each patron pays his own repair bill. The farmers of the vicinity are principally stockraisers, who find that it pays to be in instant touch with the markets. R.

Ohio Telephone Notes.

H. M. Gove has sold his interest in the Millcreek Valley Telephone plant to the City and Suburban Telephone Company of Cincinnati, which gives the latter the control. The toll rates have been reduced from 10 to five cents. Subscribers will be furnished with new instruments and other improvements will be made in the plant. It is probable that a building for the exchange will be erected at Wyoming.

It has been decided to spend about $40,000 in improving and enlarging the Independent telephone plant at Mansfield.

The National Telephone Company will make several important improvements in its plant at North Baltimore, and it is stated that the system will in a short time be connected with the United States lines for long-distance service.

Graffton Baker of Melmore and Harvey Close of Plankton are engaged in organizing a telephone company to connect these towns with several others in that vicinity, as well as with the long-distance lines, probably the Bell.

A reorganization of the Wellsburg Telephone Company, Wellsburg, has been affected, and it will be known in the future as the Wellsburg Home Telephone Company. The officers are: President, Henry Stengle; secretary, Geo. W. Russell; manager, Claude Wyant. Lines will be extended to Brilliant and Wheeling.

The Parkersburg, Marietta and Interurban Electric Company has arranged to operate its trains by means of a regular telephone train-dispatching system.

O. M. C.

Indiana Telephone Items.

The New Long-distance Telephone Company, at the monthly meeting of the board of directors, on Tuesday, declared its regular one per cent. quarterly dividend, payable January 1st to stockholders of record December 25th.

The growth of the business of the New Telephone Company of Indianapolis continues. Even since the completion of its two new branch exchanges, the company is unable to take care of the business coming to it, and will be obliged to erect a new building at the rear of its main exchange.

The Kinloch Long-distance Telephone Company of Missouri has completed its pole line to Terre Haute and will push the work of stringing the wires. It

is expected to be ready to connect with the New Long-distance Telephone Company of Indianapolis at Terre Haute for through service between Indianapolis and St. Louis by February 1st.

Judge Baker of the federal court has issued a temporary restraining order against the city of Evansville to prevent interfering with the rights and property of the Cumberland Telephone and Telegraph Company. Mayor Covert was the only official served with notice. The order is made returnable the first Monday in February before United States Commissioner Wartman. The city has the right to go into court at any time and make answer, and, by giving 10 days' notice, may ask that the restraining order be dissolved. If this course is pursued, the issues will be raised at once; otherwise the merits of the case will be heard the first week in April.

F.

Michigan Telephone Items.

A resolution has been introduced in the Detroit City Council to instruct the corporation counsel to draft a bill for state control of the telephone systems of Michigan, requiring interchangeable service between all. The Bell people claim their contract with the parent company does not permit the connection of their telephones with those of any other make, and that any such law will not be valid.

Two hundred citizens met in Jackson last week and decided to discard the Bell telephones for those of the Independent company. Those who felt they must have connection with Detroit were the only ones who favored the Michigan Telephone Company.

The Citizens' Telephone Company of Grand Rapids has decided to put in an automatic switchboard.

A bill in chancery has been filed by the Central Trust Company of New York in the United States Circuit Court, to foreclose a mortgage given by the Michigan Telephone Company to secure $600,000 of bonds issued by the Detroit Telephone Company, the Michigan company having guaranteed the payment. It is claimed that the Michigan company has failed to develop and carry out the Detroit company's business, but has consolidated it with its own, decreasing expenses, avoiding competition and increasing its income. Default in the payment of interest amounting to $18,000 is claimed, and the Detroit company is declared insolvent.

C. G. W.

Southern Telephone Developments.

The committee on granting a franchise to Mrs. Annie McElroy Brett at Chattanooga, Tenn., will report favorably upon granting the franchise for 21 years, Mrs. Brett agreeing to allow the franchise to become void if $300,000 is not expended in one year, if work is not started in six months and if 2,000 subscribers are not secured.

The Richmond (Va.) Telephone Company has begun the work of putting wires underground. About $250,000 will be expended in the work which, it is expected, will be completed in six months.

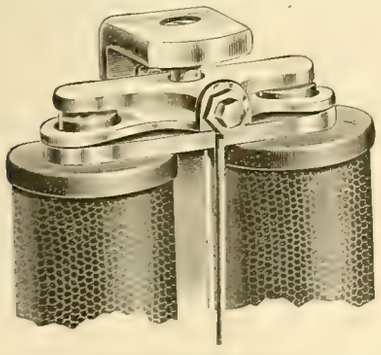
The Asheville (N. C.) Telephone Company is rebuilding the telephone plant at Hendersonville, N. C. A new switchboard is being installed by the Stromberg-Carlson Telephone Manufacturing Company.

The American Long Distance Telephone Company, to operate between Petersburg, Va., and Cheraw, S. C., has obtained a franchise to put in a long-distance station at Fayetteville, N. C.

L.

New Telephone Ringer.

In the accompanying illustration is shown a new ringer, recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., and Chicago, Ill. The ringer is said to embody new and simple features in the matter of adjustment, which in most ringers on the market heretofore has been crude, and in many cases inaccurate. A screw passes through the permanent magnet, armature and armature-frame support, and is threaded into the armature yoke. By turning this screw, a shoulder upon it is made to engage against the frame, which supports the armature, and this, being made of spring steel, allows it to be pressed downward, thus bringing the armature nearer the cores, while the turning of the screw in the opposite direction allows the distance between the cores and armature to be increased. This adjustment is very simple and requires the turning of only one screw, which may be done as easily after the ringer is mounted in a telephone as before.



NEW TELEPHONE RINGER.

GENERAL TELEPHONE NEWS.

The strike of the operators of the Iowa Telephone Company in Des Moines, Iowa, which was in progress for almost six months, was settled recently at a meeting of representatives of the company and of the Trade and Labor Assembly. The telephone girls are to be paid wages 15 per cent. in excess of the union scale, it is said, and all of the girls who struck are to be taken back to work. The company further agrees not to in any way discriminate against the strikers. The injunction suit to restrain the representatives of union labor from boycotting the company is to be dismissed.

A telephone war is on in Cooperstown, N. Y., between the Central New York (Bell) company and an Independent company. For years the Bell company operated in Cooperstown, charging what were considered exorbitant rentals. Townspeople determined to combine and effect a reduction of prices or drive the old line from the field. The village is becoming a network of wires overhead, and tall poles line both sides of the principal streets. One of the opposing companies has offered to install telephones and give six months' service free to its subscribers. Both companies claim to be gaining ground daily.

A novel use of the telephone is reported from Bernardsville, N. J. A constable of Baskingridge had received a complaint that some persons in his neighborhood were breaking the game laws of the state by hunting and shooting on Sunday. With this information, he succeeded in locating the guilty one at a stone quarry, where he was an employe. Forthwith he proceeded to the quarry and made the arrest. The manager of the quarry, being short of workmen, interceded, and an agreement was reached whereby the case would be settled over the telephone. Justice Bowers of Bernardsville responded to the telephone call, and on hearing the case recited by the constable imposed a fine of $20 and costs, which was paid on the spot.

NEW COMPANIES.

The Daisy Telephone Company of Borden, Ind., has been incorporated with a capital of $2,000. The incorporators are W. H. Porter, W. E. Gray, B. F. Stalker and others.

The Sibley Telephone Company of Sibley, Ill., has been incorporated with a capital of $1,000 to operate a telephone system. The incorporators are W. H. Hamilton, A. A. Absher and F. A. Warner.

TELEPHONE MEN.

H. P. Didriksen will in the future have entire charge of advertising, correspondence and general office affairs for the Eureka Electric Company of Chicago. Mr. Didriksen is well fitted for his new position, having been successful in this line of work in other lines of business, as well as in the field of telephony. His energy and enthusiasm should prove valuable in his new position.

At the recent banquet given by the Stromberg-Carlson Telephone Manufacturing Company at the Great Northern Hotel, Chicago, the following-named gentlemen were present: Alfred Stromberg, T. R. Finucane, C. W. Stiger, A. J. Rousseau, H. G. Webster, A. Haubrich, Eugene L. Brown, F. L. Martin, William Bowen, F. L. Middleton, R. B. Tyler, E. C. Lewis, H. B. Hewitt, H. D. Eddy, L. R. Krum, C. E. Knickerbocker, A. S. Munsell, G. A. Muir, Paul D. Meyers, G. H. Pierce, B. B. Willis, H. L. DuPont, G. L. Burlingame and C. H. Hague. Following the banquet, Mr. Bowen, in behalf of the salesmen, presented Messrs. Stiger and Middleton each with a scarf pin with diamond setting. Pleasant speeches were made by the recipients and others. The use of a new book of "Standard Switchboard Specifications" was explained to the salesmen.

MANUFACTURERS AND DEALERS.

The Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., and Chicago, Ill., recently closed a contract with the Southern Electrical Construction Company of Huntington, Ind., for a 2,400-line, full lamp-signal, central-energy switchboard, with a present equipment of 700 lines, for Bowling Green, Ky. The contract includes 700 telephones, a toll board, chief operator's desk and complete power equipment.

Announcement is made that the Haines & Noyes Company has become affiliated with the Couch & Seeley Company, telephone manufacturer, Boston, Mass. The Haines & Noyes Company will in the future be the western department of the Couch & Seeley Company, with offices in Chicago, where a large stock will be carried. The Couch & Seeley Company is one of the largest and oldest telephone manufacturing companies in the East, and its apparatus is well known. The Haines & Noyes Company has been in existence but a little over two years, but it has built up a large business and has become well known throughout the telephone trade. All communications or orders from the West, including the western part of Canada and Mexico, should be directed to the Haines & Noyes Company, western department of the Couch & Seeley Company, 153-157 South Jefferson Street, Chicago.

Weston Instrument Patents Upheld.

An equity action for infringement brought by the Weston Electrical Instrument Company against J. Francis Stevens and Elmer P. Morris, doing business as the Keystone Electrical Instrument Company, has been decided in favor of the Weston company. The suit involves two letters patent granted to Edward Weston for electrical instruments, one being a reissue, No. 11,250, dated June 28, 1892, the other No. 470,340, granted March 8, 1892. The decision was handed down by Judge Coxe of the United States Circuit Court for the Southern District of New York. The following extracts from the opinion of the court will give the gist of the decision:

Mr. Weston was the first to make a successful commercial voltmeter for measuring alternating currents. His voltmeter, soon after coming on the market, superseded all others, and is to-day recognized as the standard instrument for measuring differences of potential in alternating-current circuits.

The device of the patent is small, simple, compact, easily operated and requires no preliminary adjustment. It can be operated at any angle by an unskilled workman, and will measure direct as well as alternating currents.

Strictly speaking, there is no prior art. If the invention be confined to alternating-current devices it can be said with confidence that there were no practical commercial instruments prior to Weston's. There were no instruments entitled to be considered as anticipations. There were two or three instruments, which, as scientific possibilities, could, it is true, reach accurate results; but as everyday working devices they were of little value.

The invention is not disclosed in any prior patent or publication.

Infringement is clear. The defendants have copied the patented instrument even in its minute details. The only difference entitled to notice is the substitution of a V-shaped spring for the upper flat spiral spring of the patent. The two springs accomplish the same result and are unquestionably equivalents.

It appearing, then, that Mr. Weston was the first to construct a commercial instrument to do this exceedingly important work, and that the defendants have appropriated that instrument bodily, it may as well be admitted that the court is not disposed to deprive the inventor of the fruits of his genius and perseverance by subjecting the patent to harsh and technical rules of construction. Few patents that come before the courts are entitled to more liberal treatment. This is a case where, upon the undisputed testimony, the inventor has accomplished something which has been of unquestioned benefit to the electrical world. In an art crowded with indefatigable and brilliant enthusiasts he has made the only successful alternating-current voltmeter in use at the present day. He alone has succeeded, even against the ablest competitors which England, France and Germany could produce.

It is unnecessary to enter upon a microscopic examination of the claims upon the question of infringement, for the reason that if the claims cover Weston's instrument, and it is thought that they do, they cover defendants' instrument also.

Patent No. 470,340, granted March 8, 1892, is for an invention supplemental and subsidiary to the main invention just considered. It is for the improved movable coil of the instrument described in the original and reissued patents.

The defenses are lack of invention and abandonment. Infringement is admitted. The invention is a comparatively trivial one and consists in improvements in the coil conductors of the prior Weston patents. The improvements, inconsequential as they seem at first, produced important results in reducing the error of self-induction and thus increasing the accuracy of the Weston voltmeter. The coil was not only lighter and more compact, but it produced a result which was distinctly an improvement over that produced by the coils of the prior art.

The complainant is entitled to the usual decree for an injunction and an accounting.

American Capitalists Plan Lighting System for Paris.

A coterie of American capitalists, supposedly headed by W. C. Whitney of New York city, is said to be at present interested in a lighting scheme for the city of Paris, France. The idea, as reported, is to secure control of the lighting interests of the city and ultimately to combine the big Paris gas and electric-light companies under one management. The promoters are said to be having quite a busy time of it. In spite of the undoubted improvement which would result from businesslike management of these public utilities, the nationalist majority in the council is almost certain to render any such scheme abortive.

Mr. Michaud, chief of the Bureau of Lighting, in speaking of the possibility of forming such a combine, is credited with having ridiculed the idea, declaring that such an arrangement would not give a solution of the present municipal difficulties. Mr. Michaud intimated that the city of Paris will shortly go into the lighting business on its own account.

The Wautaga Electric Company of Washington County, Tenn., has been incorporated with a capital of $60,000. A. M. Young heads the board of directors.

SPACE TELEGRAPHY.

Marconi Sends Messages Across the Atlantic Successfully.

Success has marked G. Marconi's experiments in transatlantic space telegraphy, several complete messages being transmitted from the station at Table Head, Cape Breton, to the Poldhu station at Cornwall, England, a distance of 2,300 miles, on December 21st. A message was sent from Lord Minto, governor-general of Canada, to King Edward, and Marconi also sent one to the king, to which he received an answer congratulating him on his success. Marconi also sent messages to the king of Italy. Other dispatches of a congratulatory nature were transmitted. Mr. Marconi sent all the messages from the Cape Breton station himself and they were received at Poldhu by Mr. Woodward, chief of the receiving staff at that station. Mr. Marconi received several congratulatory telegrams in addition to those from the kings of England and Italy. One of these, from Edison, read "Congratulate you most sincerely on your success." Another, from Dr. Graham Bell, was as follows: "Hearty congratulations. Rejoice at your success."

Mr. Marconi announced that he first succeeded in transmitting messages from Table Head to Cornwall about a month ago, but it has only been within the last few days that his apparatus has been perfected so that successful transmission could be achieved. The messages sent on December 21st went through without a hitch. After a little organizing the stations will be put in shape for commercial messages, which will be transmitted at the rate of 10 cents a word, or at a press rate of five cents a word. It is calculated that the Marconi company will be able to handle 1,000 words an hour. Some time ago the English government, which controls the telegraph system of the United Kingdom, refused to make connection with the Poldhu station, and this consent, of course, will have to be obtained before land connections in England can be made.

After remaining at Table Head for a short time, Marconi plans to go to the Cape Cod station, where he will superintend the erection of a station for the transmission of commercial business for the New York section. Machinery for the equipment of the station is there awaiting him. The inventor has announced that within a few weeks his station at Cornwall, England, will be equipped with devices which will permit of the transmission of complete messages to this side.

In sending his messages, Marconi made use of his new magnetic detector, which gave complete satisfaction, it is said. When the station is placed in regular operation transformers will be used for the transmitting apparatus. These will raise the voltage of 2,000 generated by a 40-horsepower alternator to 20,000 volts. Other apparatus will be used to raise this voltage to a range of from 50,000 to 70,000 volts.

Collins' Lecture.

Under the caption of "Operative Systems of Wireless Telegraphy," A. Frederick Collins, the well-known writer, discussed before the New York Electrical Society recently the history, theory and apparatus of space-telegraph engineering practice. The history of high frequency, high-potential current, electric waves and the fundamental principles involved in wireless telegraphy from the time Lindsay signaled across the river Tay in 1854 to the sending of messages by Marconi in 1896 was briefly referred to. Open and closed oscillator and resonator circuits and their functions were explained, as well as the application of these methods to systems in practice. The propagation of electric waves was touched upon and the lecturer unfolded the two prevailing theories; the first, that based on Hertz deductions on the propagation of electric waves by means of wires," and the second, on his own experiments "on electric radiation." In the course of the lecture Mr. Collins emphasized his own novel theory that the lack of commercial success in syntonization could be traced to the use of the earth at both transmitting and receiving terminals and the effect of its variable capacity on the tuning of the circuits. He also inclined to the belief that syntonization was not likely to be effected by pure electrical resonance, but that a mechanical element having acoustic resonance properties would be required as an auxiliary to the scheme for tuning.

The lecturer then showed that at the present time there are no less than 10 systems in actual service in this country and abroad, and various theories as well as the apparatus of Marconi, Slaby-Arco, Braun, Guarini, Fessenden and De Forest then engaged the speaker's attention.

It would seem that a greater effort has been made abroad to solve the difficult problem of electrical resonance, while in the United States the trend of effort has been along the lines of more rapid, accurate and economical transmission of intelligence.

The lecture was well illustrated with a number of diagrams of the different systems which were followed alternately with photographic views of the apparatus they represented. In conclusion, Mr. Collins exhibited a fundamental system, having in operation a complete wireless telegraphic equipment with masts and antennæ, leaving little to the imagination. During the course of the lecture a Marconi coherer and a Fessenden wave detector were passed for critical examination.

Developments of De Forest-Smythe System.

Some of the recent work at the De Forest-Smythe wireless-telegraph station at Coney Island is very interesting. On Sunday, December 7th, the operators there on watch for the Hamburg-American liner Deutschland picked up the boat at a distance of 60 miles. The Deutschland carries a Slaby-Arco system, but arrangements have been made with the Hamburg-American company, whereby this steamer communicates with the De Forest wireless station on approaching and leaving New York.

On December 11th the Coney Island station caught messages from the American liner Philadelphia until that vessel was six hours from port, the last message being received perfectly when the boat was 100 miles distant. The Philadelphia is equipped with Marconi apparatus, and the boat was overheard calling up the Babylon station, and later, the Sagaponack station. On several occasions the Coney Island operators have listened to the Sagaponack station calls, over a distance of 80 miles. The remarkable part of this reception is that no transformer, "jigger" or tuning device whatever was used at the Coney Island station; merely the simple aerial conductor, consisting of two stranded copper cables 210 feet in height. As far as known 20 to 35 miles has been the greatest distance recorded for successful transmission without a "jigger" in connection with the receiver, and the fact that these messages were received so successfully without this adjunct speaks well for the extreme sensitiveness and reliability of the De Forest-Smythe "responder," or anti-coherer. The receiver used is only five by four by three inches in size.

While the steamship Deutschland is in dock at Hoboken daily communication is maintained with the De Forest station on the roof of the Chesebrough Building, No. 17 State Street, New York city, notwithstanding the miles of metal warehouses, steel-frame buildings and shipping lying between. This was not, however, possible until the De Forest-Smythe "responder" replaced the regular coherer on the Deutschland station.

The Providence Journal has decided to establish wireless-telegraph communication between Block Island and Newport. The cable connecting the Island has worked very unsatisfactorily for a long time, and the Journal estimates that, as a news-getting agency, as well as a commercial carrier, and as affording an excellent shore station for communication with passing vessels, the Block Island wireless plant will be a good investment. De Forest-Smythe wireless apparatus will be employed throughout. As there is no electric power at either point, the alternating current required by the De Forest-Smythe transmitter will be generated by a 2½-horsepower Secor kerosene engine at each station, driving a special 60-cycle generator. The outfits are identical, in fact, with those which the United States Signal Corps used so successfully during the war maneuvers last fall.

The fishing steamer, J. S. Warden, which leaves New York for deep-sea fishing, now carries a De Forest-Smythe wireless telegraph apparatus, and the fishermen are kept in constant touch with the Coney Island station. As New York business men frequently take a day's outing on board, it has become the custom to send out stock quotations, keeping those interested in touch with the market. This has been found to be an attractive feature. The government stations at Fort Wadsworth, S. I., and Fort Hancock, Sandy Hook, have been completed and turned over to the United States Signal Corps by the De Forest company. Col. H. C. Dunworthy, chief signal officer, Department of the East, who has felt a keen interest in the plan to replace the faulty cable between the forts, and who was largely instrumental in bringing about this improvement, has charge of the two wireless-telegraph stations.

The answer of the De Forest Wireless Telegraph Company to the infringement suit brought by the Marconi company has been filed in the United States Circuit Court before Judge E. Henry Lacombe. Charles Neave and Edmund Wetmore are retained by the De Forest company and prepared the answer in the suit. William Henry Bliss is general counsel for the De Forest company.

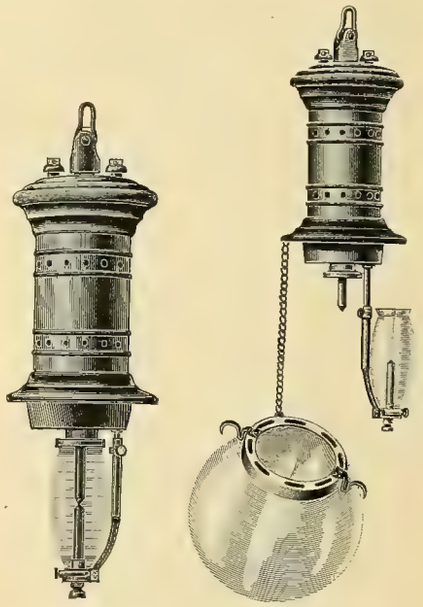
The fundamental patents, three in number, for the De Forest-Smythe space-telegraph system were granted on December 16th. One of these patents has 65 claims and relates particularly to the receiving apparatus. The detector controlling the circuit comprises electrodes, between which is interposed a paste which is composed of an electrolytically-conducting liquid and a porous solid. Solid conducting particles are contained in the paste, the resistance between the electrodes and the detector being normally low and being increased when the detector is subjected to the influence of electrical oscillations, so that the signal device is actuated. One of the other patents describes the method which consists in maintaining electrical pressure in a local circuit, the pressure normally operating to establish conducting paths of comparatively low resistance, and then disrupting the conducting paths under the influence of oscillations produced by the received energy waves and in proportion to the energy of such waves to increase the resistance of the circuit, so that on cessation of the waves a normally low resistance condition is restored in the circuit. The patents are issued to Lee De Forest of Jersey City and E. H. Smythe of Chicago.

Stone Space-telegraph Patents.

John S. Stone of Boston, Mass., is bringing out a system of space telegraphy, and modifications of the system are covered by four patents granted on December 16th. One of the inventions relates to a method of determining the direction of motion of a train of electromagnetic waves, and consists in receiving the energy of the waves in conductors or parts of a conductor, in conveying the electric oscillations thereby produced in the several conductors or parts of a conductor to a suitable electric translating device, and in changing the positions of the conductors or parts of a conductor relatively to the direction of motion of the electromagnetic waves till a position is found in which the combined effect upon the translating devices of the several electric oscillations conveyed to it by the conductors or parts of conductors is nil. Another method patented by Mr. Stone is that of transmitting electromagnetic signal waves and of simultaneously receiving other electromagnetic signal waves. It consists in generating the electromagnetic signal waves to be transmitted by producing electric vibrations in two or more vertical conductors and in receiving the energy of signal waves to be received in vertical conductors placed in lines or planes of interference of the signal waves to be transmitted.

Globe Direct-current Enclosed-arc Lamp.

Improvements are constantly being carried forward in the arc-lamp field, and one of the latest additions is the Globe direct-current, enclosed-arc lamp, manufactured by the Globe Electric Manufacturing Company of Cleveland, Ohio. Some of the features about this lamp which make it desirable for general use are its compactness, extreme simplicity of design and dustproof case. It is easily trimmed and requires little or no attention beyond that. One of its distinguishing features is the contact, which consists of ball bearings, making it practically an impossibility for the carbon to stick. The accompanying illustrations show an indoor lamp and the complete lamp with the globe lowered for trimming. While general efficiency is the object of the manufacturer of this lamp, beauty of design is also taken into consideration. The Globe company also goes extensively into the manufacture of reflectors and arc headlights for suburban trolley cars. Its facilities enable it to fill orders on short notice, a point of importance at the present time, when it is difficult to get good deliveries on this class of apparatus.



GLOBE DIRECT CURRENT ENCLOSED-ARC LAMP.

Transportation Building at St. Louis Exposition.

Henry W. Schlueter of Chicago was awarded the contract for the Transportation Building for the St. Louis Exposition last week, his bid being $692,000. This was the second opening of bids, the first set being rejected because the amounts exceeded the appropriation. Several changes were made in the original plans that brought the bids within the limit. The Transportation Building is the largest in the main group, covering 17 acres, and is exceeded in ground space only by the Agricultural Building, for which 22 acres are allotted.

New Electric-railway Systems.

William B. Potter of Schenectady, N. Y., already well known for his inventions in the line of alternating-current railway systems, has added a new and interesting system to those already patented by him. The new system comprises certain means, whereby an operator on a car may cause the working conductors constituting the conducting system through which current is fed to a motor or motors to be supplied with current from any one of a number of sources, whereby the motor or motors on the car may be caused to run at suitable speeds or to start from or come to rest through suitable gradations in speed.

"In organizing an electric railway to operate in accordance with my invention, I prefer," says Mr. Potter, "in cases where the railroad is of considerable length, to divide the working conductors up into sections. Some of these sections, such as those

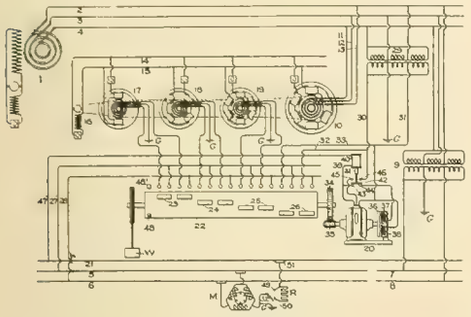


FIG. 1. NEW ELECTRIC-RAILWAY SYSTEMS.—POTTER ALTERNATING-CURRENT SYSTEM.

corresponding to portions of the road where no stops are to be made, are supplied by alternating current at a certain frequency, while other sections corresponding to portions of the road along which stops are to be made are arranged to be supplied with currents of a frequency controllable at the will of the operator on the car. For purposes of economy, as well as convenience, I find it preferable to supply the railroad, as a whole, by means of energy derived from a single central station and to obtain alternating currents of different frequencies by suitably transforming the current derived from the main source."

The accompanying drawing (Fig. 1) illustrates diagrammatically one embodiment of the invention. At (1) is indicated a source of electrical energy—such, for example, as a three-phase alternating-current generator, the particular nature of the generating means being unimportant. Transmission lines (2) (3) and (4) extend therefrom and along the line of the railway. The working conductors from which current is collected and supplied to the motors on the railway vehicles are indicated at (5) and (6). These conductors (5) and (6) constitute a single section, an adjacent section being shown at (7) (8). The section (5) (6) is supposed to represent a portion of the conducting system located near a station or other stopping place, while the section (7) (8) corresponds, on the other hand, to a portion of the road on which no stops are normally made.

When the railway vehicles are on portions of the line between stations—such, for example, as those corresponding to the conductors (7) (8)—they are supposed to operate at full speed. The conductors (7) (8) may therefore be supplied with current of normal and invariable frequency, and to this end suitable connections are made between the transmission lines (2) (3) (4) and the conductors (7) (8). As illustrative of such connections, there is shown a step-down transformer (9) with primary and secondary leads connected, respectively, to the transmission lines (2), (3), and (4) and to the working conductors (7) and (8), one terminal of the secondary being grounded to correspond with the ground connection of the motors representing the return circuit for the three-phase current utilized by the motor.

The section comprising the conductors (5) (6), unlike the section comprising the conductors (7) (8), is arranged to be supplied with currents of different frequencies, the particular means employed being shown partly in diagram and partly by pictorial representation. The alternating currents of different frequencies may be separately generated or produced in a great many other ways; but for the present purpose Mr. Potter proposes to use a generating means consisting of a synchronous motor (10) supplied with current from the transmission lines (2), (3), and (4) and mechanically connected to a number of generators (17) (18) (19) in such a way as to secure suitable gradations of frequency in the currents produced by the generators.

To make suitable connections between the generators of different frequency and the section of the supply system comprising the working conductors (5) (6) of the railway, the inventor makes use of a switch the movement of which is controlled from an electric circuit which may be opened and closed on the railway vehicle as it moves along. In the instance shown the switch is driven by a small induction motor (20), the circuits of which are opened and closed by a relay device connected to a controlling conductor 21, extending along the line of the railway parallel to the working conductors and with which a sliding contact is made by means of a contact shoe carried by the car. One form of a switching device consists of a cylinder (22) mounted in suitable bearings, so as to revolve about its axis, and having thereon a series of angularly and progressively displaced contacts (23), (24), (25) and (26), adapted to engage successively a number of co-operating fixed contact fingers. The cylinder is driven by a three-phase motor (20), the armature of which is locked in any desired position by the magnetic clutch (37) (38).

By an inspection of the diagram it will readily be seen that as the controlling switch is turned the fixed contacts (23) are first to engage their co-operative contact fingers, thereby connecting the generator (17) which is of the lowest frequency with the leads (27) (28), which are joined to the working conductors (5) (6), thereby supplying the working conductors with current of minimum frequency. As the controlling switch continues its movement the generator (17) is cut out of circuit and the generator (18) is substituted therefor, while upon still further movement the generator (18) is cut out and that numbered (19) substituted. Upon completion of the movement of the controlling switch the generator (19) is cut out of circuit and the working conductors connected across the secondary of the transformer (29), thereby receiving current of the same frequency as that flowing in the transmission lines (2), (3) and (4). It is to be understood that the currents derived from the generators (17), (18) and (19) vary in frequency, as well as in voltage, in such a progression as to give the desired rate of acceleration to the railway vehicles as the controlling switch is turned by means of its driving motor.

The circuits of the motor (20) and of the electromagnetic clutch (37) are directly controlled by means of a relay device (39), which in its turn is brought into operation when the operator on the car grounds the controlling conductor (21) in a suitable manner.

The controlling circuit on the railway vehicle consists of a resistance (R), having two terminals connected, respectively, to fixed contacts (49) (50), one terminal of the resistance (R) being also connected to a contact shoe (51), arranged to slide along the controlling conductor (21). A switch (52) is arranged so as to connect either of the fixed contacts (49) and (50) to ground, as shown at (G).

Various important advantages are said to accrue from the use of a system operating in the manner described. Thus, for example, when the frequency of current in the supply system is progressively increased in order to start the motor or motors connected thereto the result, so far as starting torque is concerned, is practically the same in effect as that secured by the use of a variable resistance in the secondary of the motor, without, however, involving the waste of energy incident thereto. There is this difference, however, that with a low frequency, although the starting torque may be made equal to or greater than that at a higher frequency with resistance in the secondary of the motor, the maximum attainable speed of the motor at this low frequency is correspondingly low. To get an increase in speed, it is therefore necessary to increase the frequency, and in the arrangement shown this increase is made progressive, so that the rate of acceleration may have some approximation to uniformity.

In stopping the motors fed from the working conductors the frequency-varying means presents valuable advantages in that it permits the motors to act as generators, thereby serving as powerful brakes, at the same time returning to the line the energy which would otherwise be lost in the brake shoes. If the motor or motors be running at normal speed, then if the frequency of current in the working conductors be reduced by a suitable amount less than that corresponding to the speed of the motors the motors will act as induction generators, since they will then be running at a speed above synchronism. The braking effect which results will then act, of course, to reduce the speed of the motors and the vehicle or vehicles driven thereby, so that the speed of the motors drops until the motors run below the value of speed corresponding to synchronism at the reduced frequency. At or about this time the frequency on the working conductors may be reduced another step, thus repeating the operations described, and this cycle of operations may be continued until the lowest frequency available is brought into use, whereupon the circuit may be interrupted altogther. These changes may be caused to take place at regularly recurring intervals by allowing the switch-operating mechanism to act continuously, or the changes may be made step by step, with any desired interval between each step, by suitably manipulating the controlling switch (52) on the car.

Since the section comprising the conductors (5) (6) and similarly operated sections are normally dead, the controlling conductor (21) is extended along the adjacent sections, so that as a car approaches a normally dead section the operator on the car by closing the circuit of the controlling conductor may bring that section up to normal frequency prior to the time the car runs into that section. When such section is reached, the frequency of current supplied to conductors of that section may be reduced in the manner described.

To Elmer A. Sperry of Cleveland, Ohio, has been granted a patent for a new and economical system of electric-railway propulsion and control. Fig. 2 is a side elevation in part section, illustrating a car and associated parts, illustrating one form of the invention. The car or locomotive consists, preferably, of a metallic framework (A) having ends (B) (B). (Here shown in section.) The locomotive rests in the usual manner upon four or more track wheels (A'). These wheels are in the present instance simply employed as idlers or rollers for the locomotive, the propulsion depending upon the engagement of the sprocket or sprockets (C) (C) with the traction rack (D), which is suitably located between or even outside of the ordinary tram-rails constituting the roadbed, running substantially parallel therewith, but insulated therefrom, and suitably anchored against longitudinal stress. The insulation of the rack (D) is rendered necessary from the fact that in the present device it is used to perform the additional function of transmitting electricity from the source of supply to the car, which it may serve to light, and perform other well-known functions, but principally to energize the elec-

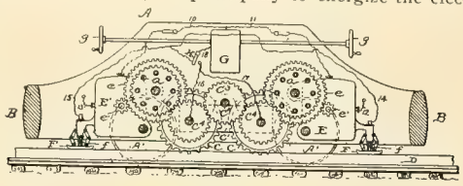


FIG. 2. NEW ELECTRIC RAILWAY SYSTEMS.—SPERRY ELECTRIC LOCOMOTIVE.

tric motor or motors within the car. To this end also it is found essential to insulate suitably the traction sprockets (C) (C) and their metallically connected parts, so as to prevent short-circuiting of traction rack (D), on the one hand, whereas, on the other, it is employed to collect the electricity from such rack and deliver it to suitable translating devices when called upon to do so. This insulation may be effected by securing in any well-known manner to the metallic truck a beam or timber of wood or other similar insulating material (indicated at C'), which in turn supports by any of the well-known means suitable journals for the shafts of the sprockets (C) (C), together with the shaft (C^{11}) of the wheel (C^3), which serves to connect and cause to revolve in unison the two sprockets (C) (C). Upon the shafts of these sprockets are suitable gears (C^4), intermeshing with the intermediate insulating gear (a) (a), which are driven by the electric motors (E) and (E') through the ordinary gear and pinion (e) and (e'), the former being rigidly secured to the gear (a), though insulated therefrom. It will thus be seen that when either one or both motors are operated the sprockets are rotated through intermediate gearing and serve to propel the car by intermeshing with the rack, which may be of any suitable form, the preferred form, however, consisting of a flat-topped perforated structure, which better serves to receive the shoes or current collectors proper.

Mr. Sperry prevents the breaking of the circuit of the teeth and rack by employing a shunt circuit, by means of which the main current or a portion or all of the operating current is handled around the contacting faces of the sprockets and rack teeth, and therefore prevented from passing such teeth, preserving the continuity and integrity of the circuit. The circuit thus being free from interruption serves far better to fulfil its function in actuating the motors, lamps, and other translating devices.

The circuit passes from the controller (G), which may be suitably actuated from either end of the car by the hand wheels (g g), to the motors (E) and (E') by wires (10) and (11), and thence to the ground by wires (12) and (13). The current leaves the rack (D) normally by the collector (F) on wires (14) and (15) to the switch (H), or the current may reach this switch from the sprockets (C) (C) through wires (16) and (17) from the switch to the controller through wire (18). It will thus be seen that the normal current supply to the motor is from the collectors (F), but that an emergency supply may be received from the sprocket (C), or by turning the switch (J) both these devices may be utilized jointly to gather current from the rack (D).

By means of this invention the operation of electric-railway systems, particularly in such places as mines and tunnels, it is stated, is very greatly simplified and made much cheaper and more efficient and satisfactory and permits the adaptation to circumstances and conditions not commercially possible in the ordinary electric-railway system. The arrangement of electrical control illustrated permits an efficient and reliable control of the motor under economical conditions and insures a certain protection and efficient action wholly absent in the ordinary electric-railway systems.

A special meeting of the Philadelphia and West Chester Traction Company is called for January 12th, to increase the indebtedness from $400,000 to $600,000.

Technology School for University of Chicago.

Dr. William R. Harper, president of the University of Chicago, in his quarterly statement, presented at the Christmas convocation, made the important announcement that plans had been completed for the establishment of a school of technology at the university. President Harper said that the demand for instruction in the technological department is becoming more pressing on every side and that the opportunity for developing technological work in the city of Chicago is confessedly a great one, perhaps the greatest in the country. In opening the school the related departments in pure science will be greatly benefited by the development of technological work side by side with them. While it is estimated that the introductory work can be provided at an expense comparatively small, namely $150,000, the money required for the full course and graduate work would be about $3,000,000.

"It is evident," said Dr. Harper, "that the organization of a high-grade school of technology in the various departments is a matter demanding a large expenditure of money and requiring effort which must cover a long period of time. There is an opportunity here in Chicago for a school which shall sustain a relation to technological schools already in existence like that of the graduate work in the university to the colleges. It is such a school that we have had in mind. How soon the university shall be able to carry out its plans is still a matter of conjecture; but it is commonly understood that the establishment of the technological work is the next important undertaking, and, if I am correctly informed, this is the urgent opinion of the faculties of the university, as well as of the board of trustees."

Consideration of Chicago Municipal-ownership Report Postponed.

The report of the special committee on municipal ownership of street railways was discussed by the Chicago City Council at its meeting on December 22d, but the full consideration of the measure was postponed to January 5th. Alderman Finn called the matter up, and several amendments were offered, while Alderman Bennett presented a substitue for the committee's bill. The substitute differs but little from the original, but provides that all contracts in franchise ordinances allowing the city to take over street-railway lines after a certain number of years shall be legal, and makes it the duty of the authorities of the city to take the necessary steps to acquire street-railway property whenever a majority of the voters have declared in favor of it.

Allgemeine-Union Combination in Germany.

Berlin advices are to the effect that the Allgemeine Elektricitäts Gesellschaft and the Union Elektricitäts Gesellschaft have entered into a working agreement which amounts to a practical consolidation. The directors of each company are elected to the directorate of the other, so that the management of both is identical, though the companies themselves remain separate. The step is said to be the result of the crisis in the German electrical industry. After the subsidence of the great boom in electrical companies, it was found that the manufacturing capacity had far outrun the market's demands; hence the efforts, successful in this case, to effect consolidations.

BOOK TABLE.

MAGNETIC DECLINATION TABLES AND ISOGONIC CHARTS FOR 1902, and Principal Facts Relating to the Earth's Magnetism. By L. A. Bauer, chief of division of terrestrial magnetism, United States Coast and Geodetic Survey. Washington: Government Printing Office. Pp. (7¼ by 11¼ inches) 404, with several figures, maps and plates.

This is an exceedingly valuable treatise on magnetism and contains besides the tables and charts a number of papers of general interest. The early history of the compass is treated at some length and the other subjects taken up are the birth of the science of terrestrial magnetism, the earth as a great magnet, the variations of the earth's magnetism, magnetic surveys, the earth's magnetic poles and magnetic moment, determination of the true meridian and the magnetic declination, etc. The volume is a continuation of the series of papers, begun in 1855, treating of the magnetic declination of the United States and published by the Coast and Geodetic Survey. The immediately preceding volume was published in 1897, and in the present volume the tables have been brought up to date and the general information spoken of above added. The frontispiece illustrates the United States Coast and Geodetic Survey Office, and other views show the exterior and interior of the magnetic observatory at Cheltenham, Md.

A news dispatch from Pekin states that China has issued an edict ordering the seizure of all Chinese telegraph lines in order to insure secrecy for government dispatches. Viceroys Chang Chih Tung and Yuan Shih Kai are ordered to ascertain the value of the shares of the telegraph companies and the properties belonging to them.

CORRESPONDENCE.

New York Notes.

New York, December 22.—Probably the most important event in New York's affairs for some time past was the recent granting of the Pennsylvania tunnel franchise by the Board of Aldermen last Tuesday. The franchise was granted by a vote of 41 to 36. The tunnel, as before stated in the Western Electrician, will start on the Jersey side in the Hackensack Meadows and extend under Manhattan Island to Long Island City. It is expected that about five years will be required to build it, and that about $50,000,000 will be spent in the work. The tunnel will cross Manhattan chiefly under Thirty-second and Thirty-third Streets. A monster station will be built between Seventh and Ninth Avenues and Thirty-first and Thirty-fourth Streets.

The traveling public is still incensed over the delays and infrequencies in the car operations on the elevated-railroad system of the Manhattan company. Much unfavorable comment—part of which is undoubtedly unjust—is heard on every hand, and the local papers are publishing long editorials on the failure of the company's officials to do their duty.

Stoppage of traffic followed the short-circuiting of three underground electric cables at Broadway and Vesey Street at eight o'clock Friday morning. It took an hour and a half to make temporary connections, and during that period cars were not running along Broadway south of Leonard Street, or on the East Side electric lines below Canal Street.

Last Wednesday the New York Central, through Eugene E. McLean, submitted its plans for the enlargement of its terminal yards from Forty-second Street to Fifty-seventh Street to the Board of Estimate. These plans are that the company will depress all of its tracks between Forty-fifth and Fifty-seventh Streets to such an extent as to enable the city to carry by viaducts or bridges over the tracks at a grade not exceeding four per cent. such of the intersecting streets from Forty-fifth to Fifty-sixth Streets as may be necessary in the public interest, the expense of extending these streets over the tracks to be borne by the city. It is thought that the Board of Estimate will ask remuneration for the above privileges, as, in all fairness to the Pennsylvania system, the New York Central company should pay for them.

Interesting statistics have been compiled concerning the street-railway traffic of the city. These give data for both the surface and elevated systems, and are, in part, as follows: During the fiscal year ended June 30, 1902, the surface and elevated railways of the city of New York carried 924,754,211 original passengers; that is, passengers paying fares. Counting the transfers, the total number of passengers carried was 1,160,030,344. It has been estimated that the railways carried last year over 1½ billion passengers. This is not the fact, for the reports of the railroads which have been sworn to and filed with the state railroad commissioners show that the surface railroads, excepting steam, and including the elevated roads, did not in the aggregate carry to exceed a billion and a half passengers.

The American Electrical Specialties Company of New York has been incorporated with a capital of $50,000. The board of directors includes James Jones, Jr., and Julius Silverman. O.

New England News.

Boston, December 19.—The Sandwich (Mass.) selectmen have granted a location to the Middleboro, Wareham and Buzzard's Bay Street Railway Company, which will build from Sandwich Depot to the Bourne line as early as possible in the spring. The Sandwich, Hyannis and Chatham Street Railway Company has been organized by people connected with the Middleboro, Wareham and Buzzard's Bay company, and will build an electric railway from Sandwich, Mass., to a point near Chatham light on Cape Cod, a distance of 45 miles, reaching towns on the south side of Cape Cod. The new company will have a capital of $500,000.

The Massachusetts Electric Companies has contracted for 10 2,000-kilowatt, turbo-alternators, to be placed in its power stations. The corporation will build stations at Quincy, Fall River and Davenport, Mass., and will close some of its smaller stations.

The selectmen of Ashfield and Buckland, Mass., have a petition to the Legislature asking for the incorporation of an electric-railway company, to build a road between Huntington and Conway, Mass. The proposed route is along a highway, three miles of which will be submerged if the city of Springfield decides to use the Huntington water supply, and Springfield officials will probably protest against the company's following this route. At Conway the proposed road will connect with the projected road to Greenfield, thus covering the territory between the Fitchburg and Boston and Albany Railroads. The company proposes to do a freight business.

The heavy snowstorm of last Saturday caused considerable delay on electric railways in this section. On Monday the Boston Elevated Railway Company employed some 600 teams and 2,000 extra men in removing the snow from the streets through which its lines pass. The company estimates that the storm cost it about $35,000.

At its next session the Connecticut Legislature will be asked to grant privileges to a number of electric-railway companies. The Connecticut Railway and Lighting Company wants to build an extension from Milford to Charles Island, a distance of three miles, and it proposes to establish a summer resort at Charles Island, which is situated in Long Island Sound. The Branford Lighting and Water Company desires to extend its road from Branford to Pine Orchard and Stony Creek, six miles. This will be part of the paralleling of the New York, New Haven and Hartford Railroad between New Haven and New London. The New London Street Railway Company wants to build extension to East New London and Riverside Park and the right to furnish light, power and heat to a proposed electric railway in Groton. Two officers of the company which proposes to build the road in Groton, will ask for a charter for an electric railway between Groton, Conn., and Westerly, R. I. They propose to build a double-track road through Poquonoc, Noank, Mystic and Stonington. It is reported that the New York, New Haven and Hartford Railroad Company is behind another scheme for building over this route. The Stamford Street Railway Company wants authority to make several extensions, including one nine miles long, to the New York state line at Long Ridge, Conn., and new lines to Noroton and Greenwich, Conn.

Stone & Webster of Boston have prepared plans for a wharf and power house for the Ponce (Porto Rico) Street Railroad Company.

The Enfield electric-light and power station at Thompsonville, Conn., is being enlarged by the building of an addition to accommodate more boilers and dynamos.

The Holyoke Water Power Company's lighting plants have been transferred to the city of Holyoke, Mass. The price paid was $706,543, which included the cost as determined by the awards and the fees of the commission that set the price. The city began the operation.

At Monday's meeting of the Boston aldermen, Alderman Norris called up his resolution that the city should not pay more than $75 per year per arc light pending the establishment of a municipal electric-lighting plant and that the mayor should ask the Legislature for authority to establish such a plant. In arguing in favor of a municipal plant, Alderman Norris stated that Boston was now paying $52,525 per annum for incandescent lights in its public buildings; that the city had paid $2,897,226 for arc lights during the past eight years; that had the city had a municipal plant during those eight years, the cost for arc lights would have been $1,326,868, or a saving of $1,570,358; that cities that have municipal plants pay an average of $44.54 per arc light per year, the highest price, $57.48, being paid by Chicago; that figuring on the same basis, Boston would have saved $375,000 on incandescent lighting in eight years, and that had Boston established a municipal plant in 1895, when the speaker advocated it, the city would own a plant worth $3,000,000 in 1910, and after that would save $62.97 per lamp per year. The resolution went over to next week's meeting of the board.

The annual meeting of the Massachusetts Electric Companies was held December 17th, with eight stockholders present. Richard Olney, C. E. Cotting, Eugene N. Foss, Percy Parker and C. F. Adams were re-elected trustees to serve three years. The annual report was accepted.

The Hartford and Middletown and the New Haven and Middletown Railway Companies have been organized and the capital stock, amounting to about $3,000,000, has been subscribed. The companies will build electric railways to connect the Connecticut cities mentioned in the titles. B.

Southern Developments.

Charlotte, N. C., December 19.—Capitalists from the North and from the Carolinas have purchased the Green River Narrows, three miles distant, where a 700-foot fall exists in half a mile, and will develop the same and bring the power to Saluda electrically, where a cotton factory and other manufactories will be built.

The promoters of the electric line from Nashville, Tenn., to Clarksville, state that the right-of-way having been secured they will begin work on the line in the early spring.

The town of Huntsville, Ala., will, on January 19th, vote on the question of issuing $20,000 electric-light bonds. The local electric-railway company states that before it will lose money by the establishment of a municipal plant, it will remove to another city.

Estimates have been prepared by Granbury Jackson of Mt. Pleasant, Tenn., for a combined water and light plant at Lawrenceburg, Tenn. A 50-kilowatt dynamo is provided for. The cost will be over $20,000. A bond issue will probably be ordered by the town to meet the expense.

The scheme to develop the big waterpower at Tallassee, near Montgomery, Ala., has proven a great success. The Montgomery Light and Waterpower Company, with $1,500,000 capital issued, and a similar amount in bonds, is the new concern just formed by consolidating two previously existing companies. Henry C. Jones has been the leading spirit in developing the waterpower and engineering the undertaking.

The Marion (S. C.) Water, Light and Power Com-

pany has been commissioned with a capital stock of $100,000. Arthur Dunn and A. N. Walker of Scranton, Pa., and J. W. Johnson of Marion are the incorporators.

The Hamlets (N. C.) Electric Light Company has been chartered, with $100,000 capital. G. O. Sanders is interested. L.

Detroit, Mich.

Detroit, Mich., December 20.—The St. Joseph and Elkhart Power Company is having some trouble in its effort to dam the St. Joseph River for the purpose of furnishing electrical power to manufacturers in South Bend and neighboring towns. The St. Joseph River Navigation Company has taken legal action in the federal courts to prevent the building of the dam which was to be located at a point six miles below South Bend, and which would prevent the plan of that company to navigate the river between St. Joseph and South Bend. It is claimed by the power company that it will cost in the neighborhood of $22,000,000 to make the stream navigable the year round, that the shipping facilities are adequate and that more power is what is needed.

Pennsylvania capitalists have organized in Grand Rapids the Grand Rapids and Chicago Railway Company, to build an electric road to Kalamazoo, Allegan and Benton Harbor.

The Saginaw-Flint electrical railway project is in discouraging straits. The Union Traction Company and the Saginaw Suburban are both reported unable to go ahead, and the recent effort of Saginaw capitalists to construct a line as soon as the weather permits is also a failure. The obstacle in the last instance is the Saginaw-Frankenmuth Electric Railway Company, which asks a large amount of right-of-way, the refusal of which is responsible for the defeat of this project.

The council of Lansing has asked the Hawks-Angus syndicate for better city service, and unless some of the provisions of the franchise are complied with in 30 days it will be subject to forfeiture. The council also gave the Lansing, St. Johns and St. Louis road an extension until March 1st within which to have its line operated with electricity.

The city of Benton Harbor has taken up the question of municipal electric lighting, and a committee was appointed to visit other towns to obtain the necessary information. It is claimed the rate now paid the private lighting company is too high. The contract with that company expires October 1, 1903. C. G. W.

From the Buckeye State.

Cleveland, Ohio, December 20.—The electric-light company at Ottawa has submitted a proposition to the City Council to lease the plant to it at a rental of $200 per month for 10 years.

The Atlantic Dynamo Company of New Jersey has been authorized to do business in Ohio.

A conductor on the Cedar Avenue line in Cleveland derailed his car a few days ago and saved it from being smashed by a freight train on the Nickel Plate road. This is the first time the derailer has been used for some time. The car was crowded.

The question of purchasing the waterworks and electric-light plant at Harrison, Ohio, will be decided by a vote of the people at the spring election. The plant is owned by James A. Graft, who has offered to sell it for $25,000.

The Zanesville Railway, Light and Power Company has completed plans for its new power house, which will be 130 by 72 feet in dimensions and will contain machinery with a capacity of 4,000 horsepower.

The Yost Electrical Manufacturing Company, with a capital stock of $75,000, has succeeded the Yost-Miller Electrical Company of Toledo, having purchased the plant, patents and everything connected with the business. The officers of the new company are as follows: President, J. M. Bour; vice-president, John Renner; secretary and treasurer, George F. Miller; general manager, J. L. Yost. Incandescent-lamp sockets is one of the principal products of the company.

Some of the Cleveland street cars have been equipped with bells at the rear to notify passengers who alight at crossings when another car is approaching on the other track. This will often prevent accidents caused by people walking around the rear of one car directly in front of one coming in the opposite direction. The bell is controlled by the motorman, who is in a position to know when passengers are likely to be in danger.

The Central Electric Company of Cincinnati has been incorporated with a capital stock of $10,000 to manufacture electrical machinery. Walter E. Fleming, W. E. Forshee and others are interested.

The Witzler Electric Light Company of Perrysburg has been incorporated with a capital stock of $10,000. C. F. Chapman, W. B. Duck and others are the incorporators.

Dr. Alois Zeckendorf, superintendent of the Fleischmann Distillery, Cincinnati, has invented an electric glove and shoe, designed to be worn by motormen on street cars. It consists of a glove or shoe with woolen lining, underneath which is coiled finely spun wire. A mild current of electricity is passed through this by means of attachments to the current, but it is said the articles are so made that it is impossible for the motorman to receive a shock from it. The street-railway officials have advised the gentleman to secure a patent on the device and believe it will be practical. O. M. C.

Information from Indiana.

Indianapolis, December 22.—The advent of winter in its mild form is proving conducive to electric-railway construction all over the state, and the work on a half dozen lines is farther advanced than was hoped for by the most sanguine promoters.

The Indiana Southern Electric Railway Company of Aurora filed articles of incorporation last week with an original stock capitalization of $10,000. This may be increased by resolution. The company proposes to build and operate a street railroad in Aurora and an interurban road between Aurora and Rising Sun, and to furnish electric light, heat and power to those and intervening cities. The incorporators are E. W. Swarthout, C. W. McMullen and others.

As predicted, the Indianapolis, Lebanon and Frankfort Traction Company, at a meeting last week, changed its name to the Indianapolis and Northern Traction Company, and reincorporated with a capital stock of $2,500,000, with the privilege of a further increase to $3,000,000. The officers of the new corporation are: President, George Townsend, Indianapolis; vice-president, P. L. Saltonstall, Boston; secretary, Winthrop Smith, Boston; treasurer, W. S. Reed, Indianapolis. Work on this system began last April, and the Indianapolis-Lebanon branch is nearly completed. The Frankfort and Lafayette branches will be built in the order named, and the entire system is expected to be in operation before December, 1903.

There is a spirited fight on hand at Kokomo, where five franchises are being asked from the City Council. The petitioners are George J. Marrott of Indianapolis, who wants a 30-year extension of his Kokomo street-railway and electric-light franchises and a franchise for steam heating, and George F. McCulloch of Anderson, who wants a 30-year franchise for an electric-lighting system and for certain concessions for his interurban line, for which the city has already granted a franchise.

The municipal electric-light plant of Richmond is still a source of annoyance to the city administration. The council has ordered the Electric Light Commission, which has full power, to make a thorough investigation of the management, and the capacity and imperfections of the plant.

The Hercules Electric and Manufacturing Company of Indianapolis has been incorporated with a capital stock of $10,000. The company will manufacture electric generators, machinery and apparatus. S. J. Kurtz, A. H. and F. H. Blackleye constitute the incorporators. F.

Northwestern Notations.

Minneapolis, December 20.—The Electric Light and Power Company of Hastings, Minn., will change its system of street lighting, and will install 30 enclosed arcs of 2,000 candlepower for $150 a month. Four are to burn all night and the remainder are on the moonlight schedule.

The installation of meters at Fergus Falls, Minn., has reduced the consumption of electricity in a marked degree. The superintendent finds that about 70 less horsepower is required to run the lights this year than last, which is equivalent to a reduction of about 700 lights. About 800 new lights have been added for new buildings, so that the actual reduction is considerably more than 700. There is now plenty of power to run the system, and the revenue coming in is greater than the flat rate produced.

It is reported that all arrangements have been completed and contracts let for the construction of an electric interurban line between Iowa City and Cedar Rapids, Iowa. Grading will begin as soon as the frost is out of the ground and will be rushed to have the line completed before the summer is over. It is expected to have the line in operation by July 1st.

The stockholders of the Union Electric Company of Dubuque, Iowa, have decided to erect an entire new plant at a cost of $200,000. It will be one of the largest in the West, and will contain all the latest features available.

S. Stewart of Morris, Minn., has asked the council to permit him to string wires on the telephone poles to supply the business portion of the city with lights. The Fowler Electric Company, which has a franchise for lighting the town, objects to the request.

Business men of Des Moines are complaining over increased charges made by the Edison Electric Light Company there. The charge for elevator power, which has been $2.50 per kilowatt, has mounted up to $7 in some cases, the company stating that such business was not desired, as it imposes a heavy strain on the plant. Bills for lighting show a tendency to grow beyond previous years. The company has the field alone, and the result is considerable talk of a municipal plant.

The council of Perham, Minn., has raised the minimum rate for electric lighting from 25 to 50 cents per month.

The Great Northern Railway Company expects to develop power from the Tumwater Falls in Washington, using the electric power to operate its trains through the long Cascade tunnel. The tunnel is about 2½ miles long and the engines leave gases and smoke in the tunnel that in several instances have been fatal to the crews of the locomotives. To obviate this, the company will not run engines through.

The mayor of Spearfish, S. D., is in a controversy with the council over a proposed extension of the electric-lighting system. A resolution passed the council providing for more light, but was vetoed by the mayor, who declared there was no provision in the annual appropriation for the increased expense. The councilmen threaten to carry the resolution over the mayor's veto.

Waterloo, Iowa, is considering a project to install a city lighting plant.

L. W. Reynolds announced at Boone, Iowa, that an electric railroad would be built by eastern men from Boone to Webster City and Fraser, about 65 miles. After this is completed, the road would be extended to Minnesota and the lake region.

The Belt Light and Power Company has about completed a new power building at Lead, S. D., which is built over the old building without interfering with the operation of the plant. Considerable new machinery has been ordered and will be installed at once. The company has extended its lighting system from Lead to Terraville and Central City.

The board of water commissioners of St. Paul has filed suit against the St. Paul City Railway Company to recover damages of $500,000 for injuries alleged to have been caused by electrolysis to the city water pipes. The court is asked to restrain the company from using the mains for conveying the return current. The complaint states that the company is able to avoid the leakage of the return current by instituting the double-trolley system.

Verndale, Minn., offered free wiring for all orders for electric lighting received before January 1st, and received orders for over 300 lights almost at once. The new plant is approaching completion and the wiring will be done as rapidly as possible.

Winona, Minn., will take bids at once for the installation of a municipal electric-lighting plant. A system equal to 390 arc lights of 1,200 candlepower is projected. The estimated cost is about $40,000.

The Creston Electric Railway, Light, Heat and Power Company announces that the proposed interurban line from Creston to Winterset, via Leith City and Macksburg, will be completed and in operation by January 1, 1904. Contracts have been awarded to the Collins Construction Company of Chicago, which will proceed with the work in the spring.

Business men of Calumet, Mich., have organized a company to maintain a heating and lighting plant. The village retains the right to purchase the plant at the expiration of five years or at any five-year period thereafter.

The earnings of the municipal lighting plant of Marquette, Mich., for November of this year exceed all previous records, reaching a total of $3,368, an increase of 12 per cent. over the preceding month. In November of 1901 the receipts were $2,868.

Grinnell, Iowa, will vote January 16th on granting a new franchise to the Grinnell Electric and Heating Company. The company seeks to make extensive improvements to its plant.

B. Pulford of Savanna, Iowa, will erect a new power building for his electric-light plant and will add a new Corliss engine and a 5,000-light dynamo. The plant is to be completed in the spring.

The Twin City Rapid Transit Company has completed a supplementary power plant on Selby Avenue in St. Paul, adding about 1,200 horsepower, and it is thought that it will not be necessary to curtail the service again, as has been the case for several weeks, owing to low water in the river.

The council of Moorhead, Minn., has granted a franchise to the proposed street-railway company. It must be ratified by the voters before it becomes effective.

The Aberdeen Gas Company of Aberdeen, S. D., controls the electric-light and gas systems of that city. The company asks a new franchise in order to make extensive improvements to both plants, that to the electric-light plant to cost $30,000. R.

Canadian Intelligence.

Toronto, December 20.—The City Council has appointed W. T. Jennings, a former city engineer, to prepare a special report on the best way of letting the radial electric railways into the city. He is said to favor the third-rail proposition, by which the gauges of the Metropolitan and Toronto railways would be harmonized.

An agreement has been reached between City Engineer Rust and Manager Keating of the street-railway company, as to the terms upon which the company stands prepared to construct a loop line on Lake Street, which is to be built and ready to accommodate the steamboat traffic in the spring. This will include the proposed overhead bridge at the foot of Young Street which the city will have to build, and which the city wants the railway company to contribute towards the cost of, but the company thinks it should have the right to extend its tracks and service across the proposed bridge free of all additional expense. The city will pay all expenses in connection with the work except the expense of supplying the rails and laying the same. The company is not to be called on to operate the service during the winter months, or when the steamboats are not running. Ordinary "T" rails are to

be used in the extension, and the company is not to be called upon to take up these rails for a period of four years, and after that only in the event of the city deciding to lay down a permanent pavement.

The Hamilton and Barton incline electric railway, under a new decision of the Hamilton judge, is to be assessed as scrap iron and not as a street railway. H.

PERSONAL.

A. A. Serva of the Fort Wayne Electric Works, Fort Wayne, was among last week's Chicago visitors.

A. P. Munning of the New York office of the Cutler-Hammer Manufacturing Company was in Chicago last week in the interests of his company.

William Henry Spencer, for the last 15 years chief operator of the Western Union Telegraph Company at St. Louis, Mo., died in that city on November 28th, after a long illness.

H. D. Handford, who has been connected with the Puget Sound Electric Railway Company, has removed to Indiana and been appointed constructing engineer of the Noblesville branch of the Indianapolis-Northern Traction Company.

C. O. Fitch, electrician of the Cudahy Packing Company of Omaha, Neb., has resigned his position to accept an appointment as superintendent of power and wires for the Hudson Valley Railway Company, with headquarters at Glens Falls, N. Y.

E. J. Lavens, formerly connected with the General Incandescent Arc Light Company, will assume entire charge of the panel-board, switchboard and switch departments of the Bossert Electric Construction Company of Utica, N. Y., on January 1st.

General Wager Swayne, general counsel for the Western Union Telegraph Company and the Wabash Railroad Company and located in New York, died on December 18th, at his home in that city. General Swayne was born in Columbus, Ohio, in 1834. He was educated at Yale, afterward studying law at the Cincinnati Law School.

Emmett Howard, who retired from the management of the Western Union Telegraph Company's office at Memphis, Tenn., on December 1st, held that position for over 21 years, entering upon its duties in 1881. Mr. Howard made a host of friends while filling his position with the Western Union company. He will take up other business in Memphis and continue to make his home there.

Dr. H. Preston Pratt, a well-known Chicago investigator in skiagraphy, has been appointed X-ray expert and electrical diagnostician of the law department of the city of Chicago, by City Attorney Owens. Mr. Owens says that this office has become necessary on account of numerous attempts at fraud through the evidence of X-ray and electrical so-called "experts" in claims against the city for personal injuries.

The Massachusetts Institute of Technology Corporation has chosen Elihu Thomson, the well-known electrician, as non-resident professor of applied electricity, and Percival Lowell, director of the Lowell Observatory at Flagstaff, Ariz., as non-resident professor of astronomy. The appointees will give courses of lectures on their chosen subjects. Professor Thomson has been a lecturer at the Institute for several years.

Henry A. Everett took charge of the Toledo Railway and Light Company as president last week, succeeding Albion E. Lang, who resigned to take a rest and make a tour of the globe. A pleasant incident in connection with the transfer of the office was the presentation of a very handsome watch to Mr. Lang by the men in his employment. The committee went to the directors' office while the board was in session, and Thomas McMahon, a conductor, made one of the prettiest little addresses that those present had heard in a long time.

Charles P. Griffin, president of the Toledo and Indiana Electric Railway Company, died suddenly at his home in Toledo on December 18th, after a short illness. The road had just been opened, and Mr. Griffin was devoting all his energies to secure its completion to Wauseon at an early date. The deceased did not become interested in electric railways until a few years ago, but since that time he has given them a great deal of time, and the Toledo and Indiana will be a monument to his name. A wife, one son and two daughters survive him.

At the annual meeting of the Engineers' Club of St. Louis recently the annual prize, consisting of $50 in gold and an engraved certificate, was awarded to Henry H. Humphrey for the best paper presented to the club during the closing year. This paper was entitled "On the Use of Beaumont Oil as Fuel." Mr. Humphrey is the consulting electrical and mechanical engineer of St. Louis who established more than a local reputation by designing, during 1901, a complete power plant of 1,500 horsepower for the DeBeers Explosive Works at Cape Town, Africa.

Mr. Francis E. Drake, an American electrical man well known and well liked, has returned to this country after three years' absence abroad. His latest work was the reorganization of the Union Elektricitäts Gesellschaft of Berlin. Prior to that time Mr. Drake was a member of the American Commission to the Paris Exposition and one of the international jurors. Just before leaving Berlin Mr. Drake and his assistant, Mr. C. S. Colton, were tendered a farewell testimonial dinner by the officers of the Union company. At this dinner, over which Herr Commerzienrath Loewe, president of the company, presided, the warmest encomiums were expressed on the work of the guests of honor, and the 40 gentlemen present united in regretting that Mr. Drake felt it necessary to sever the ties that bound him to Germany. Mr. Drake is now in Chicago, where he will remain for a few days.

ELECTRIC LIGHTING.

An electric-light plant, to cost $5,000, will be built at Dallastown, Pa., to supply current for lighting and power purposes.

The Atkinson Heat and Light Company of Atkinson, Neb., has been incorporated with a capital of $5,000. The company purposes to construct and operate electric-light plants. The incorporators are Dell Akin, W. H. Allen, J. P. McNichols and others.

The City Council of Huntsville, Tenn., has called a special election to be held on January 19, 1903. At that time a vote will be taken on the question of issuing $20,000 of bonds for the purpose of building and equipping a municipal electric-light plant.

The United Gas and Electric Company of San Jose, Cal., has ordered a new battery of Babcock & Wilcox boilers and a 900-horsepower engine, the latter to be direct-connected to a new General Electric generator. This will give the plant a total of 12,000 horsepower, which is said to be equal to the output of any plant in the state.

ELECTRIC RAILWAYS.

The Chicago City Railway Company expects to place 80 new cars on its electric lines in Chicago on February 12th. The company's officials state that their service has been hampered by a lack of electric power, but that it is installing machinery for 2,700 horsepower, and when it is ready large cars will be put on the electric lines.

Justice Betts in the Supreme Court has appointed Joseph A. Duffy of New York city receiver for the New Paltz and Poughkeepsie Traction Company, in an action brought against it by the Franklin Trust Company of Brooklyn, to foreclose a mortgage. The receiver's bond was fixed at $40,000. The traction company operates an electric road which crosses the Poughkeepsie Bridge.

The Seattle-Everett Interurban Railway of Seattle, Wash., has been incorporated, with a capital stock of $1,500,000, to operate a trolley system between Seattle and Everett, both in the state of Washington. The trustees and incorporators are M. D. Haynes, James E. McMurray, Fred E. Sander and Charles E. Shepard. The distance between the two termini is 33 miles.

A petition for a rehearing in the transfer cases of the Chicago street-railway companies against the city of Chicago has been denied by the Supreme Court of Illinois. This ends the litigation regarding the transfer cases so far as Illinois courts are concerned, but the cases, it is said, will be taken to the United States Supreme Court. The state Supreme Court some time ago held that the street-railway companies must give transfers on all their lines.

A Pittsburg dispatch states that after keen competition and extended trial of the different systems of train control, the Brooklyn Rapid Transit Company of Brooklyn, N. Y., has awarded the contract for all its elevated trains to the Westinghouse Electric and Manufacturing Company for the Westinghouse electro-pneumatic control. Among the special advantages claimed for this system of control is the feature than any derangement will at once shut off the current and bring the train to a stop. There are said to have been instances recently with some other systems where the power could not be shut off.

The American Railways Company of Philadelphia reports the following earnings for the month of November: Total gross earnings, $94,599, as compared with $73,815 for the same month in 1901; total for the five months commencing with July 1, 1902, $544,058, or $126,111 more than was earned during the same period last year. The company has an authorized capital stock of $25,000,000, of which $3,751,000 is outstanding. The officers of the company, whose headquarters are at Philadelphia, are as follows: President, Samuel G. De Coursey; vice-president, William F. Harrity; secretary and treasurer, C. L. S. Tingley; general manager, H. J. Crowley.

The Union Railway Company of New York city is about to build a large sub-station at West Farms, for which it has purchased from the Westinghouse Electric and Manufacturing Company a large amount of apparatus, including three 1,000-kilowatt, three-phase rotary converters, with starting motors, self-cooling, oil-insulated transformers and alternating-current and direct-current switchboards. The transmission will be at 6,300 volts and 3,000 alternations. The alternating-current switchboard wil be equipped with new type of oil-break, electrically operated switches. The Bayard Street station of the Metropolitan Street Railway Company of New York city is also being equipped with these switches.

POWER TRANSMISSION.

The Hannawa Falls Water Power Company of Potsdam, N. Y., has gone into the hands of a receiver. The receiver, E. J. Page of Syracuse, was appointed by Justice Houghton of Saratoga Springs, who made the order on the petition of a majority of the company's directors who declared that the company was insolvent, and asked for its voluntary dissolution.

The Home Electric Company of Correctionville, Iowa, has been incorporated with a capital stock of $10,000. The company will begin business on January 1, 1903. The corporation purposes to furnish electric power to the Sioux Valley Milling Company, which company is to have a representative on the board of directors. The incorporators are M. H. Harter, N. S. Harper, E. H. Baldwin and E. C. Bailey.

The trustees of the Sanitary District of Chicago are considering the plan to ask the Illinois Legislature to pass a bill this winter authorizing the district to develop the canal waterpower for the use of the city of Chicago. This work will require the expenditure of several million dollars, and the necessary funds will have to be obtained either by the sale of bonds or an increase in the direct tax allowed the Sanitary District. The present bonded indebtedness of the district is $16,300,000, and cannot be increased under the existing revenue laws without action by the Legislature. It is suggested that the Legislature might pass a bill increasing the drainage-board tax from one-half of one per cent. to one per cent.

SOCIETIES AND SCHOOLS.

It is said that the British Association has accepted an invitation from the British South Africa Company to hold its annual meeting in 1905 at Victoria Falls, on the Zambesi River. The company has set aside $35,000 for the expenses of the scientists.

The November bulletin of the Lowell Textile School of Lowell, Mass., contains illustrations of three of its buildings and information concerning the growth of the school. A new course in electricity in charge of E. E. Nelson has been successfully launched. A modern system of electric transmission is being installed in one of the new buildings.

The Massachusetts Institute of Technology, Boston, Mass., will confer the degree of doctor of engineering (Eng. D.) upon students in a graduate school of engineering research to be opened October 7, 1903. Students of marked ability who have received a degree of bachelor of science or have done work equivalent thereto, will be admitted to the school upon proper application and acceptance. Six fellowships of $500 will be open to competition at the opening of the year 1903-04.

The International Association of Municipal Electricians, through its executive committee, announces that several papers covering many subjects of interest to electrical engineers, have already been promised for its next convention. The committee will be pleased to receive any additional suggestions and offers of papers. These suggestions should reach the committee not later than February 1, 1903, and the papers must be in the hands of Frank P. Foster, Corning, N. Y., secretary, not later than July 1, 1903. With a view of increasing the value of its question box, members desiring information on subjects connected with municipal electrical affairs are invited to send their questions to the committee.

PUBLICATIONS.

The Ball Engine Company of Erie, Pa., issues an illustrated circular descriptive of its new steam-engine governor.

Descriptive catalogues for filing, reference, and specification purposes are requested by George Welsby Scott, consulting engineer, 758 The Rookery, Chicago.

"Twenty Chapters of Reasonable Arc-lamp Talk" is the title of a neat little booklet just issued by the Electric Appliance Company, Chicago, which is selling agent for the Adams-Bagnall arc lamps.

An attractive mailing card distributed by the Buffalo Forge Company of Buffalo, N. Y., shows views of the seventeenth-century iron foundry in France and also the metallurgists of antiquity. Various Buffalo cupola blowers and exhausters are illustrated on the reverse of the card.

MISCELLANEOUS.

The Phosphorous Compounds Company has been incorporated in New York state and will do business at Niagara Falls. The incorporators are George M. Prest, Perry J. Fuller and Joseph S. Richards, all of New York. It is also understood Niagara Falls men will be interested. The company will manufacture and handle phosphorous compounds, alkalies, chemicals, etc.

A new form of guy anchor for use in pole-line construction appears on the market. The anchor is designed like a screw, so that it can be placed in position without digging, filling or tamping. This

leaves the ground undisturbed, and hence a tremendous pull can be placed upon the anchor without dislodging it. A 12-inch anchor is acredited with having successfully withstood a pull of 36,000 pounds when bored into five feet of clay.

TRADE NEWS.

The Central Electric Company of Cincinnati, Ohio, has been incorporated with a capital of $10,000. The incorporators are W. E. Fleming, W. O. Kline, W. E. Beggs and J. B. Taylor.

The Putnam Electric Company of Brazil, Ind., has been incorporated with a capital of $200,000. The incorporators are J. P. Bryson, R. N. Bryson, J. N. Halstead and William E. Halstead.

The New Jersey Autolectric Company has been incorporated with an authorized capital stock of $100,000. The incorporators are George M. Babcock, Edward N. Van Vliet and Lyman B. Robinson.

The Nebraska Electric and Fixture Company of Omaha, Neb., has been incorporated with a capital stock of $50,000. The corporation may manufacture motors, dynamos and electrical appliances. Among the incorporators are P. W. Horbach, A. G. Munroe and E. J. Sullivan.

The New York Central Railroad Company has made a contract with the General Electric Company and with Westinghouse, Church, Kerr & Co. for the installation of steam engines and electric alternating-current generators for the Weehawken, N. J. (West Shore terminal) station. The company is expending some $50,000 on its electric plant there.

Interests of the Chas. K. Hill electric supply houses of Pittsburg, Pa., are forming the Crescent Electric and Manufacturing Company. The company will be incorporated on December 30th. The company will capitalize at $12,000, this capitalization to be increased to $50,000 later on. The incorporators and directors will be Charles K. Hill, J. D. McNeil and W. F. Mitchell.

John A. Stewart, for many years connected with the General Electric Company, the Bullock Electric Manufacturing Company and Rossiter, McGovern & Co., has started into business for himself in Cincinnati and Ludlow, Ky., under the firm name of the John A. Stewart Electric Company. Mr. Stewart's company will deal in second-hand electrical machinery of every description, and it has already secured considerable electrical apparatus. The company has leased a three-story factory building, having 150,000 square feet of floor space, at Ludlow, Ky., which will be converted into smelting works for the refining of metals for its own use as well as for the trade. The factory has a large foundry in connection for the production of armature coils and commutator parts. A part of the factory will be used for a second-hand electrical machinery warehouse.

The Curtiss-Crippen Engineering Company, doing an engineering and contracting business for complete installations, with offices in the Monadnock Block, Chicago, is sales agent for the DeLaval Steam Turbine Company and the sales of the DeLaval turbine outfits in this section are being actively pushed by L. F. Mahler, district manager. Mr. Mahler has acted as engineer of installations for most of the European representatives of the DeLaval system, as well as for the American factory. Mr. Mahler is also district manager of the New York Electric Headlight and Train Lighting Company, which uses the DeLaval system. The sets put out by this company take up the space of an ordinary trunk, and are placed in one corner of the baggage car, taking steam from the engine at any pressure. Equipments of this nature are in operation on the Pennsylvania and Pullman systems, and are said to be giving satisfaction. Frank B. Rae, well known to the western engineering fraternity, is consulting engineer of the Curtiss-Crippen Engineering Company.

BUSINESS.

J. H. Fowler, president of the Fowler-Jacobs Company, Chicago, producer of cedar poles and other cedar products, states that his company has done three times as much business this year as last year. This company is said to be one of the largest producers of cedar poles, and has unsurpassed facilities for getting the poles out of the woods. The Fowler company has supplied poles to many of the leading telephone, telegraph, electric-light and street-railway companies, and, judging from present indications, the coming year promises to be productive of a larger volume of business than any previous year.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office), December 16, 1902.

715,740. Draw Bench. George Baehr, McKeesport, Pa., assignor to the National Tube Company, Pittsburg, Pa. Application filed February 14, 1902.

In an apparatus for forming tubing are combined an electric motor for actuating the drawing mechanism, a generator having two field windings of different carrying capacities and wound in opposite directions, the larger of the field windings being connected in series with the armature of the motor, the windings being so proportioned as to neutralize each other when the motor is running under a friction or light load, and a source of current for exciting the generator fields.

715,741. Interchangeable Direct and Alternating-current Arc Lamp. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed March 11, 1902.

The lamp has a movable carbon and a clutch mechanism mounted on a non-vibrating metallic flexible support and placed in operative relation to the carbon.

715,797. Electric Arc Lamp. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va., and Philadelphia, Pa. Application filed April 7, 1902.

In the lamp are a clutch for feeding one of the carbons, a solenoid controlling the reciprocation of the clutch, a dash-pot provided with a piston adapted to reciprocate readily during normal reciprocation of the clutch and means for checking or braking the abnormal movements of the piston.

715,798. Insulating Metallic Surfaces or Wires. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va., and Philadelphia, Pa. Application filed April 10, 1902.

The compound consists of asbestos combined with an albumen aluminated borate of lime amalgam.

715,817. Communication With the Aid of Electromagnetic Devices. Isidor Kitsee, Philadelphia, Pa. Application filed June 19, 1897. Renewed April 29, 1902.

In a system of telegraphy are two or more sending and receiving stations, means at the sending station for generating magnetic impulses of opposite polarity, means for carrying the generated impulses between the sending and receiving stations and means at the receiving station for receiving the magnetic impulses.

715,821. Driving Mechanism for Motor Vehicles. Joseph Ledwinka, Chicago, Ill., assignor to the Imperial Electric Motor Company. Application filed February 10, 1902.

Combined with a vehicle wheel is a motor arranged at the inner end of the vehicle-wheel hub and having its armature shaft extended through the hollow axle. Power-transmitting connection is provided for driving the vehicle wheel.

715,827. Rheostat. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 22, 1901.

The rheostat comprises a number of resistance units having all parts of their length exposed to the air, each unit being supported between two wire screens and mounted on heat-refractory insulating plugs carried by the screens.

715,856. Method of Drawing Butt-weld Pipe. Peter Patterson, McKeesport, Pa., assignor to the National Tube Company, New York, N. Y. Application filed May 14, 1901. Renewed January 2, 1902.

The method of forming butt-weld tubing consists in introducing a tube-blank into a heating furnace, raising its edges to a welding heat, and then drawing the same by means of an electric motor out of the furnace until its front end has entered a welding bell, and then increasing the speed of drawing the blank through the bell.

715,857. Apparatus for Drawing Butt-weld Pipe. Peter Patterson, McKeesport, Pa., assignor to the National Tube Company, New York, N. Y. Application filed May 14, 1901. Renewed January 2, 1902.

There are two motors of different speeds, one of which is permanently geared to the draw chain, and an electric clutch for coupling the other motor to the draw-chain.

715,875. High-potential Insulator. George H. Rupley, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 13, 1901.

The insulator consists of two concentric tubes of insulating material with an annular space between them, and a filling of insulating material containing a hydrocarbon in the space.

715,878. Swiveling Trumpet for Telephones. Arthur Schoeler, Elberfeld, Germany. Application filed April 7, 1902.

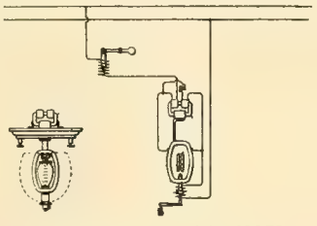
A swiveling bent trumpet is attached to a telephone casing.

715,901. Controlling Electric Arcs. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 12, 1902.

Combined with stationary electrodes are means for starting an arc between the electrodes, a coil for controlling the arc, and means for supplying the coil with a current due to the differential action of two currents, one flowing in shunt to the arc and the other in series therewith. (See cut.)

715,920. Electric Battery. David H. Wilson, Chicago, Ill. Application filed April 30, 1902.

The electrode comprises two cups or receptacles integral with each other and separated by a suitable space, the cups or receptacles opening in opposite directions.



NO. 715,901.—ARC CONTROLLER.

715,930. Transformer for Polyphase Alternating Currents. Emil Ziehl, Berlin, Germany, assignor to the Berliner Maschinenbau-Actien-Gesellschaft, vorm. L. Schwartzkopff, Berlin, Germany. Application filed June 20, 1902.

There are two longitudinal cores, end bridges and intermediate connection bridges with coils placed on both longitudinal cores, the coils of each phase being placed opposite one another partly on the one and partly on the other longitudinal core.

715,975. Controller for Electric Motors. Eugene R. Carichoff, East Orange, N. J. Application filed August 1, 1901.

In the controller combined with the controller cylinder and driving means for imparting motion thereto, are a notched wheel and spring pawl for intermittently and yieldingly retarding the rotation of the cylinder, and a torsion spring for transmitting in either direction to the cylinder quicker impulses of motion than those given by the driving means, a portion of the driving means lying normally between and adapted to engage either end of the spring to place it under tension.

715,983. Trolley Wheel. Leonard Chroninger and John E. Adams, Findlay, Ohio. Application filed May 21, 1902.

The trolley has a specially formed wheel.

715,999. Telephone System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill. Application filed June 17, 1901.

See page 466.

716,000. Apparatus for Communicating Signals Through Space. Lee De Forest, Chicago, and Edwin H. Smythe, Freeport, Ill., assignors to the Wireless Telegraph Company of America. Application filed July 5, 1901.

See page 468.

716,008. Working Zinc and Substances Containing Silicic Acid in Electric Furnaces. Alfred Dorsemagen, Wesel, Germany. Application filed August 24, 1901.

A method of working a zinc silicate ore consists in preparing a charge of zinc silicate and carbon, then subjecting the charge to the action of an electric current sufficient to determine the reduction and volatilization of the zinc and the formation of carbide of silicon, and then suitably condensing the products of reduction and volatilization.

716,033. Overhead Electric Carrier and Hoisting Device. Henry M. Harding, New York, N. Y. Application filed January 16, 1902.

In the device are combined a motor, a track on which the motor travels, an arm depending from the motor, the lower end of the arm being bent at an angle, and an electric hoisting device supported on the angular portion.

716,048. Electric Heater. Joseph H. Jenkins, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 24, 1897.

The heater comprises a flexible core bent into a series of alternate helical coils and bends or loops, a resistance wire helically wound about the respective helical coils of the core, and means for supporting the core at the respective bends or loops thereof.

716,056. Storage Battery. Edgar J. Knapp, Chicago, Ill. Application filed May 19, 1902.

A storage-battery plate is provided with constraining means at its corner portions for maintaining it in its normal plane against buckling or curling tendencies, the means being in the form of corner caps.

716,065. Automobile. Joseph Ledwinka, Chicago, Ill., assignor to the Imperial Electric Motor Company, Chicago, Ill. Application filed January 31, 1902.

A motor member is arranged at the inner end of the wheel-hub of one of the wheels. There are means for mounting the motor member so that it in effect forms a single unitary structure with the wheel axle, and a pivotal connection between the unitary structure and the axle member, whereby the motor member and wheel together can be turned relatively to the axle member. (See cut on next page.)

716,101. Electric Railway. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 28, 1900.

See page 469.

716,102. Compounding Dynamo-electric Machines. Edward B. Raymond, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 31, 1896.

Combined with an electric circuit of a shunt transformer are a series transformer shunted by a phase-shifting device, and a circuit connecting the secondaries in series, with their electromotive forces in partial opposition.

716,103. Electric Measuring Instrument. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 20, 1901.

The instrument has a current-carrying conductor mounted for lateral movement in a narrow gap between the poles of a magnet, the conductor being fixed at one end and connected at the other with an indicating device.

716,113. Driving Mechanism of Motor Cars. Albert Schmid, Havre, France. Application filed January 28, 1902.

The mechanism comprises an internal combustion engine, a dynamo having a double-wound armature and driven by the engine, the dynamo having two commutators and two sets of brushes, a pair of electric motors connected to the dynamo and arranged to drive the vehicle, and a controller arranged to change the connections of the dynamo.

716,125. Electric Railway. Elmer A. Sperry, Cleveland, Ohio. Application filed October 20, 1902.

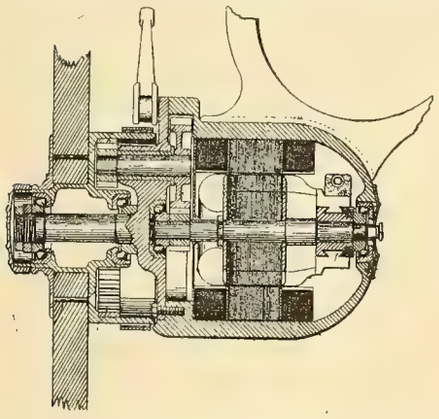
See page 469

716,130. Alternating-current Electric Meter. Chas. P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 11, 1898.

The method of registering a predetermined proportional amount of wattless current in an alternating-current circuit consists in producing in one or more of the coils of an electric registering or indicating instrument an inductive reactive effect and a resultant relative shifting of the actuating magnetomotive forces, corresponding to the proportionate amount of wattless current to be measured, and actuating properly adjusted registering or indicating mechanism, by the magnetomotive forces due to the currents in the coils of the instrument. (See cut.)

716,131. Electric Regulator. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 24, 1902.

A machine adapted to generate alternating currents is combined with means traversed by currents from the machine and responsive to the frequency of the currents and to the load on the machine for regulating the speed of the machine.



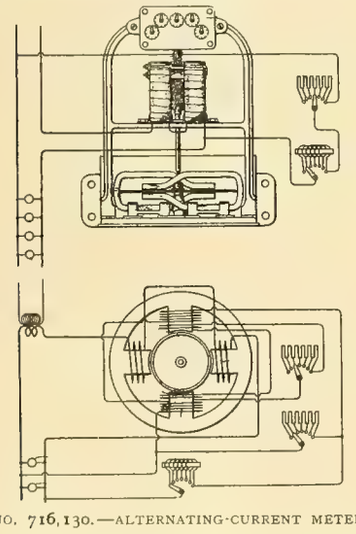
NO. 716,065.—AUTOMOBILE.

716,134. Method of Determining the Direction of Space-telegraph Signals. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed January 23, 1901.

For this and three succeeding patents see page 468.

716,135. Apparatus for Determining the Direction of Space-telegraph Signals. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne, and Brainerd T. Judkins, trustees. Application filed January 23, 1901.

716,136. Apparatus for Simultaneously Transmitting and Receiving Space-telegraph Signals. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed January 23, 1901. Renewed February 24, 1902.



NO. 716,130.—ALTERNATING-CURRENT METER.

716,137. Method of Simultaneously Transmitting and Receiving Space-telegraph Signals. John S. Stone, Boston, Mass., assignor to Louis E. Whicher, Alexander P. Browne and Brainerd T. Judkins, trustees. Application filed January 23, 1901. Renewed February 24, 1902.

716,155. Electric Cable. Julius H. West, Berlin, Germany. Application filed September 21, 1901.

The cable comprises a zigzag strip of insulating material provided with notches and wires in the notches.

716,178. Railway Signaling System. Henry Bezer, New Rochelle, N. Y. Application filed November 25, 1898.

In the system are a normally closed circuit including a pair of opposed electromagnets, a shunt circuit including one of the electromagnets and excluding the other, and an armature between the electromagnets. The electromagnets and armature are so constructed that the attractive force of the electromagnet excluded from the shunt circuit will normally preponderate in all positions of the armature.

716,179. Railway Signaling System. Henry Bezer, Kingsland, N. J. Application filed December 6, 1899. Renewed May 16, 1902.

The rails of a track are combined with a non-polar relay having opposed coils and an armature between the coils, the relay having its opposed coils connected in series with such rails, and means for sending an electric current differentially through such coils.

716,186. Combined Telephone and Telegraph System. Charles E. Buell, Camden, N. J. Application filed February 26, 1902.

716,189. Motor-control System. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 3, 1901.

The inventor describes a motor-controller consisting of a group of independent elements arranged to control both the direction of rotation and the speed of one or more motors, each of the elements comprising a single set of contacts connected to the motor circuit, and means for actuating the same.

716,193. Dynamo-electric Machine. Oliver F. Conklin, Springfield, Ohio. Application filed August 11, 1902.

In the armature are combined the coils support and commutator. A fan is placed between the support and commutator, and there are openings through the support forming the intake for the fan, and coils on the support also supported by the fan and arranged with openings forming the discharge for the fan.

716,200. Controlling Electric Motors. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 2, 1899.

A combined magnetic and friction brake for electrically driven devices is described. It comprises connections for short-circuiting the propelling motor when the supply circuit is broken, a friction brake, a coil holding the latter released when the circuit is closed, and an auxiliary releasing coil controlled by current in the short-circuit.

716,203. Wireless Telegraphy. Lee De Forest, Chicago, and Edwin H. Smythe, Freeport, Ill. Application filed September 1, 1900.

See page 468.

716,206. Inductance Coil. Friedrich Dolezalek, Halensee, Germany, assignor to Siemens & Halske, Aktiengesellschaft, Berlin, Germany. Application filed July 19, 1902.

The coil has a magnetic core, and a winding surrounding the core and composed of a number of fine wires enveloped in a common insulating covering.

716,222. Rheostat. John L. Hall, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 27, 1901.

The rheostat is provided with a retractile switch arm, a spring actuated detent on the arm, a frame co-operating with the detent pivoted to yield in the direction of strain on the arm and adapted to engage the switch in different positions, and electromagnetic means for releasing the engagement.

716,243. Safety Apparatus for Hoisting Engines. Jaroslav Karlik, Gottesberg, and Martin Witte, Waldenburg, Germany. Application filed May 17, 1902.

Means are electrically operated by the explosion of a cartridge for actuating a brake.

716,252. Electric Brush. Robert D. Laughlin, Ravenna, Ohio, assignor to the National Carbon Company, Cleveland, Ohio. Application filed May 10, 1902.

A laminated electric brush is composed of alternate layers of carbon and plumbago.

716,263. Speed Indicator. Laurence Mott, New York, N. Y. Application filed February 11, 1902.

One claim reads: In a speed indicator the combination of a rotary support, a relatively fixed support, conductors forming parts of a circuit and carried respectively by each of the supports, an electric lamp on the fixed support controlled by the circuit, continuously contacting conductors on the respective supports for preserving the continuity of the circuit between the supports, a centrifugally actuated device on the rotary support, and contacts on the rotary support included in the circuit and adapted to be brought together by the device, whereby a continuous illumination of the lamp is secured when the contacts are together. (See cut.)

716,278. Cooling Dynamo-electric Machines. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 26, 1901.

The machine has casing heads provided with radial ribs, thin partitions secured to the ribs with openings at the outer and inner edges, and means for causing the air in the casing to flow radially inward between the heads and the partitions.

716,293. Supervisory Signal for Telephone Exchange Systems. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 1, 1901.

See page 466.

716,301. Signaling. Raymond C. Spaulding, Montclair, N. J. Application filed January 29, 1902.

A sound-producing device, actuated by fluid pressure, is combined with a light-producing device located in the electric circuit, a switch controlling the circuit and light-producing device, means for producing fluid pressure to operate the sound-producing device, and means whereby the pressure operates the controlling switch simultaneously therewith.

716,302. Combined Telephone, Telegraph, Electric-light and Power System. Alexander M. Stark, Toronto, Canada. Application filed July 12, 1901.

716,305. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 19, 1902.

There are combined constant-potential multiphase mains, constant-current mains and means possessing capacity but insensitive to harmonics for transferring energy between the mains.

716,306. Process of Electrolytically Preparing Metals and Alloys for Lithographing Purposes. Otto C. Strecker, Cologne, Germany. Application filed April 19, 1900.

Part of the process consists in submitting the plate as an electrode to electrolytic action in a solution of salts and gum-arabic.

716,311. Electrical Conductor. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 23, 1902.

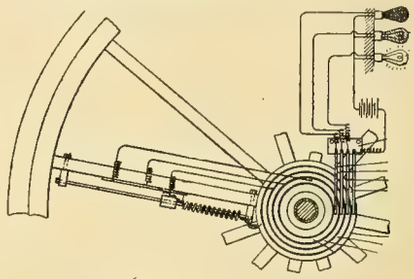
A compound electrical conductor is composed of elements having temperature coefficients of opposite signs and proportioned in amount, relatively to each other, so that the variation of resistance of one element with temperature compensates for the opposite variation of resistance of the other element.

716,314. Igniter for Hydrocarbon Engines. William W. Tuck, Richmond Hill, and August Wassmann, Astoria, N. Y., assignors to Abbot Augustus Low, Brooklyn, N. Y. Application filed December 18, 1901.

An electric igniter is described.

716,329. Antiseptic Protector for Telephone Mouth Pieces. Robert I. Willmarth, San Francisco, Cal., assignor to Adam Bergman, Sacramento, Cal. Application filed February 13, 1902.

In combination with a telephone mouthpiece is a disk of absorbent material across the front entrance of the mouthpiece, saturated with a disinfectant.



NO. 716,263.—SPEED INDICATOR.

716,334. Method of Communicating Signals Through Space. Lee De Forest, Jersey City, N. J., and Edwin H. Smythe, Chicago, Ill., assignors to the Wireless Telegraph Company of America. Original application filed July 5, 1901. Divided and this application filed August 4, 1902.

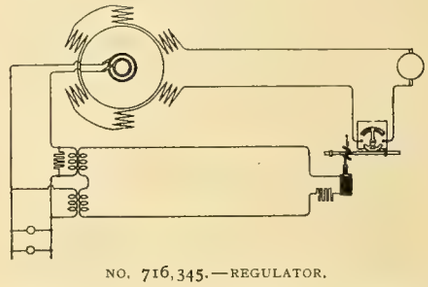
See page 468.

716,345. Compounding Dynamo-electric Machines. Edward B. Raymond, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed October 31, 1896. Divided and this application filed April 26, 1902.

The method of regulating a main circuit consists in applying to a secondary circuit in series two alternating electromotive forces, one dependent upon the voltage of the main circuit, and one upon the current in the main circuit, the two electromotive forces being dephased by an angle greater than a right angle, and compensating by the variation of current in the secondary circuit for the variation of electromotive force in the main circuit caused by shifting of phase of current in the circuit. (See cut.)

716,351. Alternating-current Electric Meter. Chas. P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed February 11, 1898. Divided and this application filed April 28, 1902.

In the wattmeter are combined the actuating coils, a reactance device included in one of the coils and registering or indicating mechanism actuated by the currents in the coils and so adjusted as to register or indicate a proportionate amount of wattless current.



NO. 716,345.—REGULATOR.

716,355. Method of Regulating Multi-circuit Generators. Henry H. Wait, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 5, 1902.

716,356. Regulating Mechanism for Multi-circuit Generators. Henry H. Wait, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 5, 1902.

REISSUE.

12,064. Motor-controller. George E. Krause and Arthur L. Bolen, Indianapolis, Ind. Application filed November 24, 1902. Original No. 712,549, dated November 4, 1902.

In the controller combined with a number of electrical resistances forming part of the motor circuit are a pair of terminals for each of the resistances and means for changing bridging connections between the terminals, whereby the resistances may be placed in series or any number of the resistances placed in parallel with the remaining series arranged resistances.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, JULY 5, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 1.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1127 Monadnock Block, CHICAGO. Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT. HEADQUARTERS FOR ELECTRIC LIGHT LINE WIRE. Chicago Insulated Wire Co.

OKONITE TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, H. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office: 53 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

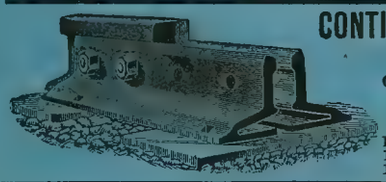
MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER TEN THOUSAND (10,000) MILES IN USE.

Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co. Troy, Ohio.

The FRANKLIN Model Shop

The Franklin Gas Engine

One-Half Horsepower.

Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.

PARSELL & WEED, 129-131 W. 31st Street, New York.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

F. B. BADT. C. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,

1504 Monadnock Block,

TELEPHONE HARRISON 745. CHICAGO.

A TELEPHONE THAT TALKS.

ERICSSON TELEPHONE CO.,

296 Broadway, NEW YORK.

It will pay you to be put on our bi-monthly free mailing list. Shall we? Thank you, send your address.

LIGHT

If you want light to see objects below the lamp

USE SHELBY LAMPS.

16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.

THE COIL DOES IT—IT'S FLATTENED.

LIFE

The Longest Life at Best Efficiency.

SHELBY USEFUL LIGHT LAMPS.

Pat. Oct. 20, 1900.

A TRIAL WILL PROVE OUR CLAIMS.

THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Voltmeter. Style B. "Flush Type."

Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

Mention the WESTERN ELECTRICIAN when writing for catalogues.

FAN MOTORS

Direct, Alternating, Ceiling, Desk, Bracket. Every style and voltage carried in stock For prompt shipment. Every motor fully guaranteed.

CATALOGUE FREE.

The Standard Electric Co.,

CINCINNATI, OHIO.

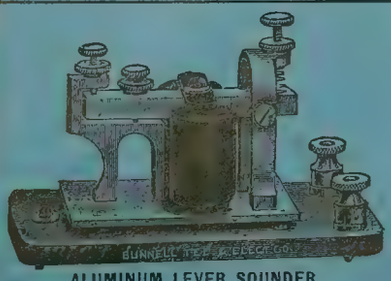
THE BUNNELL TELEGRAPHIC AND ELECTRICAL CO.

110-120 BEEKMAN STREET, NEW YORK.

TELEGRAPH, TELEPHONE, RAILWAY AND ELECTRICAL SUPPLIES.

FACTORIES:
NEW YORK CITY
AND
MILFORD, CONN.

District Messenger Call, Police, Patrol, Watchman's, Burglar and Fire Alarm Boxes and Equipment.



ALUMINUM LEVER SOUNDER.

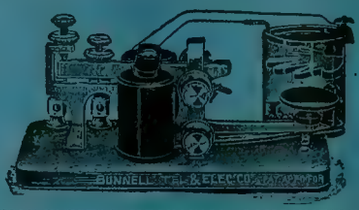
TRY OUR

BEEKMAN DRY BATTERY,
BEEKMAN IRON BOX BELL,
BEEKMAN ANNUNCIATOR WIRE,
BEEKMAN TELEPHONES.

UNEQUALED IN QUALITY
OR PRICE.

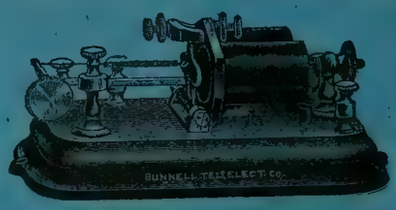
OUR GOODS
ARE GUARANTEED.

CATALOGUE OR LEARNERS' MANUAL FREE ON RECEIPT OF POSTAGE.

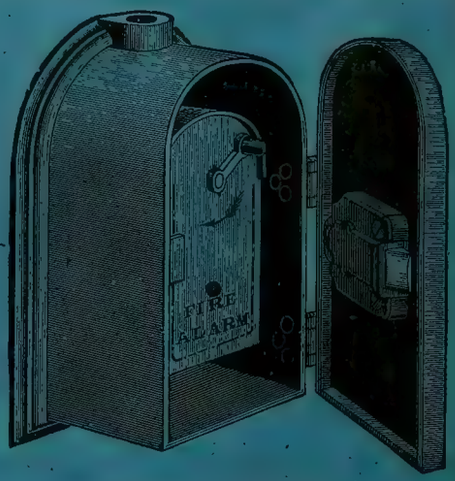


BEEKMAN ELECTRO-MECHANICAL COMBINATION SET.

THE BEEKMAN MEDICAL BATTERY.



STANDARD MAIN LINE RELAY.



No. 5 FIRE ALARM BOX.

CROCKER-WHEELER SYSTEM

FOR

MACHINE TOOL OPERATION

BY

MULTIPLE VOLTAGE CONTROL OF SPEED

INCLUDES

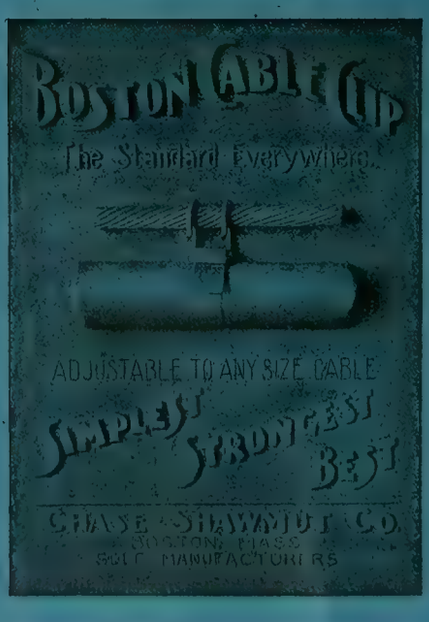
A Simple Generating Unit,
The Attachment of Standard Motors to the Tools,
A Strong and Convenient Controller,
A Balancing Transformer to Automatically Regulate the System,

RENDERING IT

Simple, Practical and Convenient.

SALES OFFICES IN ALL LARGE CITIES.

Main Office and Works, - **AMPERE, N. J.**



THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.

The "Exide Accumulator" For Electric Vehicles.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: Philadelphia, Allegheny Ave. & 19th St. | New York, 100 Broadway. | Boston, 60 State St. | Chicago, Marquette Bldg. | Baltimore, Equitable Bldg | St. Louis, Wainwright Bldg. | San Francisco, Nevada Block. | Cleveland, New England Bldg. | Detroit, Michigan Electric Co. | Havana, Cuba. F. G. Greenwood, Mgr. 34 Empedrado Street.

R-52

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

FOR HIGH GRADE

INSULATING VARNISHES

ADDRESS

STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

Chas. L. Brown. E. E. Leasure.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. CHICAGO

Bug-Proof Bell. Segerdahl Patent.

Sample, 3-in. Nickel, 50c Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO.,

87-89 W. Van Buren Street, Chicago, Ill.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS. PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS. We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

For Classified Index of Advertisements See Page 6.

Adams-Bagnall Electric Co.. 8
Akron Smoking Pipe Co..... 5
American Battery Co.....10
Amer. Electrical Heater Co..10
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Badt & Co., F. B..... 1
Baker & Company..... 3
Barnett Company, G. & H....20
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg.Co.—
Beardsley Gravity Dam & Construction Co..... 3
Beidler & Co, Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bossert El. Construction Co.. 3
Brown & Leasure..... 3
Buffalo Forge Co.....20
Bullock Electric Mfg. Co.....11
Bunnell Telegraph.&Elec.Co. 2

Carney Brothers Company...17
Central Electric Co..... 5
Central Manufacturing Co...17
Central Telephone & El. Co..14
Century Glass Co.....10
Chase-Shawmut Company... 2
Chicago & Alton Railroad....16
C. & N. W. R. R.....16
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....16
Chicago Pay Station Co.....14
Colt, Henry A..... —
Colorado Lamp Co., The.....—
Columbia Telephone Mfg.Co.—
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 2
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 9
Diamond Meter Company ... 4
Dicke Tool Company.....—
Diehl Manufacturing Co..... 6
Dixon Crucible Co., Joseph..16

Eclipse Pulley Covering Co..10
Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....20
Edwards & Company.....11
Electrical Engineer Institute.10
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co.... 9
Fulmer Lumber Co., D. M. ...17

General Electric Company... 4
General Incandescent Arc Light Company..... 5
General Incand. Lamp Co....—
Glass Wool Mfg. Company...10
Goodrich Line.....11
Great Western Smelting & Refining Company.... ...—
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....—
Holmes Fibre-Graph. Co.....—
Hopkins & Co, A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools.... 5
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....5, 15, 17
Klein & Son, Mathias.....17
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....11
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller..... 7
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad.....
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....10
Munsell & Co., Eugene.....—

National India Rubber Co...—
Naugle Tie Co., E. E 17
New York Ins. Wire Co..... 9
Norton Tool Company, The..11

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Pass & Seymour..... 7
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17
Pratt Institute..... 5

Reisinger, Hugo.....—
Reliance Electric Company.. 9
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....—
Roebling's Sons Co., J. A....20
Rose Electric Company 12
Rose Polytechnic Institute... 5

St. Louis Elec. Supply Co .. 20
Sargent & Lundy.....11
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Signaloid Chemical Works...—
Simplex Electrical Co.,The.1,10
Smith Co., S. Morgan..... 9
Spies Electric Company..... 3
Sprague Electric Company...10
Standard Electric Company.. 1
Standard Pole & Tie Co.... .17
Standard Umderg. Cable Co..—
Standard Varnish Works 3
Stanley Instrument Co..... 9
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company..... 7
Stow Mfg. Company..... 5
Streeter, A. L.....11
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Torrey Cedar Company..... .17
Triumph Electric Co.....20

Valentine-Clark Co., The....—
Varley Duplex Magnet Co.... 9
Vindex Electric Company....—
Vomacka & Mazenek .....—
Vulcanized Fiber Company. 20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co.....18
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Wickes Bros.....12
Willyoung, Elmer G.....11
Wisconsin Central R. R.....16
Wittenberg Cedar Co.....17
Worcester Company, C. H....17
Worcester Polytechnic Inst..—

Yonkers Specialty Co 7

59012

Better than ever and a little the best of any on the market today—

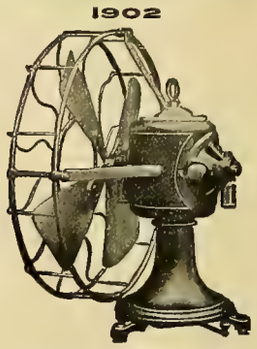
1902 PARAGON 1902

NOISELESS **FAN MOTORS** COMPACT

ALL STYLES AND SIZES EASY RUNNING RIGID CONSTRUCTION

—CALL AND SEE THEM OR WRITE FOR PRICES—

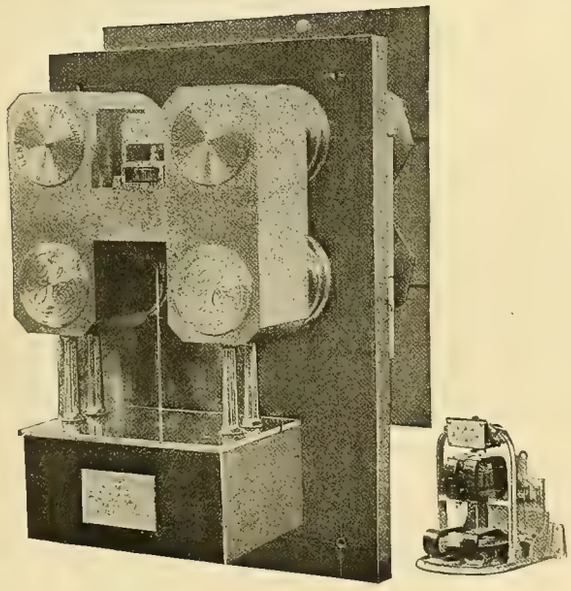
CHICAGO EDISON COMPANY, 139 ADAMS ST., CHICAGO.



PARAGON DESK FAN

THE GENERAL ELECTRIC COMPANY

MANUFACTURERS



THOMSON RECORDING WATTMETERS.

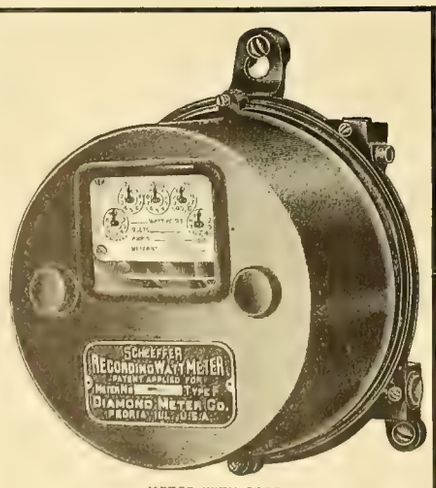
For all Classes of Service

and of all Capacities

FROM 3 AMPERES TO 30,000 AMPERES.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y.

Chicago Office, Monadnock Building. Sales Offices in all Large Cities.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

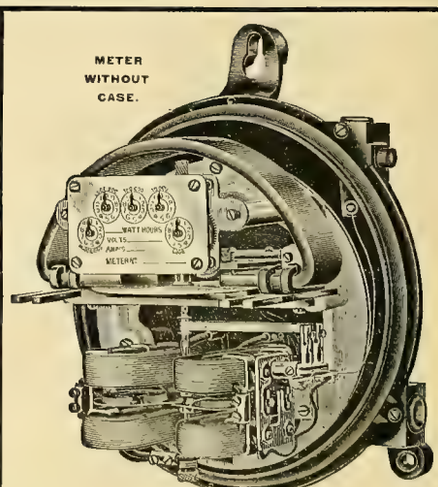
IMPROVED CONSTRUCTION.

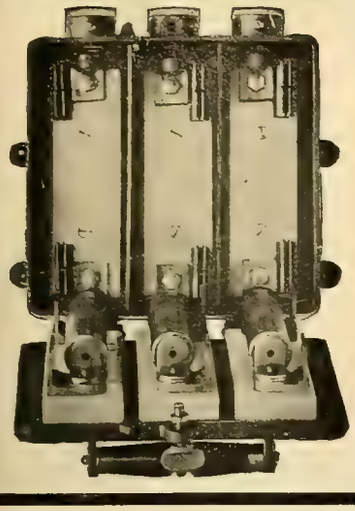
Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.





D. & W. SAFETY DEVICES
AND ENCLOSED FUSES

SEND FOR DESCRIPTIVE BULLETINS.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

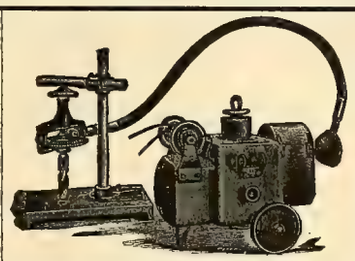
GENERAL WESTERN AGENTS,
264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

PRATT INSTITUTE
BROOKLYN, N. Y.
TWO-YEAR COURSES IN
APPLIED ELECTRICITY
AND IN
STEAM AND MACHINE DESIGN
Write for Catalogue and Particulars.

ROSE POLYTECHNIC INSTITUTE
A College of Engineering. Mechanical, Electrical, Civil Engineering; Chemical Courses; Architecture. Extensive shops. Modernly equipped laboratories in all departments. Expenses low. 29th year. For catalog, address C. L. MEES, President, Terre Haute, Ind.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 86 Queen Victoria Street, London, England.

RESIN SOLDER
IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.

BRANCH OFFICES:
Eastern District, Keystone Telephone Building, Philadelphia, Pa.
Middle District, Electric Building, Cleveland, Ohio.

What the I. C. S. did for me.

I was employed as erecting engineer when I enrolled for a course of training in electricity in the International Correspondence Schools, of Scranton, Pa. Before I finished the Course, I successfully designed and constructed an $80,000 plant for the Municipal Electric Light, Power, and Water System, of Healdsburg, Cal., and I am now superintendent of the system. My station engineers have enrolled on the strength of my success, and I am satisfied that their efficiency will be rendered greater thereby. The Reference Library furnished with my Course provides an invaluable aid in my work. It is almost impossible to conceive of any greater benefits derived from education than have come to me through my Course in the International Correspondence Schools.

W. W. BARNES, Healdsburg, Cal.

Do you want a better salary and position?

Such evidence as the above is proof conclusive of the value of our training. Actual results are the best argument. We have hundreds of endorsements like the above—just as strong, just as convincing. Isn't this one convincing enough to induce you to cut out, fill in, and send us the attached coupon with X marked before the position for which you wish to be trained?

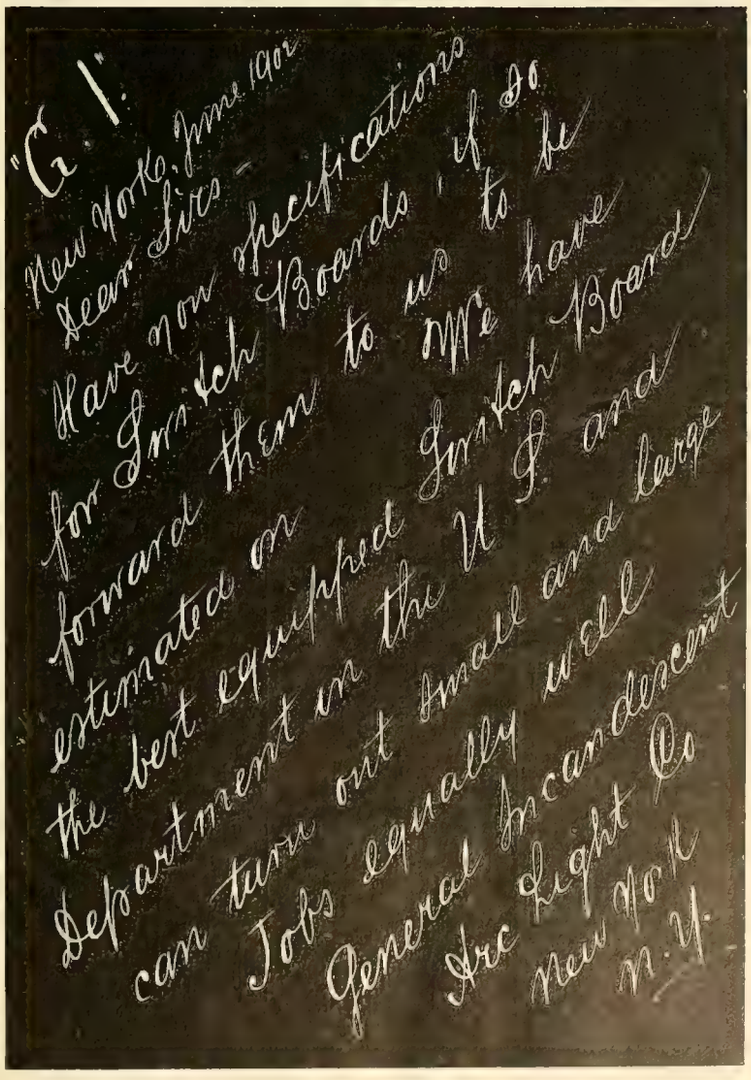
Do It Anyway.

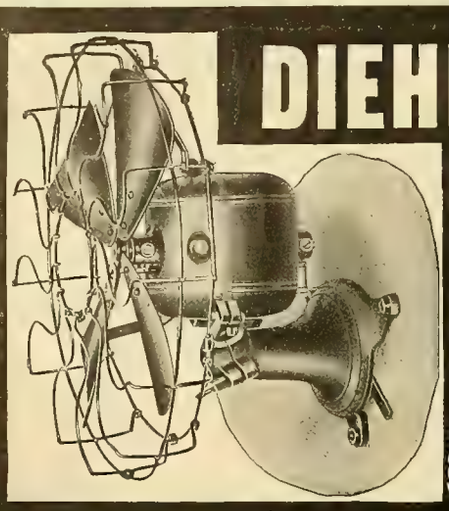
International Correspondence Schools,
Box 1002, Scranton, Pa.

Please explain how I can qualify for the position marked X below.

	Electrical Engineer		Fire Underwriters' Inspector
	Telephone Engineer		Interior Wireman
	Telegraph Engineer		Foreman Dynamo Room
	Erector of Electric Machinery		Foreman Electrical Repairs
	Manager Electric Railway		Dynamo Tender
	Manager Electric Light Plant		Electrical Lineman
	Supt. Electric Light and Power Plant		Motorman

Occupation _____ *Age* _____
Name _____
Street and No. _____
City _____ *State* _____





DIEHL FAN MOTORS

Are Excellent Sellers

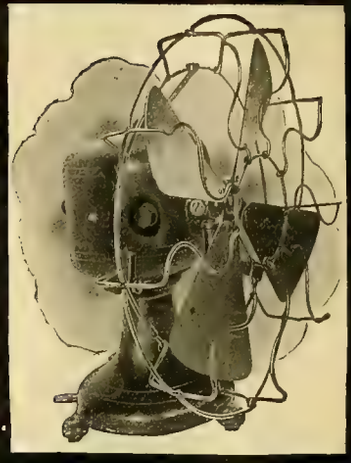
BECAUSE

they are handsome in design, superior in finish, efficient, durable, and never get out of order. Made in 9-inch, 12-inch and 16-inch. Send for catalogue which shows 16 designs of Ceiling and Desk Fans.

DIEHL MANUFACTURING CO.

SALES OFFICES:
561 Broadway, New York.
128 Essex St., Boston.
1217 Filbert St., Philadelphia.
Central Electric Co., Chicago.
Newman-Spranley Co., New Orleans.
Waco Electrical Supply Co., Waco, Tex.

MAIN OFFICE AND WORKS ELIZABETHPORT, N. J.



CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Eclipse Pulley Covering Co.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.
Yonkers Specialty Co.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Bunnell Telegrap. & Elec. Co.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Bullock Elec. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Pass & Seymour.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Bullock Elec. Mfg. Co.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Electrical Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Central Electric Co.
Crocker-Wheeler Company.
Diehl Manufacturing Co.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Alarm Equipments.
Bunnell Telegrap. & Elec. Co.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Glass Wool.
Glass Wool Mfg. Company.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Rose Polytechnic Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Colorado Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Designer.
Flora, E. E.

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Carney Brothers Company.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulley Covering.
Eclipse Pulley Covering Co.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Rosettes.
Pass & Seymour.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Telegraphic Supplies.
Bunnell Telegraph. & Elec. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Cort, Henry A.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

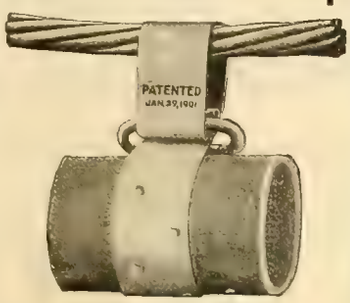
Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The Metropolitan Aerial Cable Clip

"SEE THAT LOOP"



over the supporting strand? It cannot become unfastened. Safer and more durable than any other clip.

Used exclusively for hanging telephone cables in New York City and environs.

Manufactured by

YONKERS SPECIALTY CO.,

WESTERN ELECTRIC CO., New York and Chicago. } Agents.
M. B. AUSTIN & CO., Chicago. }

Yonkers, N. Y.

THE POCKET VOLT AND AMMETERS

List price this range, $11.

of the WHITNEY make are thoroughly accurate and reliable. They are built with powerful permanent magnets, jewel bearings, and have equally divided scales.

Telephone battery and signal inspectors find them invaluable. You should not be without them.

STANDARD RANGES

VOLTMETERS.	AMMETERS.
0 to 3 Volts.	0 to 150 Milliamp.
0 to 5 Volts.	0 to 1 Ampere.
0 to 10 Volts.	0 to 2 Amperes.
0 to 15 Volts.	0 to 3 Amperes.

SEND FOR CATALOGUE AND PRICE LIST.

MACHADO & ROLLER,

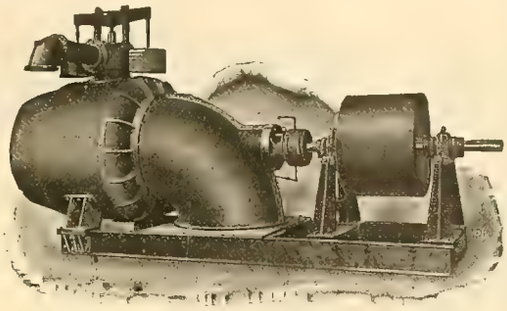
GENERAL SELLING OFFICE OF WHITNEY ELECTRICAL INSTRUMENT CO.

203 Broadway, New York, N. Y.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

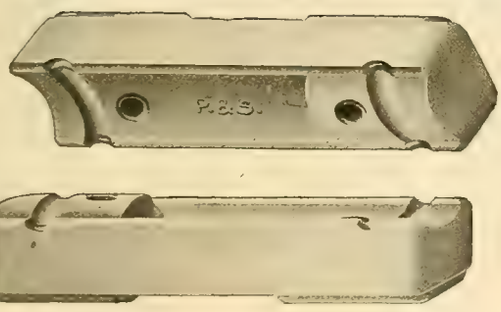
STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,

257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver St.
NEW ORLEANS, 304 Hennen Bldg.
PHILADELPHIA, 612 Arch St.
CHICAGO, 311 Dearborn St.
LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.



The Strongest and Most Practical Cleats and Tubes on the Market.

MADE FROM THE CELEBRATED

P. & S. Porcelain.

COMPLETE LINE CARRIED IN STOCK.

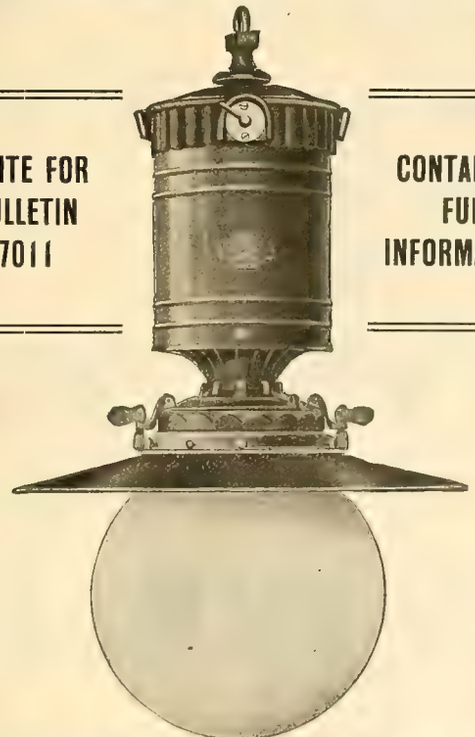
PASS & SEYMOUR, Inc.,

SOLVAY, N. Y.

NEW YORK. CHICAGO. BOSTON. CINCINNATI. SAN FRANCISCO.

SERIES ALTERNATING ARC LIGHTING SYSTEMS

WRITE FOR BULLETIN 7011



CONTAINING FULL INFORMATION.

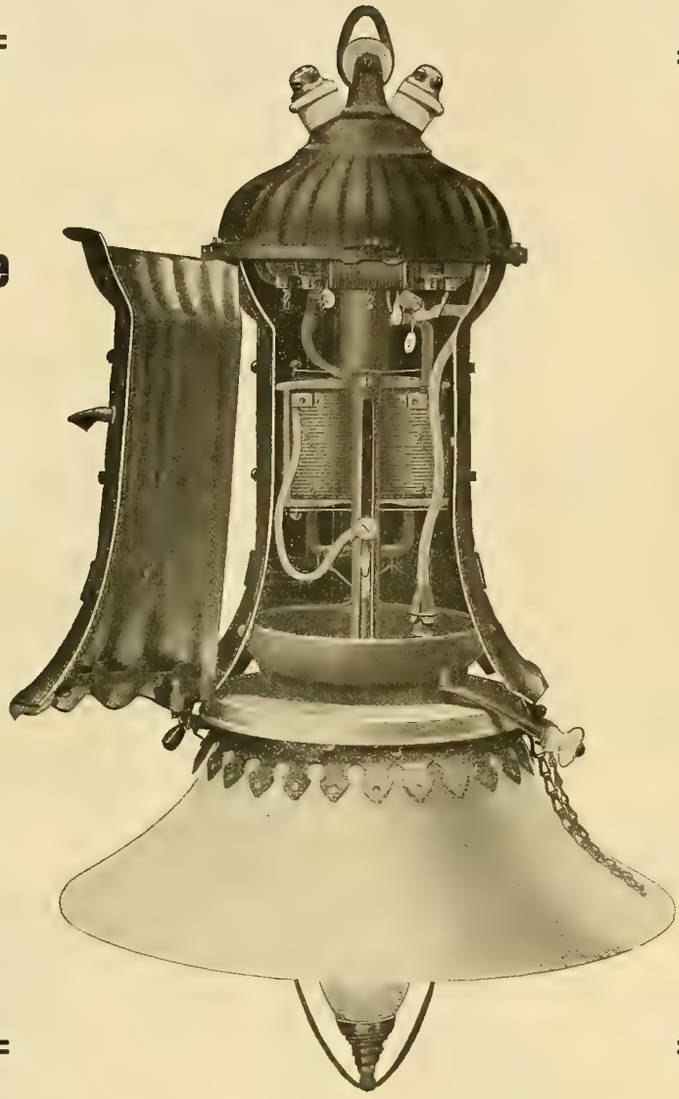
WESTERN ELECTRIC COMPANY,

CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market.
It's good to look at and built to stand the most severe service.
Never has been beaten in a competitive test.



Their Efficiency and Regulation are Perfect.
Easiest lamp to trim made.
Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. G. POMEROY,
No. 309 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
C. A. THOMSON,
No. 136 Liberty Street.

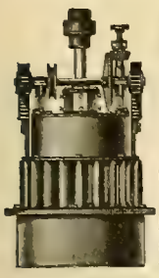
FOAMING STOPPED AND DRY STEAM DELIVERED

BY USING **DEARBORN BOILER COMPOUNDS.**

MADE TO SUIT THE WATER AS PER ANALYSIS.
NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND. WRITE FOR PARTICULARS.

DEARBORN DRUG & CHEMICAL WORKS, 27-34 RIALTO BUILDING, CHICAGO, ILL.

Offices From New York to Honolulu. Telephone Harrison 3930 and 3931.
WM. H. EDGAR, PRESIDENT.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

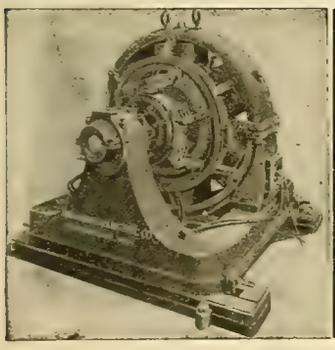
It's No Secret...

That the proper illustration in an **Ad.** pays for itself and the entire space of the ad.

WE MAKE THE PROPER KIND ...
TRY THEM AND SEE

Real order fetchers
Full of force...

Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.



"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - - WIS.
AGENTS WANTED EVERYWHERE.

TELEPHONE MEN

and others interested in

Magnets, Coils, Solenoids and Fine Wire Windings

will find it to their advantage to correspond with us when in the market for anything in the above line. . . . .

MAGNETS furnished complete with either INSULATED or DUPLEX Windings

Catalogue on Application.

Varley Duplex Magnet Co.

PHILLIPSDALE, R. I. CHICAGO, ILL.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

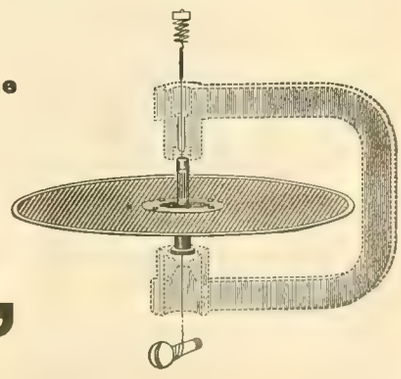
NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

DO YOU KNOW

the Importance of magnetically floating the moving parts of a meter?

Send for description and book full of good information "ABOUT METERS."



STANLEY INSTRUMENT COMPANY,

General Sales Office, 158 Broadway, New York, N. Y.
Pacific Coast Agency, 33 New Montgomery St., San Francisco, Cal.

We are wire merchants too;
Western repository with Chicago warehouses
Roebling's and American Steel & Wire Co.'s iron and
steel telephone wires.
Paranite white core and Peerless black core
rubber covered wires.
"O. K." weatherproof, "O. K." slow burning weatherproof
and "O. K " slow burning wires,
conduit wires—marine wires
fixture wires—switchboard cables
Submarine cables—lead cables
telephone cables—large C. M. cables.

No order too large to ship quickly
and none too small—our address is:—

ELECTRIC APPLIANCE COMPANY, ELECTRICAL SUPPLIES
92 & 94 WEST VAN BUREN ST., CHICAGO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.
X-Ray Tubes.
Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

FLEXIBLE MICANITE

IMPROVED STYLE B. Its Flexibility and High Insulating Qualities Remain Unimpaired Indefinitely. Far Ahead of Anything Heretofore Furnished. Price as Low as Inferior Goods.

SEND FOR SAMPLES AND CIRCULAR.

MICA INSULATOR COMPANY,
NEW YORK. —PATENTEES— CHICAGO.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
The Simplex Electrical Co.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of 40 miles of railway out of Dover, Del., for the Del. Gen'l Elec. Ry. Co.

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

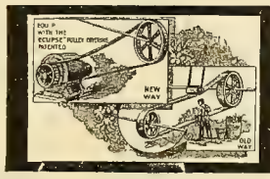
50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances,
Write for catalogue. 193-197 River St. DETROIT MICH

GLASS WOOL
FOR STORAGE BATTERIES AND LABORATORY WORK, FILTRATION PURPOSES, ETC.
$2 a lb. Discount furnished on application.
GLASS WOOL MFG. CO.,
207 W. Madison St., CHICAGO.

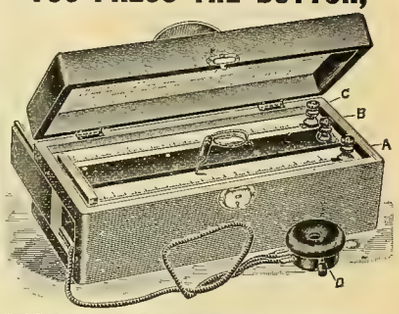
ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book,
"Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute,
Dept. K. 240-242 W. 23d St., New York.



WE SAVE YOU
in your belting and journals. **WE PUT IT IN ON 60 DAYS' TRIAL.** We increase the speed of your machines, thus increasing your production and saving you money.
THE ECLIPSE PULLEY COVERING CO.,
Phone Central 2816. 1508-1509 Ashland Blk.,
CHICAGO, ILL.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

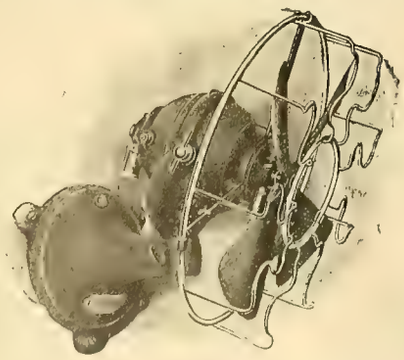
"YOU PRESS THE BUTTON,"



THE OHMMETER DOES THE REST."
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to
ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

LUNDELL FANS

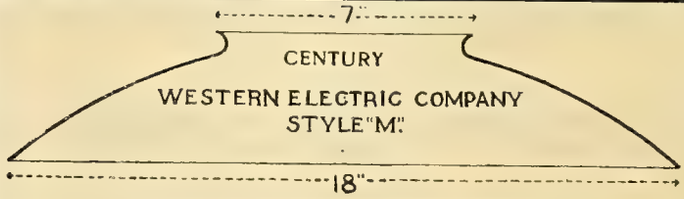


Superior in Design and Construction.

Cooling, Economical, Safe.

Catalogue No. 03304.

SPRAGUE ELECTRIC CO.,
GENERAL OFFICES: 527-531 WEST 34th STREET, NEW YORK.



WE CAN PLEASE YOU IN THE LINE OF

ELECTRICAL GLASSWARE

and are Prepared to Furnish you with Globes or Shades for all Types of Lamps.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

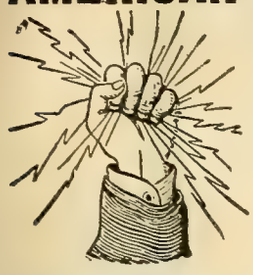
WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

FRANK N. PHILLIPS, President. C. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Bullock ELECTRIC MFG CO. CINCINNATI O U.S.A.

Electrical Machinery
411

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

SARGENT & LUNDY,
Engineers,
1000, 46 E. VAN BUREN ST., CHICAGO.
FREDERICK SARGENT. A. D. LUNDY

TEST INSTRUMENTS.
Portable Sets for Resistance, Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

PATENTED GALVANIZED STEEL CABLE HANGER.
Note Beautiful Mechanical Simplicity.
SEND FOR SAMPLE.

Before attachment. In place on cable.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.

11½-inch "Spread," points up or down. 20 inch "Spread," points up or down.

Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

NONSENSE, WITH SENSE, FOR CENTS.

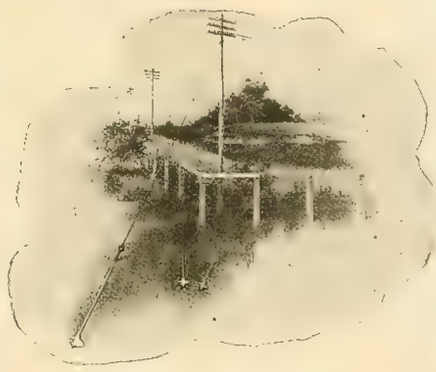
"A TRUTHFUL LIE."

Here's to the anchor of Stombaugh,
A device to which to tie to—
Here's to the anchor of Stombaugh,
Which truly lies and lies so true.

—STOMBAUGH.

Watch this space for change.

The installation of the
STOMBAUGH GUY ANCHORS
is simplicity itself. That is the reason they appeal so strongly to those who have anything to guy.



Write us for Information, Prices and Catalogue.

W. N. Matthews & Bro.
603 Carleton Bldg.
ST. LOUIS.

HOW THEY WORK.

STREETER SPRING MOTOR FANS

173-75-77 SOUTH CLINTON STREET, CHICAGO.

FAN MOTORS FOR GENERAL USE.
No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.

FIRST COST THE LAST.
No expense whatever to maintain.

EASY TO WIND.
Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.

WRITE FOR CIRCULAR.

THE TELEPHONE HAND-BOOK

BY HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

4 Days Lake Trip
$13. Including Meals and Berths—Chicago to ESCANABA, Mich. and Return. Leave Chicago Wed., Fri., & Sat. 8:00 p. m.

7 Days Lake Trip
$25. Including Meals and Berths—Chicago to Mackinac Island and Return. Leave Chicago Saturdays 8:30 p. m.

Muskegon or Grand Haven
and RETURN $2.75
Leave Chicago 7:45 p. m., daily.

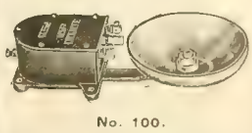
GOODRICH LINE STEAMERS

Finest Service on the Lakes

For complete information see local Railroad Agent or address
R. C. DAVIS, C. P. A., GOODRICH LINE,
Foot of Michigan Ave., - Chicago, Ill.

EDWARDS AND CO.

THE "RECTI" BELL
FOR AUTOMOBILES AND ELECTROMOBILES.



No. 100.

This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.

NEW YORK, N.Y.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a thoroughly practical mechanic, electrician and successful inventor. A pioneer in arc lighting and electric railways. Has experience in up-to-date manufacturing. Filled responsible positions for years. Would connect with parties to manufacture up-to-date money-making specialties. Can furnish best of references in regard to ability and responsibility. For particulars address BOX 82, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By electrician, age 35, all around telephone man having 12 years' experience with both Bell and Independent systems. Might invest small amount in good exchange. Best of references. Address BOX 88, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent or manager of an electric-light plant or street railway. Am up to date in both branches, having had 17 years' experience. At present installing a light plant, but will be at liberty in a week. If you want a good man write me. Address BOX 145, Waverly, Tenn.

WANTED.

Linemen and construction foremen — good wages and work the year round. Address OTTO WETTSTEIN, JR., Telephone Contractor, La Porte City, Iowa.

WANTED.

In any town where the electric light company does not sell the HYLO Lamp, a salesman. The electrician and repair man under our plan can make money on the side introducing the HYLO. Write us for particulars and state experience fully. We want salesmen. THE PHELPS COMPANY, 101 State St., Detroit, Mich.

WANTED.

One second-hand, 2-phase, 60-cycle, 1,100-volt generator; 150 to 250 K. W. CEDAR RAPIDS ELECTRIC LIGHT & POWER COMPANY, Cedar Rapids, Iowa.

WANTED.

A man to take charge of an electric light station, nothing to do with the outside work. Must be a thorough steam engineer and machinist and have a thorough knowledge of dynamos. Also a man to look after all outside work, including lines, wiring, customers, etc. 2,000 horse power plant—city of 30,000 population. Good salaries and steady employment to the right persons. Address BOX 83, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITIONS OPEN.

PER MONTH.

3 Draftsmen for R. R. Work. . - $125.00
8 Draftsmen for Electrical Work, $70.00 up.
3 Engineers and Electricians, - 75.00 up.

Engineers and Draftsmen will do well to register with us free of charge.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse - 250 volt M. P.
1—125 K. W. Thompson-Ryan - 250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.
1— 55 K. W. Fuller - - - - - 250 volt M. P.
1—100 K. W. General Electric 500 volt M. P.
2— 90 K. W. General Electric - 500 volt M. P.
1— 62 K. W. T.-H. D 62 - - 500 volt M. P.
1—100 K. W. General Electric - 125 volt M. P.
1—100 K. W. Triumph - - - 125 volt M. P.
1— 80 K. W. Keystone - - - 125 volt M. P.
1— 65 K. W. Jantz & Leist - 125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

Telephone exchange in one of the best towns in the Cherokee Nation. Address Lock Box 121, Afton, I. T.

FOR SALE.

The following electrical machinery:
1 No. 9 Wood arc 9.6 am., 80 lt.
1 extra armature for same.
1 No. 7 Wood arc 9.6 am., 40 lt.
122 Wood open arc lamps gear feed.

This apparatus is in excellent condition, and can now be seen in operation. Delivery August 1, 1902. Address THE GREENVILLE ELECTRIC LIGHT AND POWER CO., Greenville, O.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Engine 38x72 inches, George H. Corliss.
Engine 30x72 inches, George H. Corliss.
Engine 30x60 inches, Hamilton Corliss.
Engine 28x60 inches, (pair) Harris Corliss.
Engine 24x42 inches, Cooper Corliss.
Engine 23x60 inches, George H. Corliss.
Engine 20x48 inches, Watts-Campbell Corliss.
Engine 16x38 inches, Watts-Campbell Corliss.
Condenser 16x20x24 inches, Deane single.
Condenser 9x12x10 inch., Worthington duplex.
Pump 20x6x24 inches, Wilson-Snyder duplex.
Pump 12x8x12 inches, Smith-Vaile duplex.
Pump 20x7x18 inches, Blake single cylinder.
Pump 16x10½x18 inch., Hughes single cylinder.
Accumulator, hydraulic, 18-inch plunger.
Compressor, air, 10x12x14 in., Hall No. 5 duplex.

Send for complete monthly stock list.

WICKES BROS., Saginaw Mich.

95-97 Liberty Street, NEW YORK CITY. 1214 Marquette Bldg., CHICAGO, ILL.
45th St. and A. V. R. R., PITTSBURG, PA.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

Rose Electric Co., St. Louis, Mo.

WANTED.

200-K. W., 250-Volt, Direct-Connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

FOR SALE AT A BARGAIN.

SECOND-HAND WATER POWER MACHINERY.

4 36-in. Horizontal Victor Turbines.
1 New Replogle Water Governor complete, Chains, Sprockets, etc.
1 Main Driving Split Pulley, 78-in. diameter, 32-in. face.
75 ft. 6½-in. Shafting, with Collars.
8 Hill Clutch Stand Bearings. 1 Bearing and Stuffing Box.
3 Bolted Couplings. 38-ft. Gate Shaft, 1⅞-in. diameter.
4 Gate Controllers complete. 1 40-in. Belt Tightener.

Turbines were operated under 11 feet head.

APPLY TO

HARRISBURG LIGHT, HEAT & POWER CO.,
HARRISBURG, PA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE. GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

CORLISS ENGINES

REBUILT AND READY.

34x60 Geo. H. Corliss,
28x60 Lane & Bodley Corliss,
20x48 Harris Corliss
20x48 Wheelock Corliss,
18x42 Allis Corliss,
18x36 Sioux City Corliss,
16x42 Hamilton Corliss,
14x24 Cooper Corliss,
12x36 Hamilton Corliss,
12x36 Harris Corliss.

AUTOMATIC ENGINES.

16x32 Buckeye Medium Speed,
14½x16 Rice Automatic High Speed,
14½x15 Armington & Sims Automatic,
13x21 Buckeye Medium Speed,
13x20 Russell Medium Speed,

BOILERS.

2 250 H. P. Babcock & Wilcox Water Tube,
1 66x18 Tubular,
2 60x18 Tubular,
6 60x16 Tubular,
3 56x16 Tubular.

W. W. WHITEHEAD COMPANY,
DAVENPORT, IOWA.

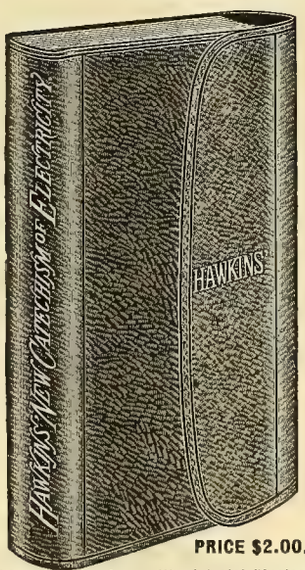
READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

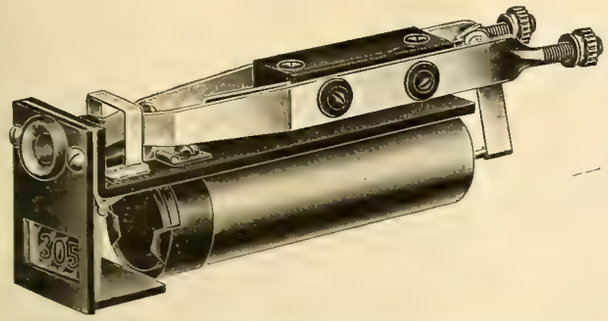
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

FIRST-CLASS EQUIPMENT THROUGHOUT.

"WESCO" TELEPHONE APPARATUS.

LOOK AT IT!

STUDY THE DETAILED CONSTRUCTION.



"WESCO" COMBINED DROP AND JACK.

"WESCO" Stands for the Best.

TO THOSE WHO USE "WESCO" APPARATUS IT MEANS:

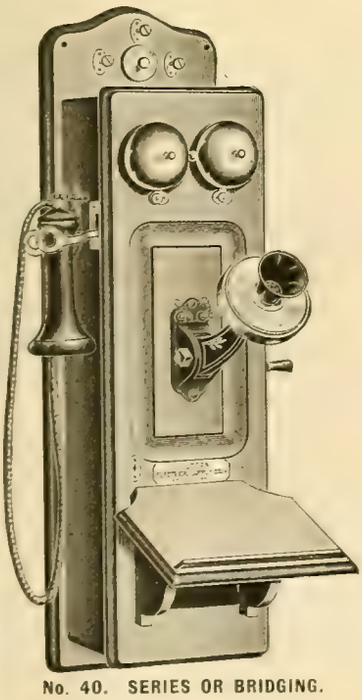
WEALTH
E MINENCE
S UCCESS
C ONVENIENCE
O PPORTUNITY

NOTICE SOME OF THE GOOD POINTS:

Has coil enclosed in tube of *Norway* iron.
Armature on front end of coil.
No bunglesome armature rod.
Shutter is retained by armature itself.
No shutters to project on face of board when they fall.
Plug cannot be inserted without restoring shutter.
Night bell contact is simple and positive.
Coil leads are German silver clips (no wires exposed).
Contacts are all full metallic.
Shell of jack not used as contact.
Two heavy German silver springs form contact with plug.
Insulation of pure hard rubber.
Each drop and jack self-contained, no unsoldering of wires necessary to remove them from board.

REQUIRES LESS CURRENT THAN ANY DROP MADE.

IT'S UP TO YOU. OUR PRICES ARE LOW.



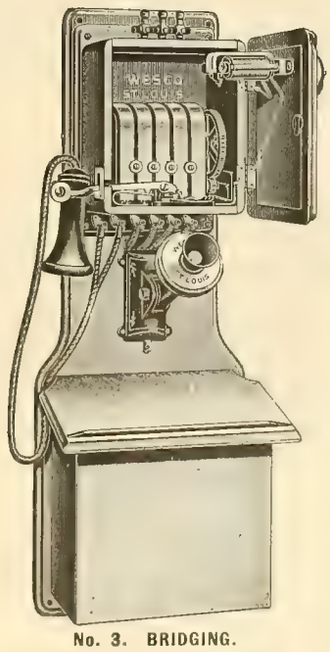
No. 40. SERIES OR BRIDGING.

SOLID BACK TRANSMITTER.

GOLD ELECTRODES.

REMEMBER THE NAME

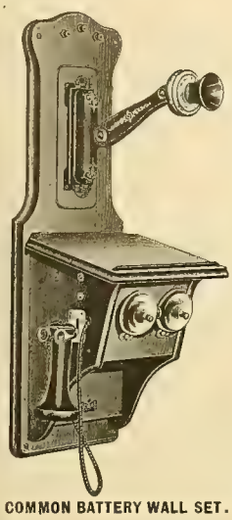
"WESCO."



No. 3. BRIDGING.

WESTERN ELECTRICAL SUPPLY CO., ST. LOUIS, MO.

Sterling Electric Co.



Manufacturers of

The Simplest and Most Perfect Common Battery Lamp Signal Multiple System ever devised.

Only one relay on each line, only one battery for calling, talking and supervising.

COMMON BATTERY WALL SET.

MAIN OFFICE AND FACTORY:

LAFAYETTE, - - - - INDIANA.

CONTINENTAL TELEPHONE CONSTRUCTION CO.

GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.

TACOMA BLDG., CHICAGO.

Western Electrician WANT ADS Bring Results.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

Mailed anywhere on receipt of price, **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

No. 1. Desk Telephone.

Success

Comes only to those telephone exchanges which use the BEST material. If you use our goods success is assured.

We can supply EVERYTHING USED WITH TELEPHONES.

No order too small for attention or too large for our capacity. Rapid deliveries our rule and each order filled with care. Large stocks always on hand.

Telephones, every style and grade. Long and short backboards. Elegant finish and design. Prices that will suit. Hard rubber receivers. Oak or walnut woodwork. New ideas in magneto bells. Each instrument guaranteed.

All kinds of telephone supplies. New parts for old telephones. Double-pole receivers.

Electricians' tools. Lightning arresters, carbon and fuse. Extension bells—standard and bridging. Circuit-closers. Transmitters of various styles. Repeating coils, induction coils, construction material of all kinds.

WRITE FOR CATALOGUE.

Central Telephone & Electric Co.,
909 MARKET STREET, ST. LOUIS, MO.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.

This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.

This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.

A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.

Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.

In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.

A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.

This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

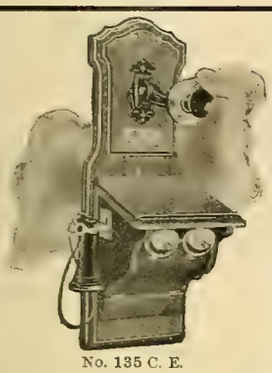
DID YOU KNOW THAT THE KELLOGG TRANSMITTER WAS GUARANTEED BETTER THAN THE BELL "SOLID BACK?" SUCH IS A FACT

BRANCH OFFICES:
Eastern District,
Keystone Telephone Bldg.,
Philadelphia, Pa.
Middle District,
Electric Bldg.,
Cleveland, Ohio.

WRITE FOR BULLETINS.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 SOUTH GREEN STREET, CHICAGO.

SWITCHBOARDS ALL CAPACITIES



No. 135 C. E.

EUREKA CENTRAL ENERGY SWITCHBOARD & TELEPHONE APPARATUS POSSESSES THE BEST PRINCIPLES and ELEMENTS THAT LEAD to SUCCESS.

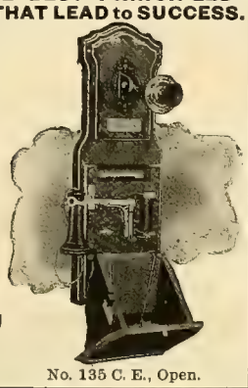
INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

Don't Overlook Your Interest.

INVESTIGATE!!!

Send for Catalog and Samples.

Get Our Prices Before Buying.



No. 135 C. E., Open.

We Can Show You Apparatus That is a Year in Advance of Our Competitors.

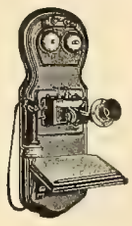
EUREKA ELECTRIC CO.,
143-149 S. Clinton Street,
CHICAGO, U. S. A.

IMPROVED
TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
CHICAGO, ILL.

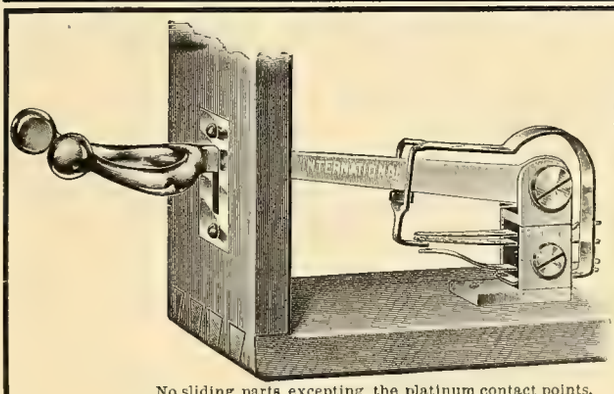
REMOVAL NOTICE.

Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING APPARATUS.

Metropolitan Telephone and Electric Co.
CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

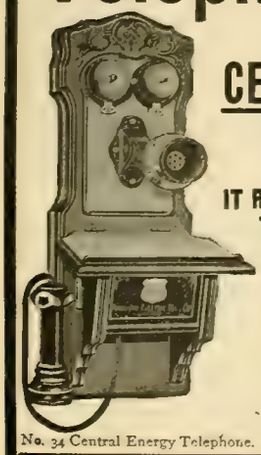
Harrison and Clinton Streets, CHICAGO, U. S. A. INTERNATIONAL TELEPHONE MFG. CO.

Telephone Troubles

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

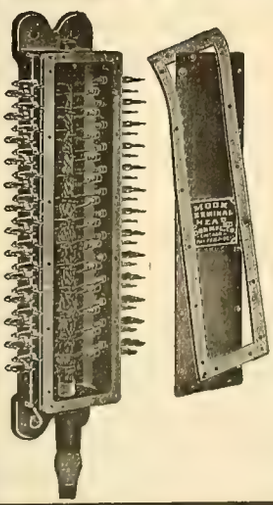


No. 34 Central Energy Telephone.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.



MOON TERMINALS

WITH

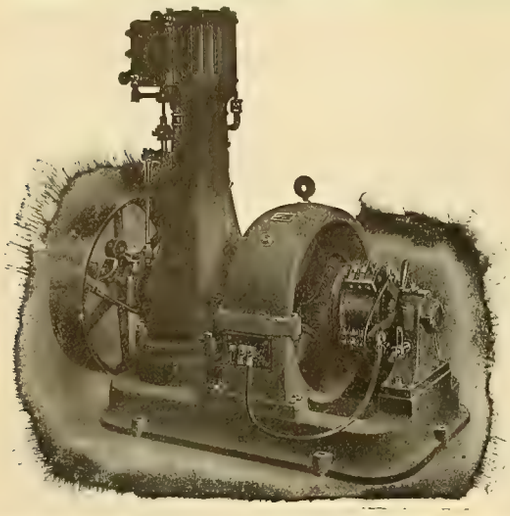
METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

The Best of Everything

THE NORTH-WESTERN LINE

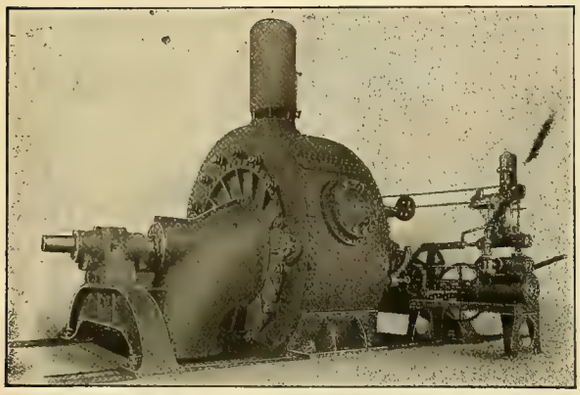
THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.



SAMSON TURBINE

UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.

Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN.
Immediate Returns.

"TELEPHONE TROUBLES ...AND... HOW TO FIND THEM,"

BY
W. H. HYDE AND J. A. McMANMAN,
FORMERLY
HASKINS' TELEPHONE TROUBLES.

This Little Book is Strictly Up-To-Date on all Matters Pertaining to Telephone Troubles and their Remedies.

Sent Postpaid for 25c.

New (eighth) edition just out, 48 pages. Many diagrams showing connections. A complete hand-book for telephone inspectors.

Telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor.

Electrician Publishing Co.,
510 MARQUETTE BLDG., CHICAGO.

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY.
Suite 510 Marquette Bldg., Chicago.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN
CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS,
CHICAGO AND PEORIA,
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER Colo., TEXAS, FLORIDA, UTAH, CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

REG. TRADE MARKS.
"Phosphor Bronze"
DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS.
ORIGINAL AND SOLE MAKERS IN THE U.S.

CEDAR POLES

LINDSLEY BROTHERS, COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

OUR POLE YARDS

ARE FULL TO THE SKY LINE WITH ALL SIZES POLES FROM 20-FOOT UP.
WON'T YOU LET US QUOTE YOU?
MALTBY LUMBER CO., BAY CITY, MICH.

Write Us

If you want CEDAR POLES
POSTS, SHINGLES,
Tie Plugs, Paving Blocks, Etc. It will pay.
THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.
C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WE MAKE A SPECIALTY OF WESTERN POLES.
LONG LENGTHS TO 80 FEET.
SHIPMENTS MADE DIRECT FROM IDAHO.
CEDAR POLES
CARNEY BROTHERS COMPANY,
610 Chamber of Commerce, CHICAGO, ILL.
YARDS AT:
DULUTH, MINN. BALL CLUB, MINN.
BLUEBERRY, WIS. BEER RIVER, MINN.
CORONA, MINN. COWAN, MINN.
YORK, MINN. BLACK DUCK, MINN.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

POLES

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.
TIES.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

M. KLEIN & SON
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

CEDAR POLES AND TIES

WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

CEDAR POLES

IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES:
Eastern District, Keystone Telephone Building, Philadelphia, Pa.
Middle District, Electric Building, Cleveland, O.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.
Large Stock Constantly on Hand.

YELLOW PINE CROSSARMS!

THE VERY BEST ARMS THAT MONEY AND CAREFUL AND SKILLED WORKMANSHIP CAN PRODUCE. WE WANT YOUR ORDERS.
THE STANDARD POLE & TIE COMPANY, 44 BROAD ST., N. Y.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

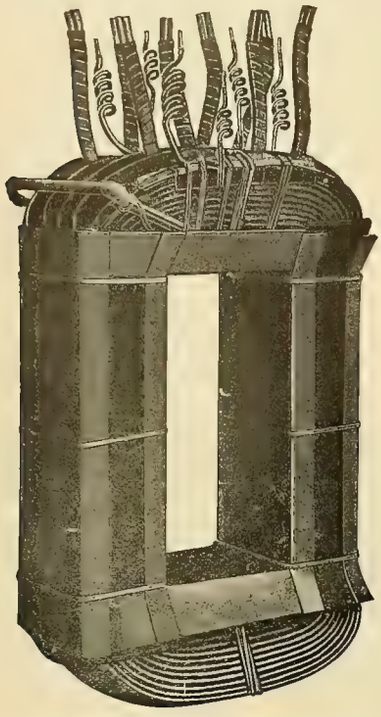
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES

LONG DISTANCE 'PHONE
WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

The Westinghouse Type N Transformer

has two primary and three secondary voltages. Each secondary voltage can be varied to suit either the varying line voltages of an extensive transmission system or to give special voltages from standard circuits.

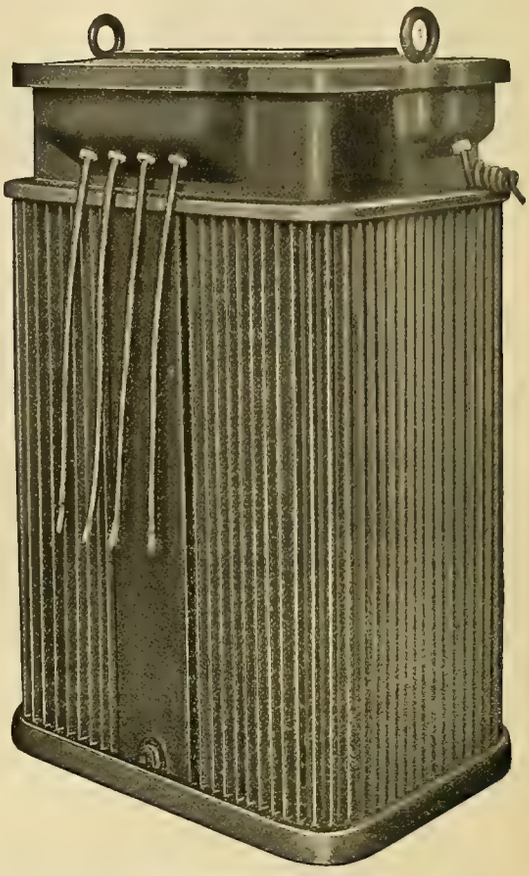


Westinghouse Type N Transformer Coils Assembled, Showing Spread Coil Feature.

All transformers are arranged for three-wire secondary distribution and the secondary coils are cross-connected to give equal voltages on both circuits, even with large, unbalanced loads.

Sizes: 1-2 to 50 K. W.
For frequencies of 7,200-16,000.

Write for circular 1060 to nearest district office of



50 K. W. Type N Transformer.

Westinghouse Electric & Mfg. Co.,
Pittsburg, Pa.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, In Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"WOOD"

ENCLOSED ARC LAMPS

FOR DIRECT CURRENT CIRCUITS

110 VOLTS MULTIPLE TYPE FORM C	SERIES DIFFERENTIAL TYPE FORM C	220 OR 500 VOLTS MULTIPLE SERIES TYPE FORM C

THE BEST LAMPS ON THE MARKET

FORM C Direct Current "Wood" Arc Lamps possess valuable features of simplicity, durability, reliability and interchangeability that warrant the above assertion. The Series lamp is the shortest lamp made for the same length carbons. The 220 or 500 volt lamp operates either two in series on 200 to 250 volt circuits or five in series on 500 to 550 volt circuits as successfully as the multiple lamp operates on 110-volt circuits, which means that both lamps are included in the above claim. More detailed information will be furnished on application.

FORT WAYNE ELECTRIC WORKS

INCORPORATED

MAIN OFFICE AND FACTORY, FORT WAYNE, IND.

A New Paper-Weight.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

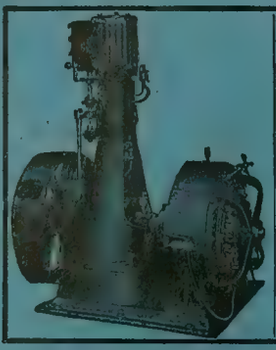
We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.
853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

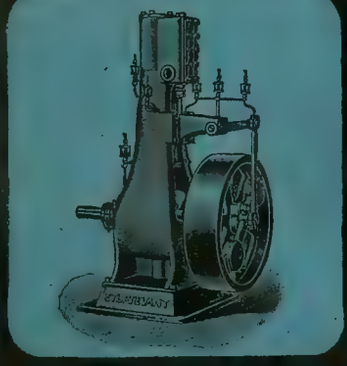
GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

STURTEVANT ENGINES



Our Specialty: High grade engines of medium capacity for high or low pressure. 60 sizes under 200 H.P.

B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK · PHILADELPHIA · CHICAGO
LONDON
173

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

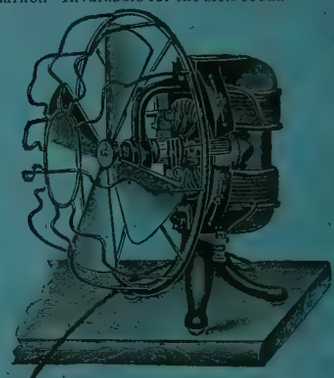
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,
FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

A COOLING BREEZE

CAN BE HAD FOR LITTLE MONEY BY ORDERING

COLONIAL DIRECT-CURRENT DESK OR CEILING FANS FROM US.

LARGE STOCK. PROMPT SHIPMENTS. LOW PRICES.

THE COLONIAL IS THE BEST FAN MADE.

ST. LOUIS ELECTRICAL SUPPLY CO.,
1118 PINE STREET, ST. LOUIS, MO.

BUFFALO HIGH SPEED ENGINES

FOR ELECTRIC LIGHTING AND POWER SERVICE.

TYPES:
Horizontal,
Vertical,
Simple,
Compound,
Belted,
Direct Connected.

BUFFALO FORGE COMPANY,
BUFFALO, N. Y.
CHICAGO OFFICE, 22-24 RANDOLPH ST.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.
NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, JULY 12, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 2.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 70-81 Cornhill, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Mills Bldg., San Francisco. 101 Milk St., Boston.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

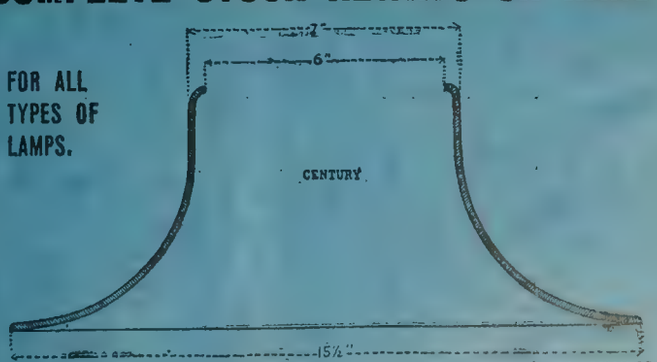
2,000 IN USE.
Bipolar and Multipolar Motors from ⅓ to 60 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.

The Ericsson phone will not buzz, and wheeze, and click, and rattle, and bang, and grunt, and roar, and groan, and whisper, and growl, and screech, and whistle, and yawp, and bellow, and crow, and creak, and snarl, and croak, and yawn, and whine, and then say: "What's the matter with you? Are you deaf?"
FULL PARTICULARS FROM
ERICSSON TELEPHONE CO. 296 Broadway, NEW YORK CITY.

Kilfyre
DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO., 247-249 Pearl St., New York City.

COMPLETE STOCK ALWAYS ON HAND.
FOR ALL TYPES OF LAMPS.


OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES AND SHADES.
WRITE US.
THE CENTURY GLASS CO., BELLAIRE, OHIO.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 83.

Weston Standard Illuminated Dial Station Ammeter, Style B. "Flush Type."

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON—Elliott Bros., No. 101 St. Martins Lane

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK

Mention the Western Electrician when writing for catalogues.

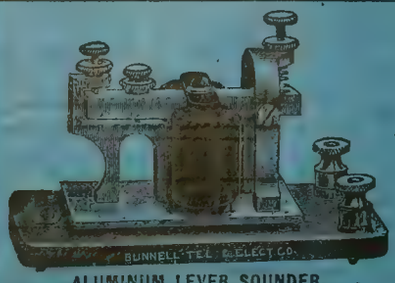
THE BUNNELL TELEGRAPHIC AND ELECTRICAL CO.

110-120 BEEKMAN STREET, NEW YORK.

TELEGRAPH, TELEPHONE, RAILWAY AND ELECTRICAL SUPPLIES.

FACTORIES:
NEW YORK CITY
AND
MILFORD, CONN.

District Messenger Call, Police, Patrol, Watchman's, Burglar and Fire Alarm Boxes and Equipment.



ALUMINUM LEVER SOUNDER.

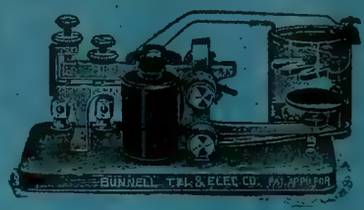
TRY OUR

BEEKMAN DRY BATTERY,
BEEKMAN IRON BOX BELL,
BEEKMAN ANNUNCIATOR WIRE,
BEEKMAN TELEPHONES.

UNEQUALED IN QUALITY OR PRICE.

OUR GOODS ARE GUARANTEED.

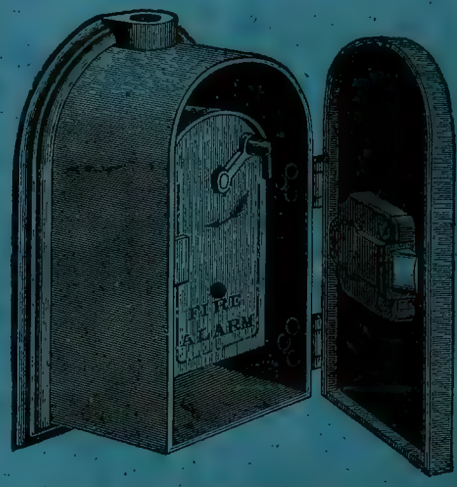
CATALOGUE OR LEARNERS' MANUAL FREE ON RECEIPT OF POSTAGE.



BEEKMAN ELECTRO-MECHANICAL COMBINATION SET.

THE BEEKMAN MEDICAL BATTERY.

STANDARD MAIN LINE RELAY.



No. 5 FIRE ALARM BOX.

MACHINE TOOLS

WHEN OPERATED BY THE

Crocker-Wheeler System

OF MULTIPLE VOLTAGE CONTROL OF SPEED

GIVE A MAXIMUM OUTPUT WITH A MINIMUM AMOUNT OF POWER REQUIRED.

The System is PRACTICAL IN DESIGN,
EASY OF ATTACHMENT,
ECONOMICAL IN RESULTS.

SALES OFFICES IN ALL LARGE CITIES.

MAIN OFFICE AND WORKS: AMPERE, N. J.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.

(SOLE MANUFACTURERS.)

BOSTON, MASS.

THOS. C. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" *For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.*

The "Exide Accumulator" *For Electric Vehicles.*

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:
PHILADELPHIA, Allegheny Ave. & 19th St. — NEW YORK, 100 Broadway. — BOSTON, 60 State St. — CHICAGO, Marquette Bldg. — BALTIMORE, Equitable Bldg — ST. LOUIS, Wainwright Bldg. — SAN FRANCISCO, Nevada Block. — CLEVELAND, New England Bldg. — DETROIT, Michigan Electric Co. — HAVANA, CUBA, F. G GREENWOOD MGR. 34 Empedrado Street

R 52

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

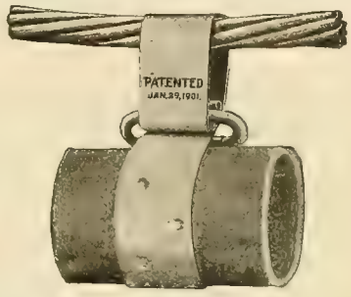
FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago. Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

Federal Electric Co.
84 Market Street, CHICAGO, ILL.

The Metropolitan Aerial Cable Clip

"SEE THAT LOOP"



over the supporting strand? It cannot become unfastened. Safer and more durable than any other clip.

Used exclusively for hanging telephone cables in New York City and environs.

Manufactured by

YONKERS SPECIALTY CO.,
Yonkers, N. Y.

WESTERN ELECTRIC CO., New York and Chicago. / M. B. AUSTIN & CO., Chicago. } Agents.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Badt & Co., F. B.....10
Baker & Company..... 3
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.10
Beardsley Gravity Dam & Construction Co.....—
Beidler & Co, Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bossert El. Construction Co.. 1
Brown & Leasure..... 11
Buffalo Forge Co.....20
Bullock Electric Mfg. Co.....11
Bunnell Telegraph.&Elec.Co. 2

Carney Brothers Company...17
Central Electric Co..... 5
Central Manufacturing Co .—
Central Telephone & El. Co..—
Century Glass Co..... 1
Chase-Shawmut Company... 2
Chicago & Alton Railroad....16
C. & N. W. R. R.....16
Chicago Edison Company .4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co .—
C., M. & St. P. R. R..... 16
Chicago Pay Station Co.....14
Coit, Henry A..... 14
Colorado Lamp Co., The.....—
Columbia Telephone Mfg.Co.13
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 7
Crescent Ins Wire & Cbl. Co. 1
Crocker-Wheeler Company . 2
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ...—
Dicke Tool Company.....16
Diehl Manufacturing Co..... 5
Dixon Crucible Co., Joseph.. 8

Eclipse Pulley Covering Co..10
Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....10
Edwards & Company..... 9
Electrical Engineer Institute,—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 4
General Incandescent Arc Light Company.....11
General Incand. Lamp Co....—
Glass Wool Mfg. Company...—
Goodrich Line.....16
Great Western Smelting & Refining Company... ...12
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co... 8
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....17
Holmes Fibre Graph. Co.....11
Hopkins & Co , A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....10, 15, 17
Klein & Son, Mathias.....17
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 11

Machado & Roller.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co.. 5
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....10
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 9
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed.....10
Pass & Seymour..... 7
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.. 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M..... 10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17
Pratt Institute.....—

Reisinger, Hugo..... 7
Reliance Electric Company.. 7
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....20
Roebling's Sons Co., J. A.....20
Rose Electric Company 12
Rose Polytechnic Institute...—

St. Louis Elec. Supply Co 20
Sargent & Lundy... .....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G ... .12
Schott, W. H. 1
Schureman & Hayden.....12
Scientific Exchange 12
Shelby Electric Company....—
Signaloid Chemical Works...—
Simplex Electrical Co., The.1,10
Smith Co., S. Morgan..... 9
Spies Electric Company..... 1
Sprague Electric Company...10
Standard Electric Company.. 7
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Stanley Instrument Co..... 9
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The.... 8
Stilwell-Bierce & Smith-Vaile Company.... 9
Stow Mfg. Company.....—
Streeter, A. L 9
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Torrey Cedar Company .... .17
Triumph Electric Co.....11

Union Pacific R. R.....16
United Telpherage Co..... . 5

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company....11
Vomacka & Mazenek .....—
Vulcanized Fiber Company 20

Wagner Electric Mfg. Co..... 6
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co .....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst..—
Yonkers Specialty Co 3

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

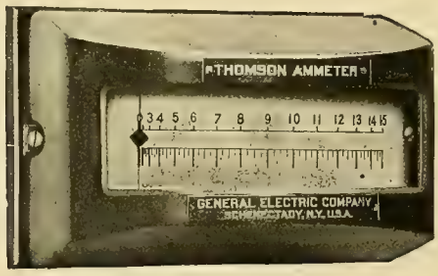
MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

THE GENERAL ELECTRIC COMPANY'S

Switchboard Instruments



Horizontal Edgewise Ammeters, Voltmeters, Wattmeters.

Standard Instruments for Alternating Current Measurements.

General Office: Schenectady, N. Y.

Chicago Office, Monadnock Building. **Sales Offices in all Large Cities.**

Ad. No. S—164

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

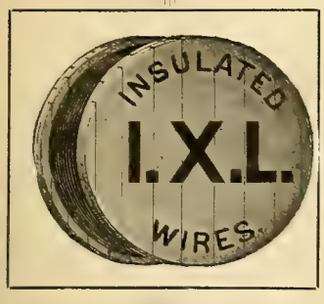
The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office, 15 Cortlandt St., New York.

(10928)



I. X. L.

WEATHER=PROOF WIRE

All Sizes Carried in Stock . . . . .
Ready for Immediate Shipment.

OKONITE IT NEVER DISAPPOINTS

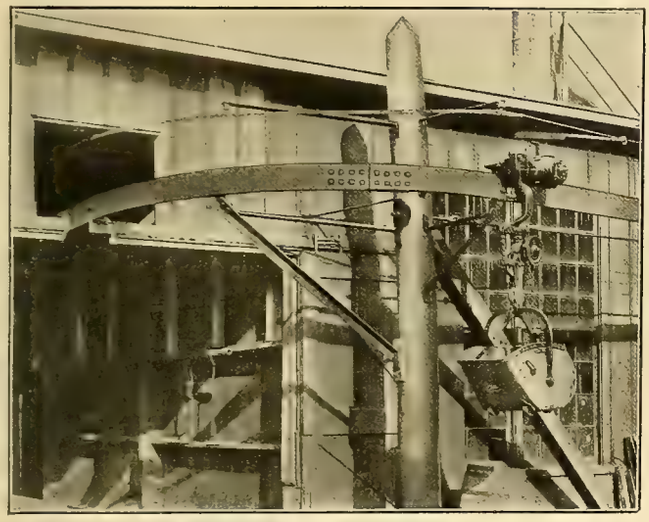
Central Electric Company,

GENERAL WESTERN AGENTS,

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

TELPHERAGE.



TELPHER WITH AUTOMATIC DUMPING BUCKET TRAVERSING A CURVE.

This shows a Telpherage plant located at Buffalo, New York. This installation is interesting on account of its automatic features. The bucket is loaded at the cars and the load is transported by electricity to the end of the line, where the bucket automatically dumps its load. The Telpher reverses itself and returns with the empty bucket to the cars for another load. The Telpher can be operated by unskilled labor with the minimum of expense for power, maintenance and first cost. Power less than one horse. The material, which is dumped into a hopper, is then elevated to the upper story. This line consists of a straight section and a right angle curve. A portion is cable, and the curve and the track in the building are solid rail. The line is supported, as will be observed from the photographs, from ordinary telegraph poles, and is an excellent example of simple construction.

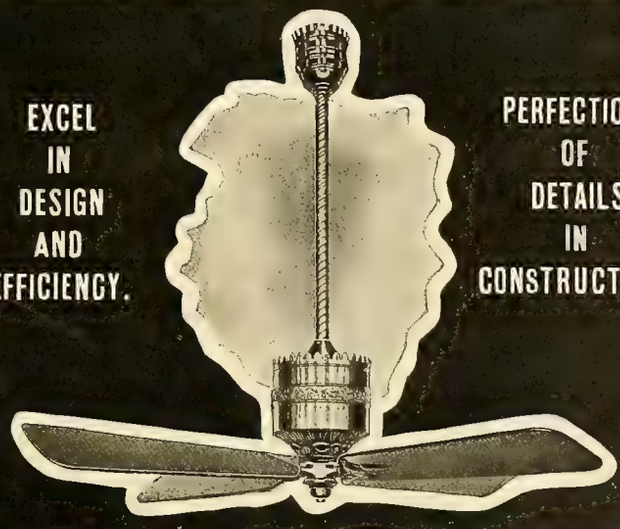
SEND FOR CIRCULARS NOS. 20 AND 24.

UNITED TELPHERAGE CO.,

20 Broad Street, New York, U. S. A.

DIEHL ELECTRIC FANS

EXCEL IN DESIGN AND EFFICIENCY.



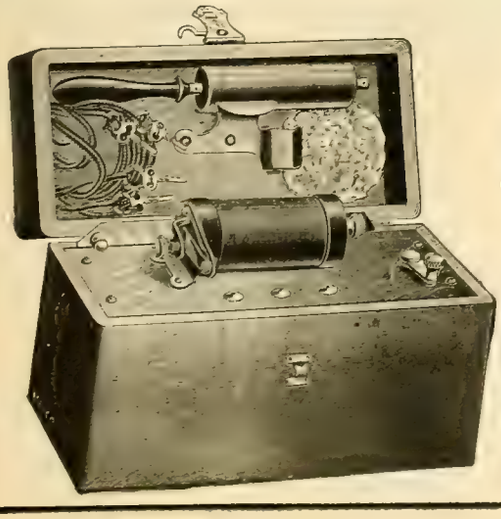
PERFECTION OF DETAILS IN CONSTRUCTION.

Our Desk, Bracket and Trunnion Fans are perfect in design and of superior finish. Send for 1902 Catalogue.

DIEHL MANUFACTURING CO.

SALES OFFICES:
561 Broadway, NEW YORK.
128 Essex St., BOSTON.
1217 Filbert St., PHILADELPHIA.
Central Electric Co., CHICAGO.
Newman-Spranley Co., NEW ORLEANS.
Waco Electrical Supply Co., WACO, TEX.

MAIN OFFICE AND WORKS:
Elizabethport, N. J.



ANTI-DOC

No. SIX

A First-Class Medical Apparatus.

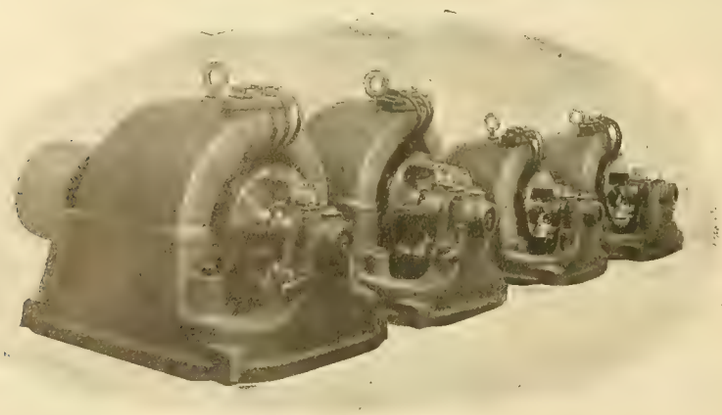
RETAIL PRICE, $2.50. SOLD BY ALL DEALERS.

MADE BY

MANHATTAN ELECTRICAL SUPPLY CO.,

32 Cortlandt Street, NEW YORK.

188 Fifth Avenue, CHICAGO.



WRITE FOR "OPINIONS," Our Pamphlet, on Our SINGLE-PHASE MOTORS.

Also send for new Bulletin, "No. W50," giving all their "FINE POINTS."

Testimonial letters show that where Wagner Company's Single phase Motors **have replaced direct current motors the power service has been better and the cost of operation less.**

For pumping and blower service these motors are especially adapted, most excellent results being secured. We are prepared to bid on direct-geared triplex pump outfits, belted ventilating outfits and belted pressure blower work, within the limit of our motor capacities, and solicit inquiry along these lines, as well as other lines of power work.

WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Bunnell Telegraph & Elec. Co.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Eclipse Pulley Covering Co.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.
Yonkers Specialty Co.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Bunnell Telegrap. & Elec Co.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Bullock Elec. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Pass & Seymour.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Bullock Elec. Mfg. Co.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Electrical Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Central Electric Co.
Crocker-Wheeler Company.
Diehl Manufacturing Co.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Alarm Equipments.
Bunnell Telegrap. & Elec. Co.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Glass Wool.
Glass Wool Mfg. Company.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Rose Polytechnic Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Colorado Lamp Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Carney Brothers Company.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulley Covering.
Eclipse Pulley Covering Co.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Rosettes.
Pass & Seymour.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Telegraphic Supplies.
Bunnell Telegraph. & Elec. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Coit, Henry A.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Telpherage.
United Telpherage Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS.
FOR DIRECT CURRENT.
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

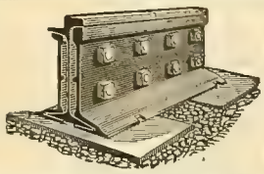
HUGO REISINGER 11 BROADWAY, NEW YORK.

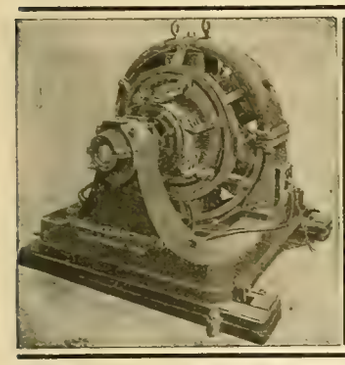
There are no Carbons better than the "Electra" and none "just as good."

CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building,
NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.





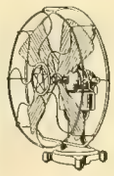
"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

SEA BREEZES RECALLED

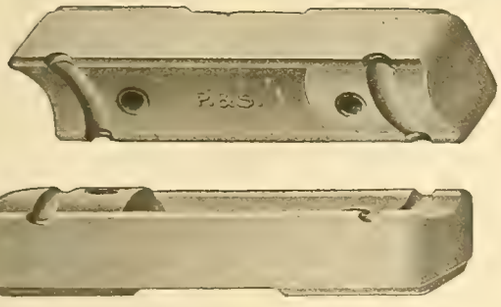
BY USING OUR FAN MOTORS.
HOT WEATHER DISCOMFORTS DISPELLED



WHERE THEY ARE INSTALLED.

ALL VOLTAGES AND STYLES.

THE STANDARD ELECTRIC CO.
CINCINNATI, OHIO.



The Strongest and Most Practical Cleats and Tubes on the Market.

MADE FROM THE CELEBRATED

P. & S. Porcelain.

COMPLETE LINE CARRIED IN STOCK.

PASS & SEYMOUR, Inc.,
SOLVAY, N. Y.

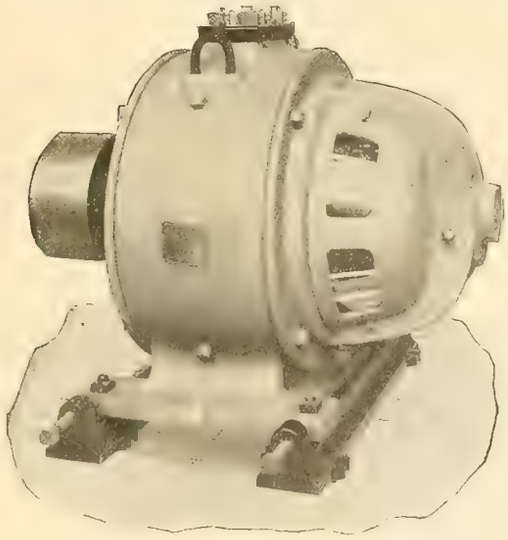
NEW YORK. CHICAGO. BOSTON. CINCINNATI. SAN FRANCISCO.

MOTORS

—FOR—

ALL SHOP APPLICATIONS.

OUR MOTORS INSURE SATISFACTORY RESULTS.



WRITE FOR POWER MOTOR CATALOGUE.

WESTERN ELECTRIC COMPANY,
CHICAGO. PHILADELPHIA.
SAINT LOUIS. NEW YORK.

DRY STEAM.

Lubrication protected by using

DEARBORN BOILER COMPOUNDS.

Made to suit the water as per analysis.

NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND.
WRITE FOR PARTICULARS.

DEARBORN DRUG & CHEMICAL WORKS, 27-34 Rialto Building, Chicago, Ill.
Telephone Harrison 3930 and 3931. WM. H. EDGAR, President. Offices from New York to Honolulu.

SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING

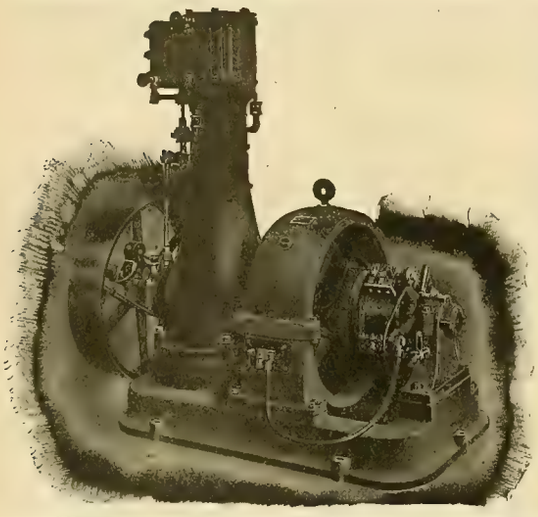
ELECTRIC LIGHTING AND POWER PLANTS,

On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

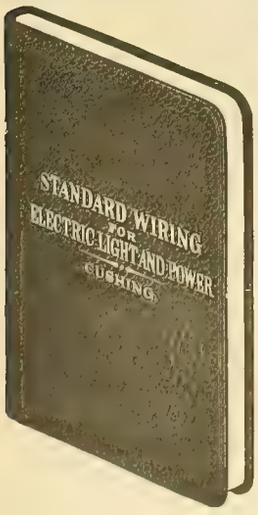
JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.



"The Recognized Authority on Wiring and Construction."

The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING
For Electric Light and Power.
By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover (pocket size), $1.00.
Sent post paid upon receipt of price, by

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO, ILL.

GRAPHITE RESISTANCE.

Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. By CLARK CARYL HASKINS. Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS.
FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

REG. TRADE MARKS. "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

EDWARDS AND CO. New York, N.Y. U.S.A.

PUSHES.

Fits in ¾ inch Hole. Fits in ½ inch hole
Fits in ⅝ inch hole.
No screws needed to fasten them as the spring clips hold them securely in place.

STREETER SPRING MOTOR FANS

173-75-77 SOUTH CLINTON STREET, CHICAGO.

FAN MOTORS FOR GENERAL USE.

No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.

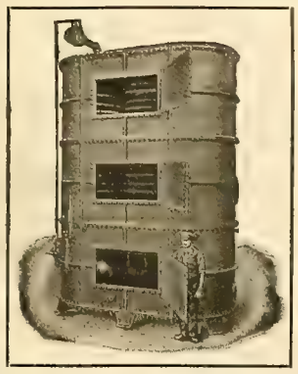
FIRST COST THE LAST.
No expense whatever to maintain.

EASY TO WIND.

Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.

WRITE FOR CIRCULAR.

When You Save Steam,



You Economize in Fuel, and

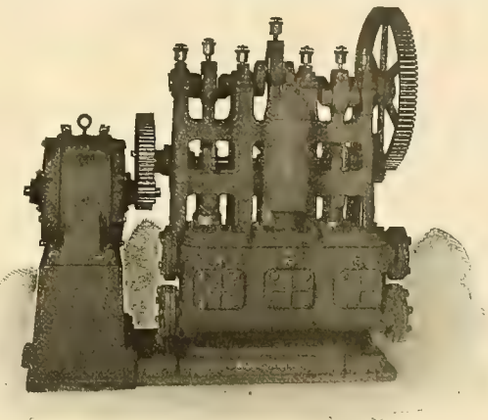
ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,



Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS

The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

Crimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Crimshaw** and **Competition Tapes** and **Splicing Compounds.**

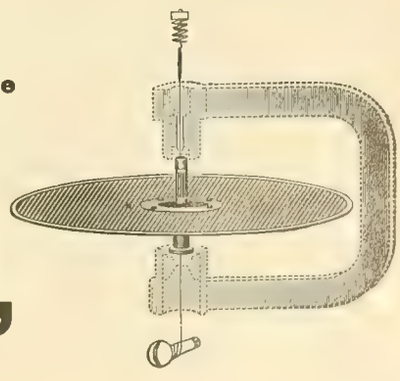
NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

DO YOU KNOW

the Importance of magnetically floating the moving parts of a meter?

Send for description and book full of good information "ABOUT METERS."



STANLEY INSTRUMENT COMPANY,

General Sales Office, 158 Broadway, New York, N. Y.
Pacific Coast Agency, 33 New Montgomery St., San Francisco, Cal.

Good advertising—ads that vibrate
must have a good article as a subject;
therefore, in this one we will get our money's worth.
In using Gutmann integrating
alternating current wattmeters
you have the one absolutely correct
and unapproachable method
of registering current consumption.

ELECTRIC APPLIANCE COMPANY, ELECTRICAL SUPPLIES,
92 AND 94 WEST VAN BUREN STREET, CHICAGO.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,
X-Ray Tubes,
Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

FLEXIBLE MICANITE

IMPROVED STYLE B. Its Flexibility and High Insulating Qualities Remain Unimpaired Indefinitely. Far Ahead of Anything Heretofore Furnished. Price as Low as Inferior Goods.

SEND FOR SAMPLES AND CIRCULAR.

MICA INSULATOR COMPANY,
NEW YORK. —PATENTEES— CHICAGO.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.
CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
The Simplex Electrical Co.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of 40 miles of railway out of Dover, Del., for the Del. Gen'l Elec. Ry. Co.

SPARKING
Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

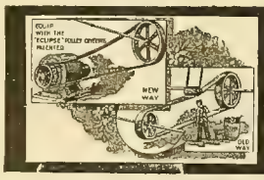
It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER.

RESIN SOLDER
IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.

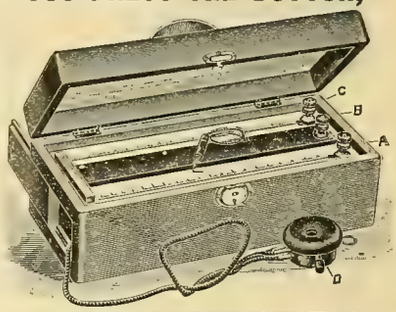
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.



WE SAVE YOU
in your belting and journals. WE PUT IT IN ON 60 DAYS' TRIAL. We increase the speed of your machines, thus increasing your production and saving you money.
THE ECLIPSE PULLEY COVERING CO.,
Phone Central 2815. 1508-1509 Ashland Blk.,
CHICAGO, ILL.

The Franklin Model Shop
Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

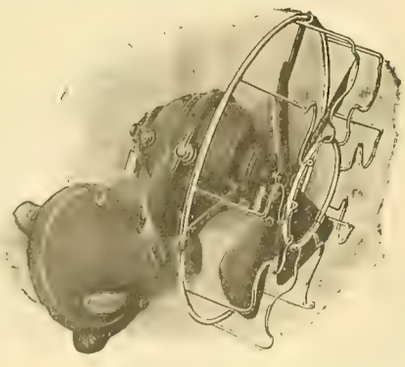
"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to
ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

LUNDELL FANS



Superior in Design and Construction.

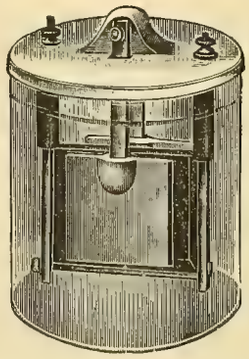
Cooling, Economical, Safe.

Catalogue No. 03304.

SPRAGUE ELECTRIC CO.,
GENERAL OFFICES: 527-531 WEST 34th STREET, NEW YORK.

EDISON PRIMARY BATTERIES.
FORMERLY KNOWN AS EDISON-LALANDE.

FOR GAS ENGINES,
SLOT MACHINES,
AUTOMOBILES
RAILROAD SIGNALS,
CROSSING BELLS,
SMALL MOTORS,
ETC.



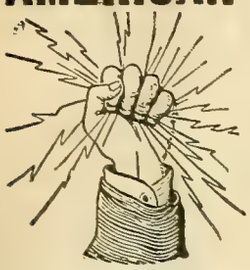
CONSTANT CURRENT
NO LOCAL ACTION,
WILL NOT FREEZE,
LIQUID TIGHT
CELLS FOR
PORTABLE
WORK.

FULL DESCRIPTION IN BOOKLET NO. 4.
EDISON MANUFACTURING COMPANY,
FACTORY, ORANGE, NEW JERSEY, U. S. A. NEW YORK OFFICE, 83 CHAMBERS STREET.
CHICAGO OFFICE, 144 WABASH AVENUE.

FRANK N. PHILLIPS, President. C. H. WAGENBEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Bullock's ELECTRIC MFG CO. CINCINNATI O U.S.A. 411

Complete Power Plants

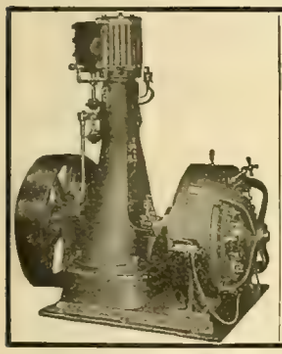
Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

TRANSFORMERS.
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

GASOLINE MOTORS
—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

CHAS. L. BROWN. E. E. LEASURE.
BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO



TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

FIBRE-GRAPHITE COMMUTATOR BRUSH — SELF-LUBRICATING — NOISELESS

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

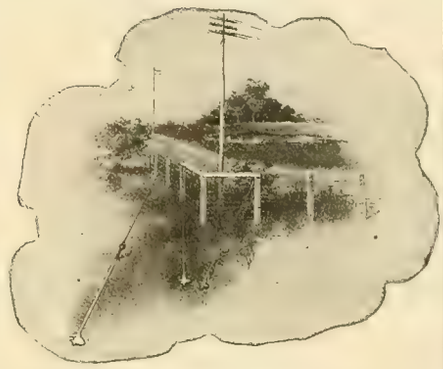
NONSENSE, WITH SENSE, FOR CENTS.

"RAILROADING"
A Stombaugh Guy Anchor,
A good wrecking crew,
Will quicker help a wreaker,
Than anything'll do.
—STOMBAUGH.

Watch this space for change.

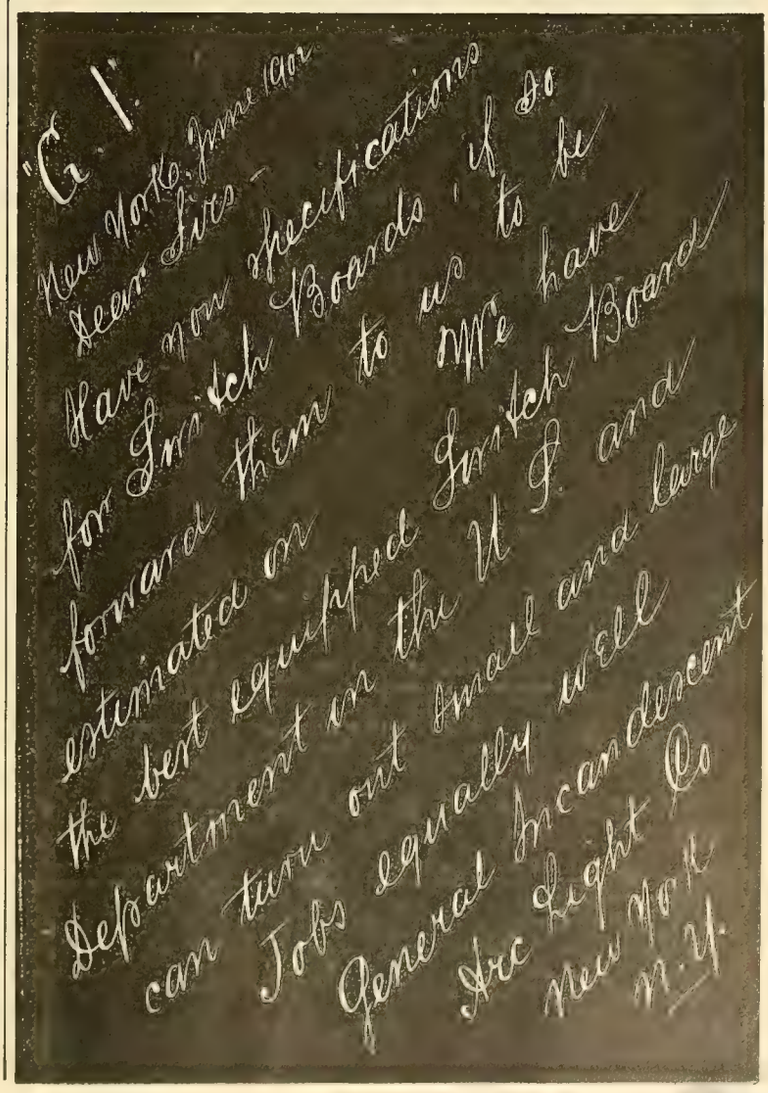
The installation of the
STOMBAUGH GUY ANCHORS
is simplicity itself. That is the reason they appeal so strongly to those who have anything to guy.

Write us for Information, Prices and Catalogue.



W. N. Matthews & Bro.
603 Carleton Bldg.
ST. LOUIS.

HOW THEY WORK.



WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As manager or superintendent of telephone company. I am 33 years of age, strictly temperate and have had 7 years' practical work with Independent telephone companies. Understand line and switchboard construction. Have just finished building 4 new exchanges and am at present manager of 5 exchanges. Best of references. Address BOX 90, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

A1 SALESMAN of six years' acquaintance with Ohio trade, wishes connection with one of the largest supply houses. Asso. preferred. Maximum sales guaranteed and fair salary expected. Address BOX 91, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

In any town where the electric light company does not sell the HYLO Lamp, a salesman. The electrician and repair man under our plan can make money on the side introducing the HYLO. Write us for particulars and state experience fully. We want salesmen. THE PHELPS COMPANY, 101 State St., Detroit, Mich.

WANTED.

200-K. W., 250-Volt, Direct-Connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

POSITIONS OPEN.

PER MONTH.

3 Draftsmen for R. R. Work. - $125.00
8 Draftsmen for Electrical Work, $70.00 up.
3 Engineers and Electricians, - 75.00 up.

Engineers and Draftsmen will do well to register with us free of charge.

THE SCIENTIFIC EXCHANGE.
No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

Rose Electric Co., St. Louis, Mo.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse - - 250 volt M. P.
1—125 K. W. Thompson-Ryan - 250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.
1— 55 K. W. Fuller - - - - - 250 volt M. P.
1—100 K. W. General Electric - 500 volt M. P.
2— 90 K. W. General Electric - 500 volt M. P.
1— 62 K. W. T.-H. D 62 - - 500 volt M. P.
1—100 K. W. General Electric - 125 volt M. P.
1—100 K. W. Triumph - - - 125 volt M. P.
1— 80 K. W. Keystone - - - - 125 volt M. P.
1— 65 K. W. Jantz & Leist - 125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 30, 1902. Sealed Proposals will be received at this office until 2 o'clock p. m. on the 31st day of July, 1902, and then opened, for the installation of an electric conduit and wiring system for the U. S. Post Office at Joliet, Illinois, in accordance with the drawings and specification, copies of which may be obtained at this office or at the office of the Superintendent of Construction, at Joliet, Illinois, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 18 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K. W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY, Rochester N.Y.

FOR SALE.

Telephone exchange in one of the best towns in the Cherokee Nation. Address Lock Box 121, Afton, I. T.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Engine 38x72 inches, George H. Corliss.
Engine 30x72 inches, George H. Corliss.
Engine 30x60 inches, Hamilton Corliss.
Engine 28x60 inches, (pair) Harris Corliss.
Engine 24x42 inches, Cooper Corliss.
Engine 23x60 inches, George H. Corliss.
Engine 20x48 inches, Watts-Campbell Corliss.
Engine 16x38 inches, Watts-Campbell Corliss.
Condenser 16x20x24 inches, Deane single.
Condenser 9x12x10 inch., Worthington duplex.
Pump 20x6x24 inches, Wilson-Snyder duplex.
Pump 12x8x12 inches, Smith-Vaile duplex.
Pump 20x7x18 inches, Blake single cylinder.
Pump 16x10½x18 inch., Hughes single cylinder.
Accumulator, hydraulic, 18-inch plunger.
Compressor, air, 10x12x14 in., Hall No. 5 duplex.

Send for complete monthly stock list.

WICKES BROS., Saginaw Mich.

95-97 Liberty Street, NEW YORK CITY. 1214 Marquette Bldg., CHICAGO, ILL.
45th St. and A. V. R. R., PITTSBURG, PA.

A. G. SCHOONMAKER CO.,

126-A Liberty Street, New York, N. Y.

DYNAMOS, MOTORS, TRANSFORMERS, METERS, ARC LAMPS.

2 250 K. W. three-phase 50 cycles General Electric 2400-volt Generators, three-bearing, with Switchboard.
2 250 K. W. Synchronous Motors for same.
3 300 H. P. Cross Compound Ball Engines.
77 10 ampere Thompson Recording Watt Meter
35 25 ampere Thompson Recording Watt Meter
15 50 ampere Thompson Recording Watt Meter
20 15 ampere Thompson Recording Watt Meter
1 30 ampere Thompson Recording Watt Meter
8 100 ampere Thompson Recording Watt Meter
1 150 ampere Thompson Recording Watt Meter
2 300 ampere Thompson Recording Watt Meter

Correspond with us to buy or sell.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN.
140 S. Clinton St., Chicago.

Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
510 Marquette Building, CHICAGO.

SCRAP?

We pay highest market prices for

SCRAP COPPER, BRASS and PLATINUM, also Incandescent Lamp Bases, etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work. Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO.,
CHICAGO.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: N. Y., CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

CORLISS ENGINES

REBUILT AND READY.

34x60 Geo. H. Corliss,
28x60 Lane & Bodley Corliss,
20x48 Harris Corliss
20x48 Wheelock Corliss,
18x42 Allis Corliss,
18x36 Sioux City Corliss,
16x42 Hamilton Corliss,
14x24 Cooper Corliss,
12x36 Hamilton Corliss,
12x36 Harris Corliss.

AUTOMATIC ENGINES.

16x32 Buckeye Medium Speed,
14½x16 Rice Automatic High Speed,
14½x15 Armington & Sims Automatic,
13x21 Buckeye Medium Speed,
13x20 Russell Medium Speed.

BOILERS.

2 250 H. P. Babcock & Wilcox Water Tube,
1 66x18 Tubular,
2 60x18 Tubular,
6 60x16 Tubular,
3 56x16 Tubular.

W. W. WHITEHEAD COMPANY,
DAVENPORT, IOWA.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

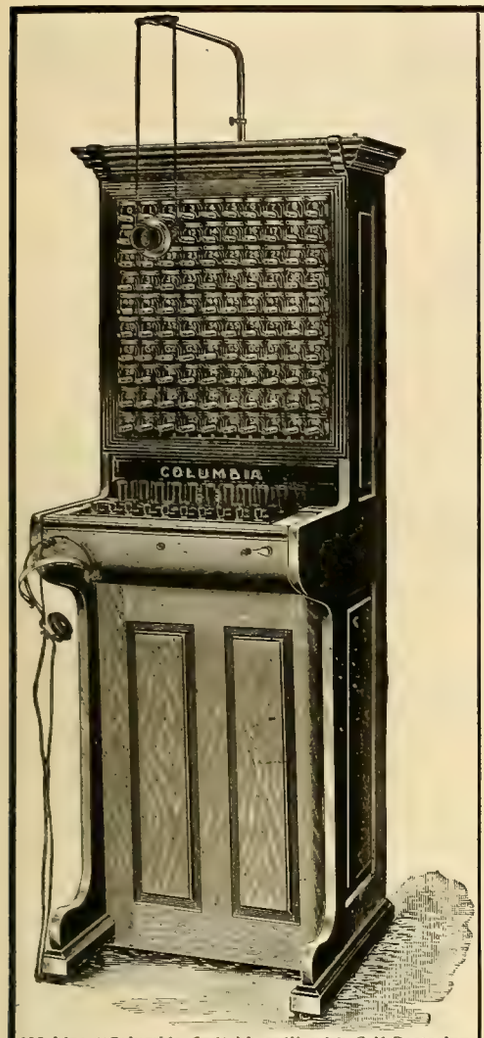
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,		1 200	lines	and telephones
Ennis, Tex, . .	"	"	1,200	"	"
Norwalk, Ohio, .	"	"	2,400	"	"
Frankfort, Mich.,	"	"	250	"	"
Dundee, Mich., .	"	"	200	"	"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS. Equipped with superior solid back transmitters, non-packing and practically indestructible.

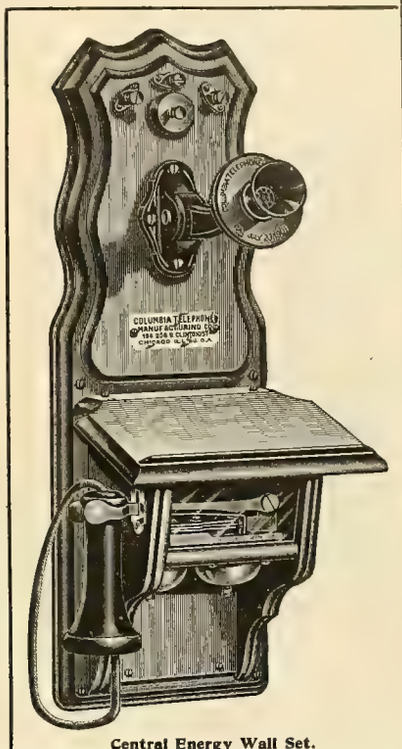
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00**.

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50**.

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00**.
The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00**.
The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1 25**.
A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.
This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.
The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.
The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.
The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the layman who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

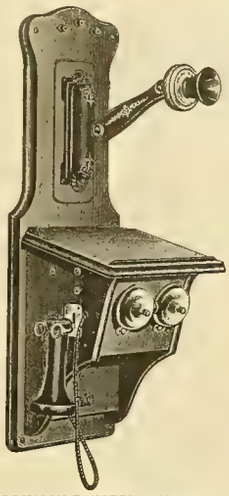
336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,

510 Marquette Bldg., Chicago.

Sterling Electric Co.



COMMON BATTERY WALL SET.

Manufacturers of

The Simplest and Most Perfect Common Battery Lamp Signal Multiple System ever devised.

Only one relay on each line, only one battery for calling, talking and supervising.

MAIN OFFICE AND FACTORY:

LAFAYETTE, - - - - INDIANA.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger

for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.

No. 1. Light, 1¾x ⅜in.
No. 2. Medium, 1¾x½ in.
No. 3. Heavy, 2x½ in.

Nos. 2 and 3 always in stock.

DEAD END HANGER. Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.

Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties and up-to-date. Tell us what you want.

Corner Brackets, Guy Shims, and Special Forgings made to order.

3-Bolt Guy Clamp.

Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.

ARE YOU LOOKING FOR TROUBLE?

IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM

—IN—

BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

8th Edition Just Out. Price, 25c.

Electrician Publishing Co.,

510 Marquette Building,

CHICAGO.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,

130 LA SALLE AVE.,

CHICAGO.

CONTINENTAL TELEPHONE CONSTRUCTION CO.

GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.

TACOMA BLDG., CHICAGO.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

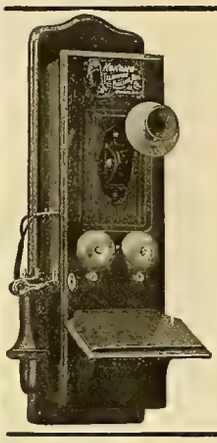
CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

New and Revised Edition JUST ISSUED.

American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

CHAPTER I.—History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V.—Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., *510 Marquette Building, CHICAGO, ILLINOIS.*

ORGANIZATION AND CONSTRUCTION.

HENRY A. COIT, LACLEDE BLDG., ST. LOUIS,

INVESTIGATES AND FINANCES

TELEPHONE PROPERTIES.

INVITES CORRESPONDENCE.

Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.
Samples cheerfully submitted. ...Prices Right.

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**

DID YOU KNOW THAT THE KELLOGG TRANSMITTER WAS GUARANTEED BETTER THAN THE BELL "SOLID BACK?" SUCH IS A FACT

WRITE FOR BULLETINS.

BRANCH OFFICES:
Keystone Telephone Bldg., Philadelphia, Pa.
Electric Bldg., Cleveland, Ohio.
347 Broadway, New York.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 SOUTH GREEN STREET, CHICAGO.

REMOVAL NOTICE.

Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING APPARATUS.

Metropolitan Telephone and Electric Co.

CHICAGO.

Telephone Troubles

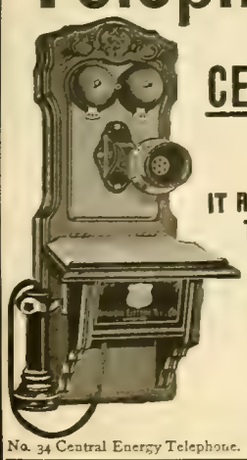
ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.



No. 34 Central Energy Telephone.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

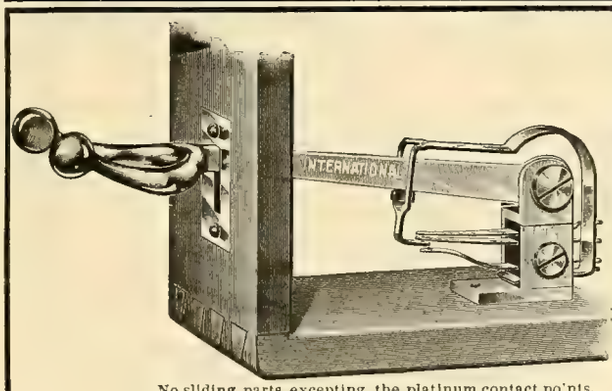
IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE. SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS

STROMBERG-CARLSON TELEPHONE MFG. CO.,
CHICAGO, ILL.

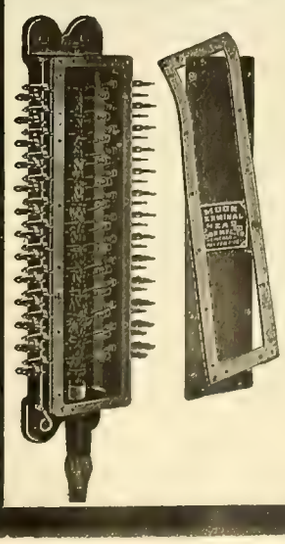


A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE

"THE OVERLAND LIMITED"

ELECTRIC LIGHTED

. . TO . .

California

VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

THE DICKE TOOL COMPANY,

FACTORY: DOWNER'S GROVE, ILL.
Eastern Office: J. E. Way, Manager, 39 Cortlandt Street, New York.
Thos. G. Grier, Electrical Building, Chicago.
St. Louis Office: W. N. Matthews & Bros., 320 N. 6th Street.

4 Days Lake Trip

$13, Including Meals and Berths—Chicago to ESCANABA, Mich. and Return. Leave Chicago Wed., Fri., & Sat. 8:00 p. m.

7 Days Lake Trip

$25, Including Meals and Berths—Chicago to Mackinac Island and Return. Leave Chicago Saturdays 8:30 p. m.

Muskegon or Grand Haven

and RETURN $2.75 Leave Chicago 7:45 p. m., daily.

GOODRICH LINE STEAMERS

Finest Service on the Lakes

For complete information see local Railroad Agent or address

R. C. DAVIS, G. P. A., Foot of Michigan Ave., GOODRICH LINE, Chicago, Ill.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

A GLIMPSE AT OUR WESTERN STOCK.

1,700	pieces	40 feet,	7-inch tops
1,700	"	40 "	8 "
1,750	"	45 "	7 "
1,250	"	45 "	8 "
1,750	"	50 "	7 "
750	"	50 "	8 "
3,000	"	55 "	7 "
750	"	55 "	8 "
750	"	60 "	7 "
300	"	60 "	8 "
250	"	65 "	8 "
200	"	70 "	8 "

Our Prices Will Interest You.

POLES

30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR TROLLEY LINE CONSTRUCTION ALWAYS IN STOCK.

YARDS:

MENOMINEE	MICH.
ESCANABA,	MICH.
NADEAU,	MICH.
CLOQUET,	MINN.
HERON,	MONT.
CABINET,	IDAHO.

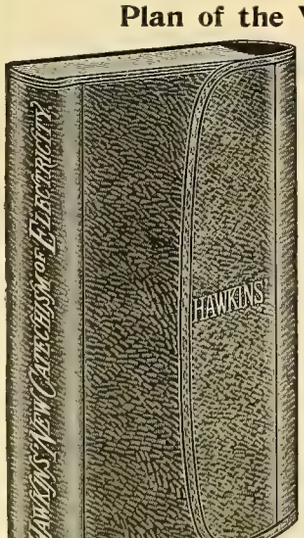
OUR ADDRESS:

FRANCIS BEIDLER & CO.

W. 22d and Loomis Sts., CHICAGO, ILL.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical impor ance are at once available.

It is an up-to date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

AS SIMPLE AS ITS NAME.

A B C —OF— THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co., 510 Marquette Building, Chicago, Ill.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS,
CHICAGO AND PEORIA,
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo., TEXAS, FLORIDA, UTAH, CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON, GENERAL PASSENGER AGENT, CHICAGO, ILL.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

OUR POLE YARDS

ARE FULL TO

THE SKY LINE WITH ALL SIZES POLES FROM 20-FOOT UP.

WON'T YOU LET US QUOTE YOU?

MALTBY LUMBER CO., BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WE MAKE A SPECIALTY OF WESTERN POLES.

LONG LENGTHS TO 80 FEET.

SHIPMENTS MADE DIRECT FROM WOODS.

CEDAR POLES

CARNEY BROTHERS COMPANY, 610 Chamber of Commerce, CHICAGO, ILL.

YARDS AT: DULUTH, MINN. BALL CLUB, MINN. BLUEBERRY, WIS. BEER RIVER, MINN. CORONA, MINN. COWAN, MINN. YORK, MINN. BLACK DUCK, MINN.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

POLES

W. C. STERLING & SON, MONROE, MICH.

Eleven Pole Yards in Michigan. Wholesale Producers for 20 years.

TIES.

THE HOLCOMB-LOBB COMPANY

CEDAR POLES & POSTS

745 MARQUETTE BLDG. CHICAGO ILL.

POLES.

WHITE CEDAR.

IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS.

Chemical Building.

CROSS ARMS.

LONG LEAF PINE AND FIR.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.

Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1703-7 FISHER BLDG. CHICAGO.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

CEDAR POLES STREET RY. TIES PERRIZO'S POLES DAGGETT MICH.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO., 229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.

Producers and Wholesalers. Escanaba, Mich.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand.

CEDAR POLES

LONG DISTANCE 'PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

CROSS ARMS

THE STANDARD POLE & TIE CO.

44 BROAD ST., NEW YORK

CROSS ARMS

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance.

Electrician Publishing Co.,

Suite 510 Marquette Bldg., - CHICAGO

CEDAR POLES

THE VALENTINE-CLARK CO.,

234 LA SALLE ST, CHICAGO

YARDS: PINCONNING, Mich. — GREEN BAY, WIS. — NEW LONDON, WIS.

The Westinghouse Type N Transformer

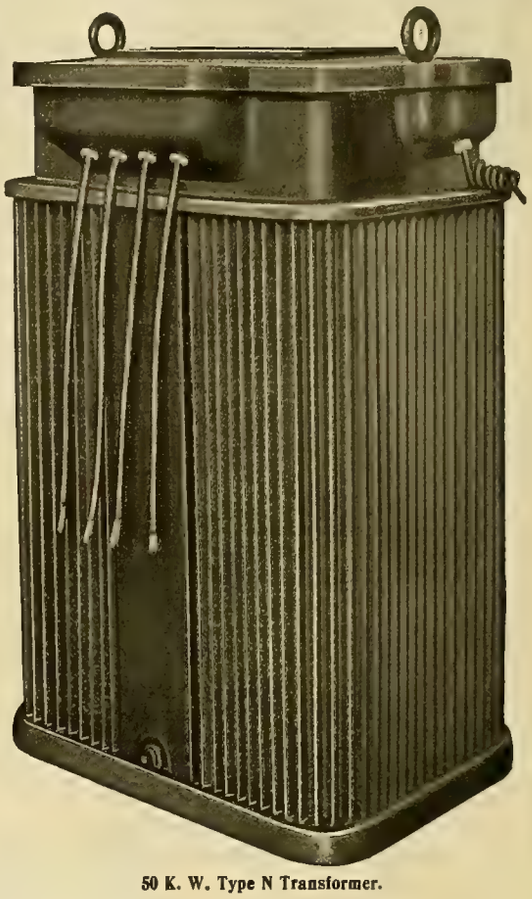
has two primary and three secondary voltages. Each secondary voltage can be varied to suit either the varying line voltages of an extensive transmission system or to give special voltages from standard circuits.

Westinghouse Type N Transformer Coils Assembled, Showing Spread Coil Feature.

All transformers are arranged for three-wire secondary distribution and the secondary coils are cross-connected to give equal voltages on both circuits, even with large, unbalanced loads.

Sizes: 1-2 to 50 K. W.
For frequencies of 7,200-16,000.

Write for circular 1060 to nearest district office of



50 K. W. Type N Transformer.

Westinghouse Electric & Mfg. Co.,
Pittsburg, Pa.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator; Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X; Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"WOOD" ENCLOSED SERIES ARC LAMPS

FOR DIRECT CURRENT
FORM C

THE BEST LAMP ON THE MARKET

SIMPLICITY, DURABILITY AND PERFECT OPERATION, COMBINED WITH A FINISHED, SYMMETRICAL APPEARANCE, ARE FEATURES OF THESE LAMPS

A HIGH-GRADE LAMP IMPLIES PERFECT WORKMANSHIP, THE BEST MATERIALS AND A FINISHED DESIGN. THESE ARE HIGH-GRADE LAMPS

FORT WAYNE ELECTRIC WORKS, FORT WAYNE INDIANA

THE LATEST BOOK.

"ELECTRIC LIGHTING,"

A PRACTICAL EXPOSITION OF THE ART FOR THE USE OF

Engineers, Students and Others Interested in the Installation or Operation of Electrical Plants.

BY FRANCIS B. CROCKER,

Professor of Electrical Engineering, Columbia University, New York.

Price $3, Prepaid. - Practical and Up-to-Date.

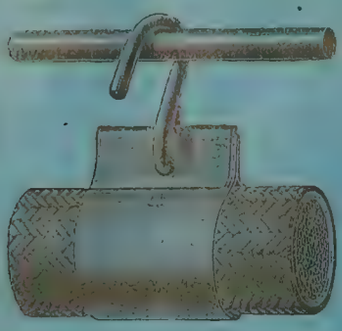
Just the Book you want. 450 Pages, over 150 Illustrations. Read the

TABLE OF CONTENTS:

Chapter I, Introduction; Chapter II, History of Electric Lighting; Chapter III, General Units and Measures; Chapter IV, Classification and Selection of Electric Lighting System; Chapter V, The Location and General Arrangement of Electric Lighting Plants; Chapter VI, Buildings for Electric Lighting Plants; Chapter VII, Possible Sources of Electrical Energy; Chapter VIII, The Steam Engine, History and General Principles; Chapter IX, Steam Boilers for Electric Lighting; Chapter X, Steam Engines for Electric Lighting, General Construction; Chapter XI, Typical Forms of Steam Engine for Electric Lighting; Chapter XII, Steam Engines for Electric Lighting, Selection, Installation and Management; Chapter XIII, Gas, Oil and Hot Air Engines; Chapter XIV, Water Wheels and Windmills; Chapter XV, Mechanical Connections between Engines and Dynamos, Direct Coupling, Belting and Shafting; Chapter XVI, Toothed, Friction and Other Gearing; Chapter XVII, Principles, Construction and Management; Chapter XXI, Applications of Accumulators in Electric Lighting; Chapter XXII, Switchboards, Including Switches, Fuses and Circuit-Breakers; Chapter XXIII, Electrical Measuring Instruments; Chapter XXIV, Lightning Arresters.

Every Engineer and Electrician who desires to thoroughly master the Art of Electric Lighting should have a copy of this book. Sent promptly.

ELECTRICIAN PUBLISHING COMPANY, Suite 510 Marquette Building, CHICAGO.



Wright Cable Hanger.

SEND FOR SAMPLES AND PRICES.

R. I. TELEPHONE & ELECTRIC CO.,
PROVIDENCE, R. I.

Mention this paper

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER COVERED, WEATHERPROOF **WIRES AND CABLES.**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

General Office and Works, Wilkesbarre, Pa. New York Office, 50 Dey St. Chicago Office, 1201-2 Marquette Bldg

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

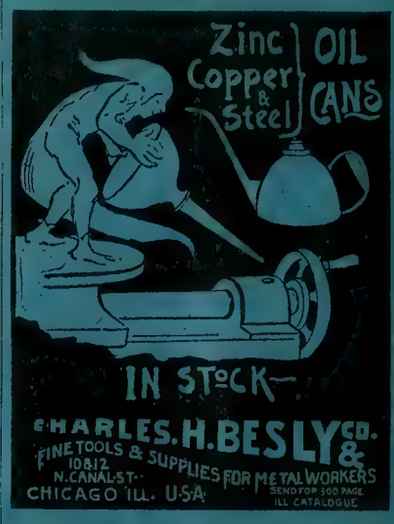
KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.



DON'T BUILD A CHIMNEY

USE MECHANICAL DRAFT

IT COSTS FAR LESS

Is independent of weather. The fan is positive in action. Responds instantly to sudden demands for more steam. Burns cheap fuel. Costs practically nothing for operation when exhaust steam is utilized

142

B. F. STURTEVANT Co BOSTON, MASS.
NEW YORK · PHILADELPHIA · CHICAGO · LONDON

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

A COOLING BREEZE

CAN BE HAD FOR LITTLE MONEY BY ORDERING

COLONIAL DIRECT-CURRENT DESK OR CEILING FANS FROM US.

LARGE STOCK. PROMPT SHIPMENTS. LOW PRICES.

THE COLONIAL IS THE BEST FAN MADE.

ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 PINE STREET, ST. LOUIS, MO.

BUFFALO HIGH SPEED ENGINES

FOR ELECTRIC LIGHTING AND POWER SERVICE.

TYPES:
Horizontal,
Vertical,
Simple,
Compound,
Belted,
Direct Connected.

BUFFALO FORGE COMPANY,
BUFFALO N. Y.
CHICAGO OFFICE, 22-24 RANDOLPH ST.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, JULY 19, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 3.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. B. WIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 76-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 58 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

CLASS WOOL
FOR STORAGE BATTERIES AND LABORATORY WORK, FILTRATION PURPOSES, ETC.
$2 a lb. Discount furnished on application.
CLASS WOOL MFG. CO., 207 W. Madison St., CHICAGO.

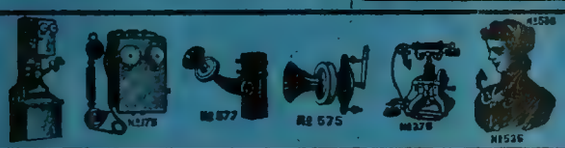
BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 60 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book, "Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.


STANDARD OF THE WORLD.
JUST A FEW LEADERS AND WE HAVE MANY MORE. SOMETHING IN OUR LINE IS SURE TO INTEREST YOU. ASK FOR PARTICULARS.
ERICSSON TELEPHONE CO., 296 Broadway, NEW YORK.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Millivoltmeter.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
Mention the Western Electrician when writing for catalogues.
LONDON—Elliott Bros., No. 101 St. Martins Lane
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONG LIFE LAMPS
FULL CANDLE POWER, EVERY SHAPE, VOLTAGE AND CANDLE POWER IN STOCK.
OUR IMPROVED PERFECTION LAMP GUARDS CAN'T BE BEAT.
Write now for circular.
THE STANDARD ELECTRIC COMPANY,
113 W. 3RD ST., CINCINNATI, O. U. S.

WHY When we have the largest, best assorted and most complete stock of

WE ELECTRICAL SUPPLIES and CONSTRUCTION MATERIAL in the United States.

SCRUPLES We guarantee PROMPT SHIPMENT and LOWEST MARKET PRICES.

CONCERNING Write us.

ORDERS

WESTERN ELECTRICAL SUPPLY CO.

ST. LOUIS, U. S. A.

When Ordering an Automobile Specify the "Exide" Battery.

EXIDE BATTERY DEPOTS FOR FURNISHING, CHARGING AND CARING FOR EXIDE BATTERIES.

NEW YORK, 148 West 18th Street. PHILADELPHIA, 250 North Broad Street.
CHICAGO 264 Michigan Boulevard. ST. LOUIS, 3937 Olive Street.
BUFFALO, 200 Pearl Street Other stations will be announced later.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

PHILADELPHIA, Allegheny Ave and 19th St. ST. LOUIS, Wainwright Building. CHICAGO, Marquette Building. HAVANA, CUBA, G. P. Greenwood, Mgr., 34 Empedrado Street.
BOSTON, 60 State Street. DETROIT, Mich. El. Co., 101 Woodward Ave. CLEVELAND, New England Building.
BALTIMORE, Continental Trust Building. NEW YORK, 100 Broadway. SAN FRANCISCO, Nevada Block.

FOR
Telephone and Telegraph
MEN ONLY

Protect the Pole Line and You Protect the Instruments.

A PECULIAR FEATURE OF THIS ARRESTER IS THAT IT REQUIRES NO ATTENTION AFTER ERECTING.

Weatherproof and Troubleproof. **Send for Descriptive Matter.**

ELECTRIC APPLIANCE CO., CHICAGO, ILL. **MINNESOTA ELECTRIC CO.,** MINNEAPOLIS, MINN. WESTERN ELECTRICAL SUPPLY CO., ST. LOUIS, MO.

RHEOSTATS
AND
ELECTRIC CONTROLLING DEVICES
OF EVERY DESCRIPTION.
THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM
FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,
MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co..... 1
American Battery Co.....10
Amer. Electrical Heater Co..10
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H..... 7

Badt & Co., F. B.....10
Baker & Company..... 3
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.—
Beardsley Gravity Dam & Construction Co..... 6
Beidler & Co., Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bossert El. Construction Co.. 6
Brown & Leasure..... 11
Buffalo Forge Co 20
Bullock Electric Mfg. Co.....11
Bunnell Telegraph.&Elec.Co.—

Carney Brothers Company...17
Central Electric Co..... 5
Central Manufacturing Co .17
Central Telephone & El. Co..14
Century Glass Co..... 5
Chase-Shawmut Company...11
Chicago & Alton Railroad....13
C. & N. W. R. R.....16
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co.. 20
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....16
Chicago Pay Station Co.....14
Coit, Henry A..... —
Colorado Lamp Co., The.....11
Columbia Telephone Mfg.Co.—
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co . 8
Diamond Meter Company ... 4
Dicke Tool Company.....—
Diehl Manufacturing Co..... 7
Dixon Crucible Co., Joseph.. 8

Eclipse Pulley Covering Co..10
Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 5
Edwards & Company..... 5
Electrical Engineer Institute. 1
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 4
General Incandescent Arc Light Company..... 9
General Incand. Lamp Co....—
Glass Wool Mfg. Company... 1
Goodrich Line.....13
Great Western Smelting & Refining Company... ....—
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....—
Holmes Fibre Graph. Co.....—
Hopkins & Co, A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H..... 7

Illinois Electric Specialty Co.14
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 6
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....11, 15, 17
Klein & Son, Mathias.....17
Kohler Brothers..... 6
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp.... 6
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller.....10
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....10
Minnesota Electric Co..... 3
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad.....16
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....10
Munsell & Co., Eugéne.....—

National India Rubber Co....—
Naugle Tie Co., E. E 17
New York Ins. Wire Co..... 8
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 6
Pass & Seymour..... 9
Pennsylvania Lines..... 9
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17
Pratt Institute..... 5

Reisinger, Hugo.....—
Reliance Electric Company..12
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....—
Roebling's Sons Co., J. A.....10
Rose Electric Company 12
Rose Polytechnic Institute... 5

St. Louis Elec. Supply Co .. 20
Sargent & Lundy.....—
Sawyer-Man Elec. Company.18
Schoonmaker Co., A. G .....—
Schott, W. H. 5
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 8
Spies Electric Company.....11
Sprague Electric Company...10
Standard Electric Company.. 1
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co..—
Standard Varnish Works 11
Stanley Instrument Co..... 5
Sterling & Son, W. C.....17
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company..... 7
Stow Mfg. Company..... 9
Streeter, A. L..... 5
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Torrey Cedar Company..... .17
Triumph Electric Co.....20

Union Pacific R. R.... 13

Valentine-Clark Co., The.....—
Varley Duplex Magnet Co... 14
Vindex Electric Company....—
Vomacka & Mazenek 10
Vulcanized Fiber Company 20

Wabash R. R.....13
Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
West Shore Route.....16
Western Electric Company... 7
Western El. Supply Co 2
Westinghouse Electric & Manufacturing Company . 18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Wickes Bros.....12
Willyoung, Elmer G..... 7
Wisconsin Central R. R.....16
Wittenberg Cedar Co.....17
Worcester Company, C. H....17
Worcester Polytechnic Inst..—

For Classified Index of Advertisements See Page 6.

Better than ever and a little the best of any on the market today—

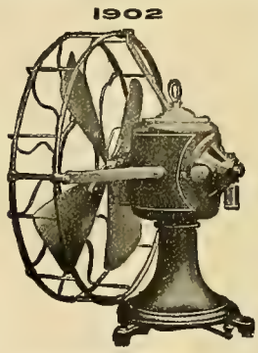
1902 PARAGON 1902

NOISELESS **FAN MOTORS** COMPACT

ALL STYLES AND SIZES EASY RUNNING RIGID CONSTRUCTION

—CALL AND SEE THEM OR WRITE FOR PRICES—

CHICAGO EDISON COMPANY, 139 ADAMS ST., CHICAGO.



PARAGON DESK FAN

THE GENERAL ELECTRIC COMPANY'S

Switchboard Instruments

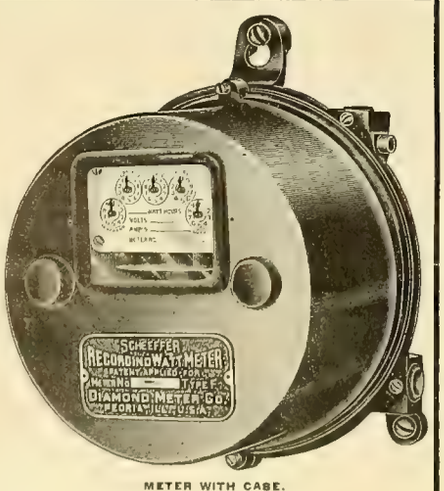
Horizontal Edgewise Ammeters, Voltmeters, Wattmeters.

Standard Instruments for Alternating Current Measurements.

General Office: Schenectady, N. Y.

Chicago Office, Monadnock Building. **Sales Offices in all Large Cities.**

Ad. No. S—164



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

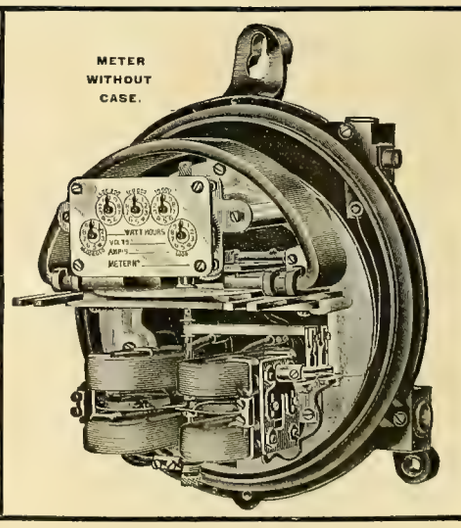
Unaffected by Alternations or Lag In Alternating Currents.

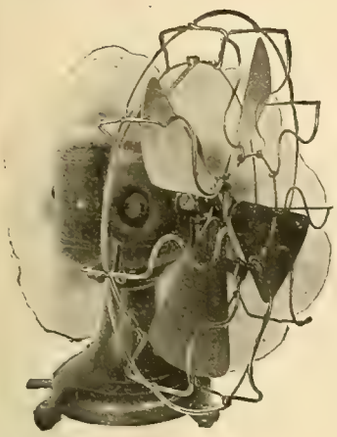
A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.

METER WITHOUT CASE.





FANS FOR

ALL VOLTAGES AND ALL CURRENTS

are shown in our new Fan Motor Catalogue.

SEND FOR IT

Central Electric Company,

264-266-268-270 FIFTH AVENUE, CHICAGO.

PRATT INSTITUTE

BROOKLYN, N. Y.

TWO-YEAR COURSES IN

APPLIED ELECTRICITY

AND IN

STEAM AND MACHINE DESIGN

Write for Catalogue and Particulars.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.

1220-21 Marquette Building, CHICAGO.

EDWARDS AND CO.

The R. E.-A. L. Monitor Bell. (Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.

All springs made of Phosphor Bronze and so formed that there is least possible strain.

Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.

Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.

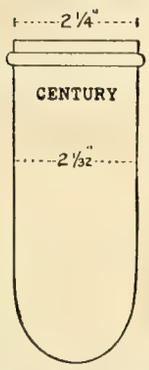
The hammer entirely concealed by gong and cannot be tampered with.

It is especially adapted for use on street cars, as, in addition to the advantages mentioned, it is dust, insect and moisture proof.

NEW YORK, N.Y.

THE ONLY HOUSE

IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.



WE CARRY GLOBES AND SHADES FOR ALL KINDS AND TYPES OF LAMPS.

OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES.

SEND FOR OUR ILLUSTRATED CATALOGUE.

THE CENTURY GLASS COMPANY, : : : BELLAIRE, OHIO.

STREETER SPRING MOTOR FANS

173-75-77 SOUTH CLINTON STREET, CHICAGO.

FAN MOTORS FOR GENERAL USE.

No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.

FIRST COST THE LAST.
No expense whatever to maintain.

EASY TO WIND.

Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.

WRITE FOR CIRCULAR.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

ROSE POLYTECHNIC INSTITUTE

A College of Engineering. Mechanical, Electrical, Civil Engineering; Chemical Courses; Architecture. Extensive shops. Modernly equipped laboratories in all departments. Expenses low. 29th year. For catalog, address C. L. MEES, President, Terre Haute, Ind.

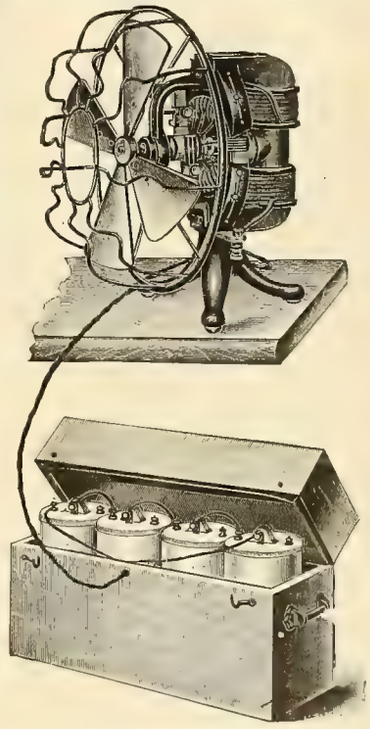
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

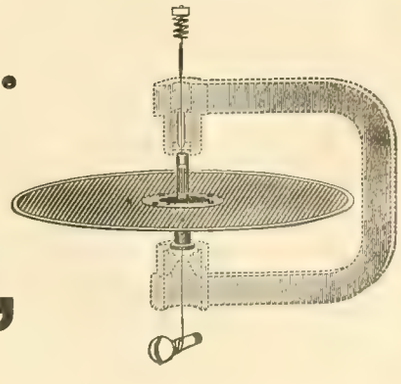
NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

DO YOU KNOW

the importance of magnetically floating the moving parts of a meter?

Send for description and book full of good information "ABOUT METERS."



STANLEY INSTRUMENT COMPANY,

General Sales Office, 158 Broadway, New York, N. Y.

Pacific Coast Agency, 33 New Montgomery St., San Francisco, Cal.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78 page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c.p lamp at any height or angle.

Incandescent Electric Light Manipulator Co.,

116 Bedford St., Boston, Mass.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building.

CHICAGO.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

The FRANKLIN Model Shop

The Franklin Dynamo

50 Watts. 10 Volts, 5 Amperes.

3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3 50, $6, $8.50. Complete $12.50. Write for circular 16.

PARSELL & WEED,

129-131 W. 31st Street, New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Bunnell Telegraph & Elec. Co.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Eclipse Pulley Covering Co.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Bunnell Telegrap. & Elec. Co.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Bullock Elec. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Diehl Manufacturing Co.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Alarm Equipments.
Bunnell Telegrap. & Elec. Co.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Glass Wool.
Glass Wool Mfg. Company.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Rose Polytechnic Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Colorado Lamp Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Minnesota Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Carney Brothers Company.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulley Covering.
Eclipse Pulley Covering Co.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co

Re-Winding Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co
Westinghouse El. & Mfg. Co.

Rosettes.
Pass & Seymour.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Speaking Tubes.
Central Electric Co
Edwards & Company.
Electric Appliance Co
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Telegraphic Supplies.
Bunnell Telegraph. & Elec. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Coit, Henry A.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell Bierce Smith-Vaile

Varnishes.
Standard Varnish Works
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

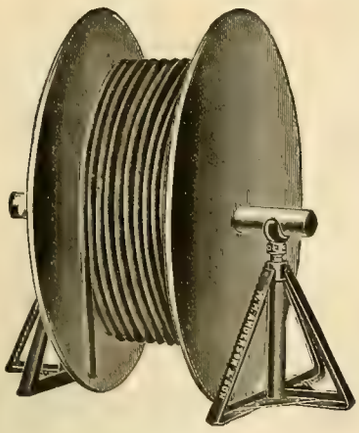
Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 8.

CABLE REEL JACK.



Made in Two Styles.

No 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,
Tool Manufacturers.
Established 1871.
St. Aubin Ave., DETROIT, MICH.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN.
Immediate Returns.

TEST INSTRUMENTS.
Portable Sets for Resistance, Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc , Etc.
11 Catalogues in print, 4c in stamps.

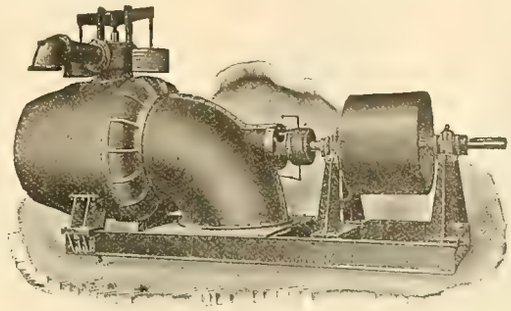
X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St.,
NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

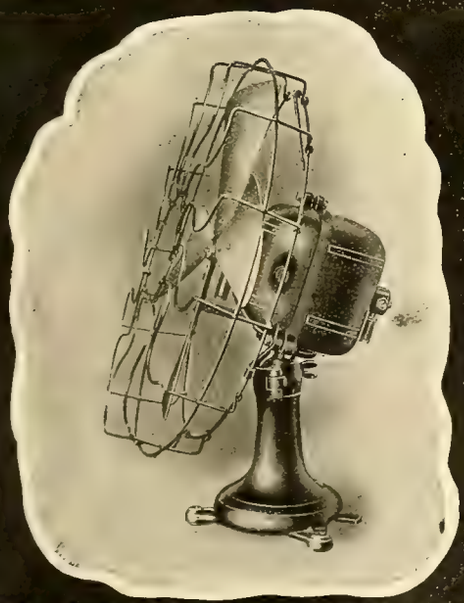
If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,
257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver St.
NEW ORLEANS, 304 Hennen Bldg.
PHILADELPHIA, 612 Arch St.
CHICAGO, 311 Dearborn St.
LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

DIEHL FAN MOTORS

EFFICIENT.



DURABLE.

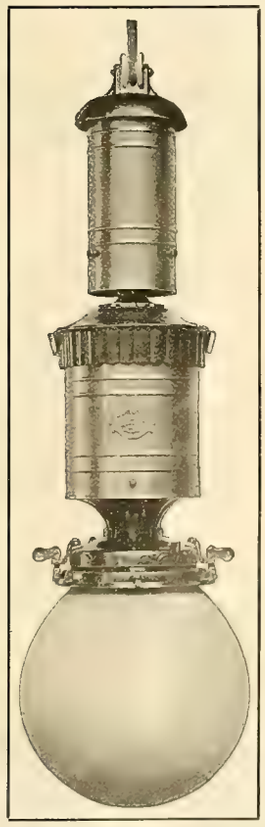
SYMMETRICAL APPEARANCE. HIGHLY FINISHED.
Our Catalogue describes our full line of 16 designs of Ceiling and Desk Fans for your selection. :: :: ::

DIEHL MANUFACTURING CO.

SALES OFFICES:
561 Broadway, NEW YORK.
128 Essex St., BOSTON.
1217 Filbert St., PHILADELPHIA.
Central Electric Co., CHICAGO.
Newman-Spranley Co., NEW ORLEANS.
Waco Electrical Supply Co., WACO, TEX.

MAIN OFFICE AND WORKS:
Elizabethport, N. J.

TYPE 405 ARC LAMPS



. . . FOR . . .

FLUCTUATING VOLTAGES

Specially designed for operation on STREET RAILWAY circuits, being provided with an automatic cut-out and substitutional resistance.

WRITE FOR BULLETINS No. 7008-7011.

Western Electric Company,
CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

JUDGMENT IS GOOD WHEN BOILERS ARE KEPT CLEAN

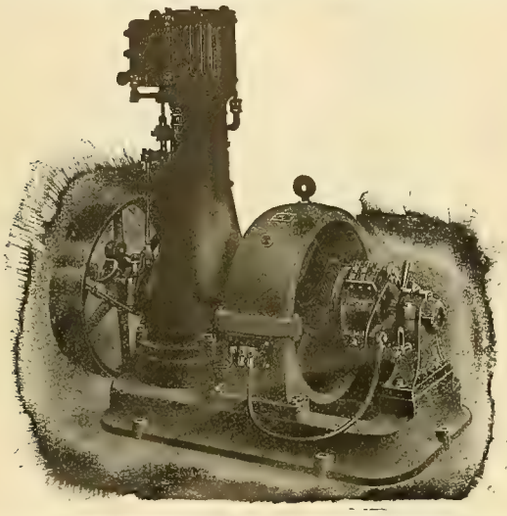
BY USING **DEARBORN BOILER COMPOUNDS.** MADE TO SUIT THE WATER AS PER ANALYSIS.

NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND.

WRITE FOR PARTICULARS.

DEARBORN DRUG & CHEMICAL WORKS, 27-34 RIALTO BUILDING, CHICAGO, ILL.

Offices From New York to Honolulu. WM. H. EDGAR, PRESIDENT. Telephone Harrison 3930 and 3931.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

Mechanical Engineers

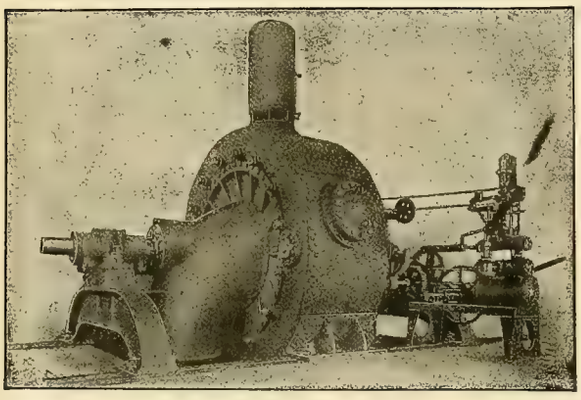
who are interested in electricity should write for our catalogue of . . . . . .

ELECTRICAL BOOKS.

Electrician Publishing Company,

Suite 510 Marquette Building,

CHICAGO



SAMSON TURBINE

UNEXCELLED FOR DRIVING

ELECTRICAL MACHINERY.

Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

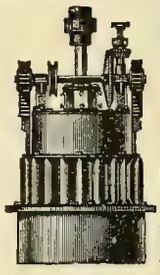
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

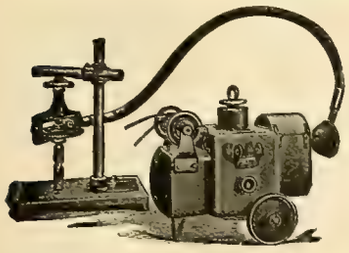
Preserve Your Copies

OF THE **WESTERN ELECTRICIAN.**

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, ... CHICAGO.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 86 Queen Victoria Street, London, England.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

EXCURSIONS
TO NEW YORK AND ATLANTIC CITY
VIA
PENNSYLVANIA LINES.

July 17th and 31st and August 7th and 14th. $18.00 for the round trip. Tickets good 12 days.

For particulars inquire of Ticket Agents, No. 248 So. Clark St., Union Passenger Station, or address H. R. Dering, A. G. P. A., Chicago, Ill.

TRADE **G. I.** MARK
STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION
GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

Worth Having!
STEVENS' MECHANICAL CATECHISM
PRACTICAL KNOWLEDGE
FOR
Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

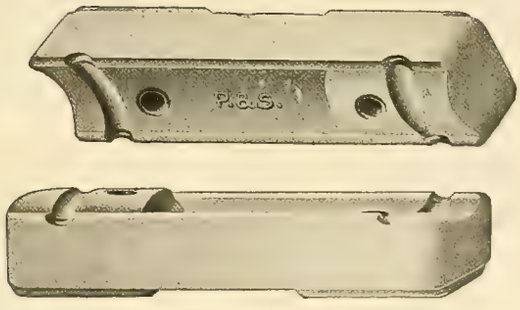
SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.



The Strongest and Most Practical Cleats and Tubes on the Market.

MADE FROM THE CELEBRATED
P. & S. Porcelain.
COMPLETE LINE CARRIED IN STOCK.
PASS & SEYMOUR, Inc.,
SOLVAY, N. Y.
NEW YORK. CHICAGO. BOSTON. CINCINNATI. SAN FRANCISCO.

the first principles, the abcology of mechanical and electrical construction is simplicity—the desired results with the fewest possible moving parts

Guttmann alternating current wattmeters a case in point—Adams-Bagnall arc lamps another.

that is one of the things we like about ourselves, we can deliver the goods.

ELECTRIC APPLIANCE COMPANY, ELECTRICAL SUPPLIES, NINETY-TWO AND NINETY-FOUR WEST VAN BUREN ST., CHICAGO.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICANITE CLOTH

HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.

MICA INSULATOR CO.
"ORIGINATORS."
CHICAGO. NEW YORK.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.
CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF
ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of 40 miles of railway out of Dover, Del., for the Del. Gen'l Elec. Ry Co.

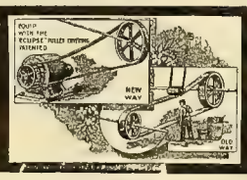
YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street, CHICAGO.

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances,
Write for catalogue. 193-197 River St. DETROIT MICH

SOLDERING SALTS.

VOMACKA & MAZANEK,
MANUFACTURERS OF
Tested Fuse Links, Fuse Wire and Specialties.
434-436 EAST 71ST STREET, NEW YORK CITY.

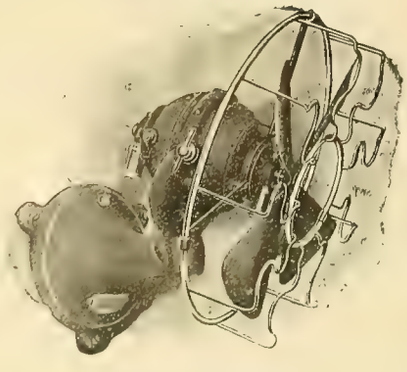


WE SAVE YOU
in your belting and journals. WE PUT IT IN ON 60 DAYS' TRIAL. We increase the speed of your machines, thus increasing your production and saving you money.
THE ECLIPSE PULLEY COVERING CO.,
Phone Central 2815. 1508-1509 Ashland Blk., CHICAGO, ILL.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1899. 171 S. Clinton St., Chicago, Ill.

For Testing Consumers' Meters
the WHITNEY Portable Wattmeters are the standard. They can be used on any frequency, are dead beat and absolutely accurate. Send for Catalogue and Discounts to
Electric Appliance Co., Chicago, Ill.
Western Electrical Supply Co., St. Louis, Mo.
Electrical Engineering Co., Minneapolis, Minn.
Standard Electric Co., Cincinnati, Ohio.
MACHADO & ROLLER,
NEW YORK, N. Y.

LUNDELL FANS



Superior in Design and Construction.

Cooling, Economical, Safe.

Catalogue No. 03304.

SPRAGUE ELECTRIC CO.,
GENERAL OFFICES: 527-531 WEST 34th STREET, NEW YORK.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Bullock Electric Mfg. Co. Cincinnati O. U.S.A.

DYNAMOS AND MOTORS

411

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

RESIN SOLDER
IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

Chas. L. Brown. E. E. Leasure.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

THE FIRST $
Is not the only one to Figure on.
COLORADO LAMPS
Will give Satisfaction for a Small Number of Dollars.
The Colorado Lamp Co.,
DENVER, COLO.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

NONSENSE, WITH SENSE, FOR CENTS.

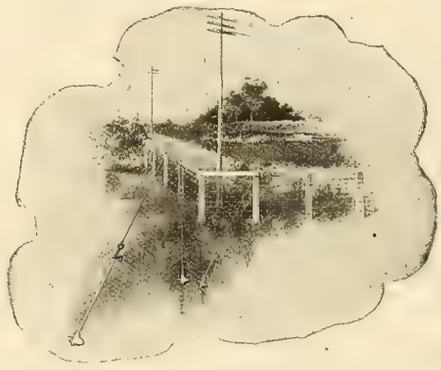
"A STANDARD REMEDY."

A pole to guy?
An Anchor try.
What Anchor, pray?
Stombaugh's we say.
It's proven best
From time and test.

Watch this space for change. —STOMBAUGH.

The installation of the
STOMBAUGH GUY ANCHORS

is simplicity itself. That is the reason they appeal so strongly to those who have anything to guy.

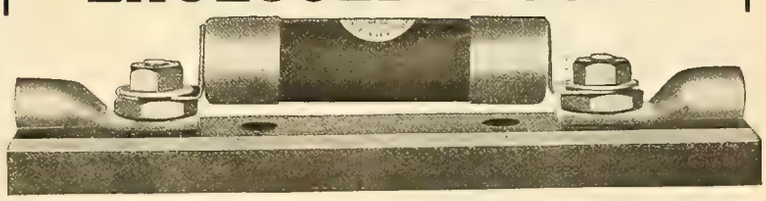


HOW THEY WORK.

Write us for Information, Prices and Catalogue.

W. N. Matthews & Bro.
603 Carleton Bldg.
ST. LOUIS.

"SHAWMUT" ENCLOSED FUSES



RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Shows whether blown by overload or short circuit.

Indicating Type P Fuse, intact.

Fuse blown by overload, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As engineer in power or light plant. Ten years' experience on engines, dynamos, rotaries and induction motors. References furnished if desired. Enquire of BOX 93 care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As manager or superintendent of telephone company. I am 33 years of age, strictly temperate and have had 7 years' practical work with Independent telephone companies. Understand line and switchboard construction. Have just finished building 4 new exchanges and am at present manager of 5 exchanges. Best of references. Address BOX 90, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

An Eastern telephone manufacturing company des res a first-class factory superintendent capable of taking full charge of operation, costs and output. Must know telephone business thoroughly. Write full information to BOX 92, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

In any town where the electric light company does not sell the HYLO Lamp, a salesman. The electrician and repair man under our plan can make money on the side introducing the HYLO. Write us for particulars and state experience fully. We want salesmen. THE PHELPS COMPANY, 101 State St., Detroit, Mich.

WANTED.

An experienced electrical supply salesman for Southwestern Territory with large firm. Send reference and detailed experience. Address BOX 94, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A 125 or 150 horsepower 25 cycle induction motor, two phase. Address UNITED INDURATED FIBRE CO., Lockport, N. Y.

WANTED.

200-K. W., 250-Volt, Direct-Connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

POSITIONS OPEN.

PER MONTH.

5 Draftsmen for Architectural, capable of designing entire buildings and figuring cost of materials, etc., $80 to $100 and Expenses
2 Draftsmen, Structural Steel $125
6 Draftsmen, Electrical ..... $70 up
1 Draftsman, Mechanical, especially good on screw machines $100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us free of charge.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.
SEE NEXT ISSUE.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse - 250 volt M. P.
1—125 K. W. Thompson-Ryan - 250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.
1— 55 K. W. Fuller - - - - - 250 volt M. P.
1—100 K. W. General Electric 500 volt M. P.
2— 90 K. W. General Electric - 500 volt M. P.
1— 62 K. W. T.-H. D 62 - - 500 volt M. P.
1—100 K. W. General Electric - 125 volt M. P.
1—100 K. W. Triumph - - - 125 volt M. P.
1— 80 K. W. Keystone - - - 125 volt M. P.
1— 65 K. W. Jantz & Leist - 125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 10, 1902.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 14th day of August, 1902, and then opened, for the installation of a conduit and wiring system for the U. S. Postoffice Building at Hot Springs, Arkansas, in accordance with the drawings and specification, copies of which may be obtained at this office or at the office of the Superintendent of Construction at Hot Springs, Arkansas, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 30,1902. Sealed Proposals will be received at this office until 2 o'clock p. m. on the 31st day of July, 1902, and then opened, for the installation of an electric conduit and wiring system for the U. S. Post Office at Joliet, Illinois, in accordance with the drawings and specification, copies of which may be obtained at this office or at the office of the Superintendent of Construction, at Joliet, Illinois, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

FOR SALE.

At bargain, One A. Thomson-Houston dynamo; one 100-H. P. Ball engine; one 100-H P. Ball boiler; one 120-H. P. Casey & Hedges boiler; 5,000 lbs. insulated copper wire. Address H. C. HUBBELL & CO., Xenia, Ohio.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K.W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY. Rochester N.Y.

I CAN SELL

Your Electric Light, Gas, Water, or Telephone Plant, no matter where it is. Send description and cash price and learn how. I have or can find the plant you want to buy. Tell me your requirements. A. M. BARRON, Desk F, South Bend, Ind.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

FOR SALE.

ENGINE 40x72 inches, George H. Corliss.
" 38x72 inches, George H. Corliss.
" 32x44x60 inches, Allis Blowing.
" 28x48 inches, Allis Blooming Mill.
" 20x48 inches, Watts Campbell.
" 20x36x36 ins., MacIntosh & Seymour Compound.
" 17x30 inches, Buckeye Automatic.
" 14x24 inches, Buckeye Automatic.
PUMP 16x30x14x24 ins., Deane Com. Duplex.
" 16x2¾x10 inches, Worthington Hydraulic Duplex.
" 12x8x12 inches, Smith-Vaile Duplex.
" 10x5x10 inches, Hall Duplex.
" 20x9x14 inches, Blake Single.
" 16x10¾x18 inches, Hughes Single.
" 12x7x10 ins., Cope & Maxwell Single.
" 10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.
45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	48x16 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	36x8 Horizontal Tubular.
5	60x16 Horizontal Tubular.	1	54x8 Vertical Tubular.

Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

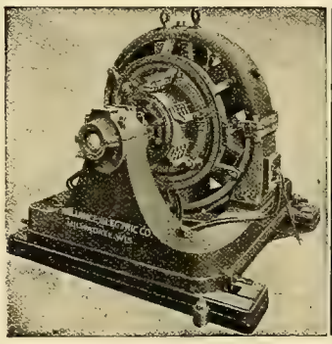
SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

Rose Electric Co., St. Louis, Mo.

ELECTRICAL BOOKS.
All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette, CHICAGO.



"RELIANCE"

GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., Chicago.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,

$1 A VOLUME.

Electrician Publishing Co.,

510 Marquette Building, Chicago.

LOW RATE EXCURSIONS

— TO —

NEW YORK AND ATLANTIC CITY
VIA THE WABASH.

Tickets will be sold from Chicago as above July 17 and 31, and August 7 and 14, at $18 for the round trip, with return limit of 12 days, including date of sale. Write for printed matter containing maps, time cards and full information.

F. A. PALMER, A. G. P. A.
97 ADAMS ST., - - CHICAGO.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO and KANSAS CITY,
CHICAGO and ST. LOUIS,
CHICAGO and PEORIA,
ST. LOUIS and KANSAS CITY,

THROUGH PULLMAN SERVICE
BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.,
TEXAS, FLORIDA, UTAH,
CALIFORNIA and OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

The Inspector
AND
Trouble Man.
By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
. . TO . .
California
VIA THE UNION PACIFIC.

This train is really a **FIRST-CLASS MODERN HOTEL**, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

4 Days Lake Trip
$13. Including Meals and Berths—Chicago to ESCANABA, Mich. and Return. Leave Chicago Wed., Fri., & Sat. 8:00 p. m.

7 Days Lake Trip
$25. Including Meals and Berths—Chicago to Mackinac Island and Return. Leave Chicago Saturdays 8:30 p. m.

Muskegon or Grand Haven
and RETURN **$2.75**
Leave Chicago 7:45 p. m., daily.

GOODRICH LINE STEAMERS

Finest Service on the Lakes

For complete information see local Railroad Agent or address

R. C. DAVIS, G. P. A., GOODRICH LINE,
Foot of Michigan Ave., - Chicago, Ill.

No. 1. Desk Telephone.

Success

Comes only to those telephone exchanges which use the BEST material. If you use our goods success is assured

We can supply EVERYTHING USED WITH TELEPHONES.

No order too small for attention or too large for our capacity. Rapid deliveries our rule and each order filled with care. Large stocks always on hand.

Telephones, every style and grade. Long and short backboards. Elegant finish and design. Prices that will suit. Hard rubber receivers. Oak or walnut woodwork. New ideas in magneto bells. Each instrument guaranteed.

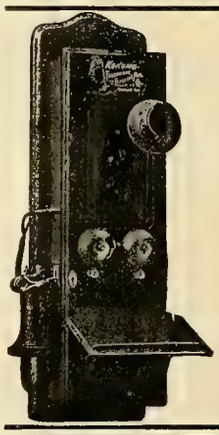
All kinds of telephone supplies. New parts for old telephones. Double-pole receivers.

Electricians' tools. Lightning arresters, carbon and fuse. Extension bells—standard and bridging. Circuit-closers. Transmitters of various styles. Repeating coils, induction coils, construction material of all kinds.

WRITE FOR CATALOGUE.

Central Telephone & Electric Co.,
909 MARKET STREET, ST. LOUIS, MO.

CONTINENTAL TELEPHONE CONSTRUCTION CO.
GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.
TACOMA BLDG., CHICAGO.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

Before attachment.

PATENTED GALVANIZED STEEL CABLE HANGER.

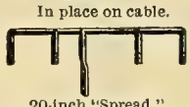
Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

In place on cable.

11½-inch "Spread." points up or down.

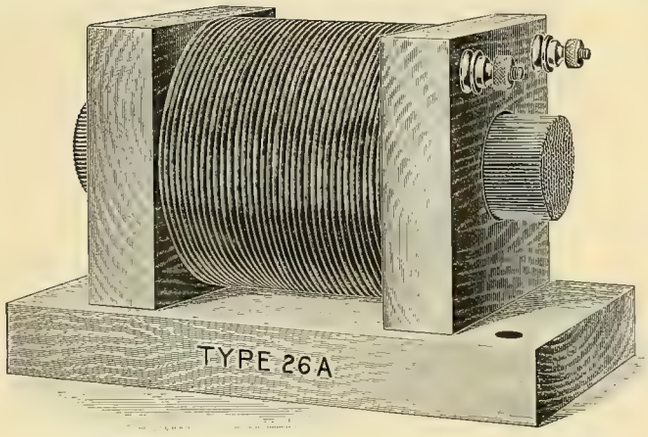
These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.



20-inch "Spread," points up or down.

Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.



SPARK COILS

FOR EVERY PURPOSE.

VARLEY DUPLEX MAGNET CO., CHICAGO, ILL. PHILLIPSDALE, R. I.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

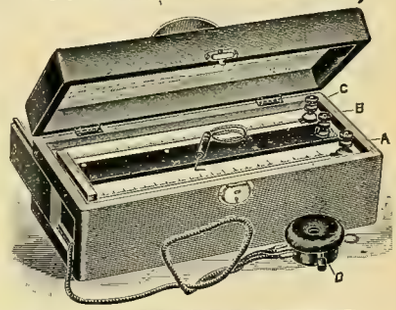
CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.

This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.

This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E Dobbs. 106 pp. Price $1.00.

A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.

Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.

In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.

A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.

This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

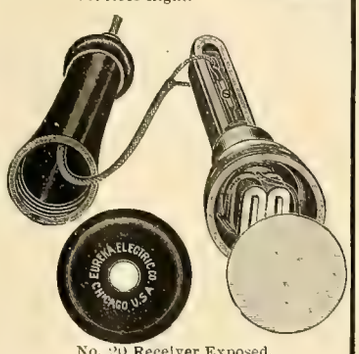
Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

SWITCHBOARDS AND TELEPHONES

of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. . .Prices Right.

Better protect your interests by obtaining our prices before placing your orders.



No. 20 Receiver Assembled. No. 20 Receiver Exposed.

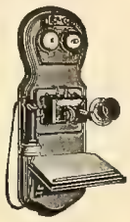
EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
CHICAGO, ILL.

TO SAY

A transmitter is the long-distance type amounts to very little now days since there are so many so called long-distance instruments on the market that will not talk 150 miles under the most favorable conditions.

GUARANTEED BETTER THAN THE "BELL SOLID BACK" IS AMPLE PROOF THAT KELLOGG TRANSMITTERS ARE REALLY LONG-DISTANCE INSTRUMENTS.

WRITE FOR GEN'L CATALOG.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 So. GREEN ST., CHICAGO.

REMOVAL NOTICE.

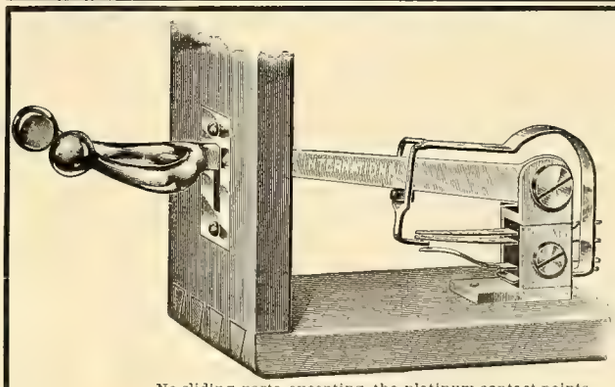
Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE **SIGNALING APPARATUS.**

Metropolitan Telephone and Electric Co.

CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

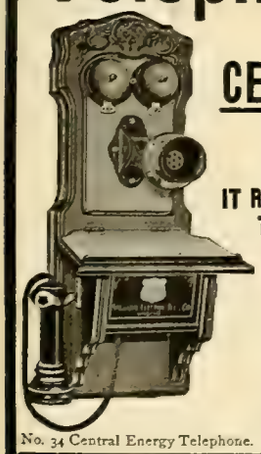
Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

Telephone Troubles

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

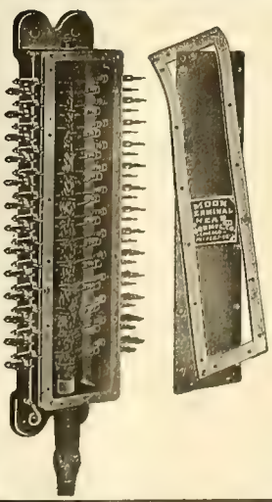


IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

No. 34 Central Energy Telephone.



MOON TERMINALS

WITH

METALLIC OUTER CASE . . .

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

JUST OUT

NEW CATALOGUE OF

ELECTRICAL BOOKS.

You Ought to Have One. Sent Free on Request.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
8th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicag ; from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

Chicago TO New York AND Boston
VIA THE POPULAR
West Shore Route

Through sleeping and dining car service via Nickel Plate or Wabash from Chicago.

Passengers via this favorite route arrive in New York at uptown station, Forty-second street, the center of the hotel and shopping district, or downtown at Franklin street station, in close proximity to all ocean steamship docks and Jersey City and Brooklyn. For tickets, sleeping car space and further information call on or address

JOHN W. COOK,
G. W. P. A.,
205 S. Clark Street, CHICAGO, ILL.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent,
Chicago, Ill.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20 foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want **CEDAR POLES**
POSTS, SHINGLES,
Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WE MAKE A SPECIALTY OF WESTERN POLES.
LONG LENGTHS TO 80 FEET.
SHIPMENTS MADE DIRECT FROM IDAHO.

CEDAR POLES

CARNEY BROTHERS COMPANY,
610 Chamber of Commerce, CHICAGO, ILL.

YARDS AT:
DULUTH, MINN. BALL CLUB, MINN.
BLUEBERRY, WIS. BEER RIVER, MINN.
CORONA, MINN. COWAN, MINN.
YORK, MINN. BLACKDUCK, MINN.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

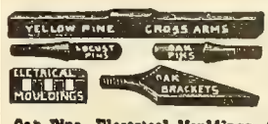
M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 37-39 W. Van Buren St., CHICAGO, ILL.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.



Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand.

CEDAR POLES
LONG DISTANCE PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA MICH.

CEDAR POLES.
WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK
Yellow Pine Cross Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

The Westinghouse Integrating Wattmeter

can be depended upon to begin recording at a lighter load than any other meter on the market and to register up to heavy overloads with accuracy, and with any power-factor. It will continue to do so for years without cleaning or recalibration.

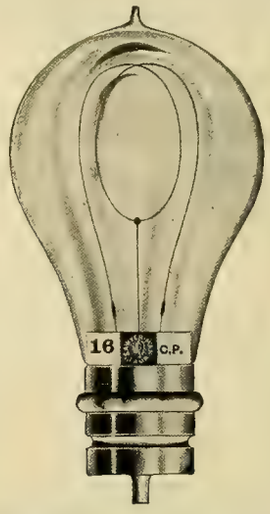
For illustrated booklet on Westinghouse Integrating Wattmeters address nearest district office of the

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Sales Offices in all large cities.

Measurements for Candle Power of Sawyer-Man Lamps.

are made by skillful operators using the very latest and best photometer equipment made, giving the highest accuracy on the basis of commercial operation.



Sawyer-Man Electric Co., New York.

85C2

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated. Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: The American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator; Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo. The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers, Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel, Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

FORT WAYNE ELECTRIC WORKS

SERIES ENCLOSED "WOOD" D. C. ARC LAMPS

MAIN OFFICE AND FACTORY, FORT WAYNE, IND.

THE BEST LAMP ON THE MARKET

SALES OFFICES IN ALL LARGE CITIES

THE LATEST BOOK.

"ELECTRIC LIGHTING,"

A PRACTICAL EXPOSITION OF THE ART FOR THE USE OF

Engineers, Students and Others Interested in the Installation or Operation of Electrical Plants.

BY FRANCIS B. CROCKER,

Professor of Electrical Engineering, Columbia University, New York.

Price $3, Prepaid. - Practical and Up-to-Date.

Just the Book you want. 450 Pages, over 150 Illustrations. Read the

TABLE OF CONTENTS:

Chapter I, Introduction; Chapter II, History of Electric Lighting; Chapter III, General Units and Measures; Chapter IV, Classification and Selection of Electric Lighting System; Chapter V, The Location and General Arrangement of Electric Lighting Plants; Chapter VI, Buildings for Electric Lighting Plants; Chapter VII, Possible Sources of Electrical Energy; Chapter VIII, The Steam Engine, History and General Principles; Chapter IX, Steam Boilers for Electric Lighting; Chapter X, Steam Engines for Electric Lighting, General Construction; Chapter XI, Typical Forms of Steam Engine for Electric Lighting; Chapter XII, Steam Engines for Electric Lighting, Selection, Installation and Management; Chapter XIII, Gas, Oil and Hot Air Engines; Chapter XIV, Water Wheels and Windmills; Chapter XV, Mechanical Connections between Engines and Dynamos, Direct Coupling, Belting and Shafting; Chapter XVI, Toothed, Friction and Other Gearing; Chapter XVII, Principles, Construction and Management; Chapter XXI, Applications of Accumulators in Electric Lighting; Chapter XXII, Switchboards, Including Switches, Fuses and Circuit-Breakers; Chapter XXIII, Electrical Measuring Instruments; Chapter XXIV, Lightning Arresters.

Every Engineer and Electrician who desires to thoroughly master the Art of Electric Lighting should have a copy of this book. Sent promptly.

ELECTRICIAN PUBLISHING COMPANY, Suite 510 Marquette Building, CHICAGO.

A New Paper-Weight.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.
353 BROADWAY, NEW YORK.
358 DEARBORN ST., HICAGO, U. S. A.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

"MOTOR DRIVEN TOOLS"

BULLETIN No. 24.

Comprising a series of illustrations of the motor drive of machine tools. A copy will be sent upon request.

Semi-Inclosed Motor Driving Press.

THE CROCKER-WHEELER COMPANY,
Office and Works: AMPERE, N. J.
Sales Offices in all large Cities.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

ST. LOUIS ELECTRICAL SUPPLY CO.,
1118 Pine St., ST. LOUIS, MO.

BUFFALO HIGH SPEED ENGINES

FOR ELECTRIC LIGHTING AND POWER SERVICE.

TYPES:
Horizontal,
Vertical,
Simple,
Compound,
Belted,
Direct Connected.

BUFFALO FORGE COMPANY,
BUFFALO, N. Y.
CHICAGO OFFICE, 22-24 RANDOLPH ST.

STURTEVANT SYSTEM OF HEATING & VENTILATION

88 *Centralized plant.*
No scattered steam piping.
Utilizes exhaust steam.
Send for Catalogue No. 84

B. F. STURTEVANT CO. BOSTON,
NEW YORK · PHILADELPHIA · CHICAGO · LONDON ·

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, JULY 26, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 4.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

N. I. R.

National India Rubber Co.'s

RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE

TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 53 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

Standard Underground Cable Co.

822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Mills Bldg., San Francisco. 101 Milk St., Boston.

Electric Cables, Conduits, Wires and Accessories.

Also High Grade Rubber Covered Wires and Cables.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

GASOLINE MOTORS

—FOR—

BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO.,

NORTH CHELMSFORD, MASS.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

The Franklin Gas Engine

One-Half Horsepower.

Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.

The FRANKLIN Model Shop

PARSELL & WEED, 129-131 W. 31st Street, New York.

THE PHOENIX GLASS CO.

MANUFACTURERS OF

GAS AND ELECTRIC GLOBES, SHADES, Etc.

SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.

Pittsburgh. New York. Chicago.

Ericsson's motto is, "The recollection of quality remains long after the price is forgotten". We say this because we mean it. We have satisfied many and knowing we can satisfy you we want you to know it. We equip new and re-equip old exchanges.

ERICSSON

We have equipments for private houses, stables, factories and offices, for indoor and outdoor use.

ERICSSON TELEPHONE CO.,

296 BROADWAY, NEW YORK CITY.

Kilfyre DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO., 247-249 Pearl St., New York City.

CENTURY

3⅞"

ALL STYLES OF

GLOBES AND SHADES

FOR ALL TYPES OF LAMPS.

WE ARE THE ONLY HOUSE IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.

WE CAN MAKE ANY STYLE YOU DESIRE.

—WRITE FOR CATALOGUE.—

THE CENTURY GLASS COMPANY, BELLAIRE, OHIO.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 86.

Weston Standard Illuminated Dial Potential Indicator, Style B.

Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

London: Elliott Bros., No. 101 St. Martins Lane

FOR HIGH GRADE INSULATING VARNISHES

ADDRESS STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

Mention the WESTERN ELECTRICIAN when writing for catalogues

Fig. 299. Standard Motor for 3 H. P. and Larger.

"OPINIONS."

Not what **WE** think of our own **SINGLE PHASE MOTORS**—but what **OTHERS THINK.** Send for this pamphlet. It will tell you what those who **HAVE BOUGHT** think.

WAGNER ELECTRIC MFG. CO.

ST. LOUIS, MO.

TRADE G. I. MARK

GUARANTEE

OF FULL

PATENT PROTECTION

TO

PURCHASERS

OF

DOUBLE POLE DOUBLE ARM G. I. CIRCUIT BREAKERS

MANUFACTURED BY

GENERAL INCANDESCENT ARC LIGHT CO.,

NEW YORK, N. Y. And All Large Cities.

TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

Don't Overlook a Good Thing.

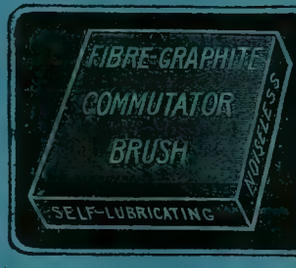
I have something entirely new in motors. New principle, one-quarter to five horsepower. Direct and alternating current, any speed, any voltage, any frequency.

Half the Weight, Increased Efficiency, Increased Durability, Perfect Ventilation, Cost Less than any other Motor.

You had better drop me a line, and I will explain in detail, send cuts, etc.

HENRY A. COIT, Laclede Bldg., **St. Louis.**

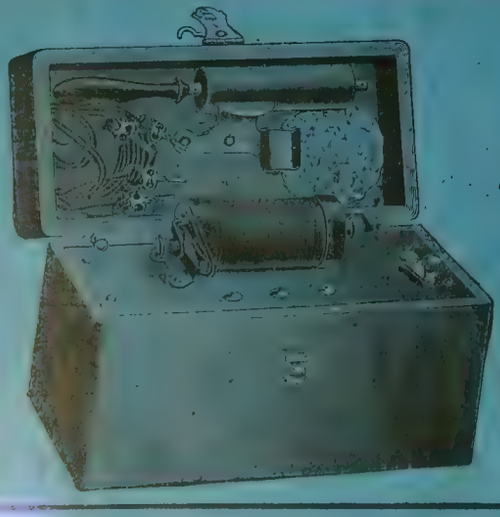
P. S.—Also something Startling and New in Electrical Specialties. Let me tell you about them.



There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5135 Wakefield St., Germantown, PHILADELPHIA.



ANTI-Doc

No. SIX

A First-Class Medical Apparatus.

RETAIL PRICE, $2.50. SOLD BY ALL DEALERS.

MADE BY

MANHATTAN ELECTRICAL SUPPLY CO.,

32 Cortlandt Street, NEW YORK.

188 Fifth Avenue, CHICAGO.

When Ordering an Automobile Specify the "Exide" Battery.

EXIDE BATTERY DEPOTS FOR FURNISHING, CHARGING AND CARING FOR EXIDE BATTERIES.

NEW YORK, 148 West 18th Street.
CHICAGO 264 Michigan Boulevard.
BUFFALO, 200 Pearl Street.
PHILADELPHIA, 250 North Broad Street.
ST. LOUIS, 3937 Olive Street.
Other stations will be announced later.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

PHILADELPHIA, Allegheny Ave and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
ST. LOUIS, Wainwright Building.
DETROIT, Mich. El. Co., 101 Woodward Ave.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, G. P. Greenwood, Mgr., 34 Empedrado Street.

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

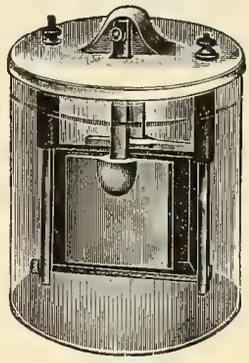
$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago.

Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

Federal Electric Co.
84 Market Street, CHICAGO, ILL.

EDISON PRIMARY BATTERIES.

FORMERLY KNOWN AS EDISON-LALANDE.



FOR GAS ENGINES, SLOT MACHINES, AUTOMOBILES RAILROAD SIGNALS, CROSSING BELLS, SMALL MOTORS ETC.

CONSTANT CURRENT NO LOCAL ACTION, WILL NOT FREEZE, LIQUID TIGHT CELLS FOR PORTABLE WORK.

FULL DESCRIPTION IN BOOKLET NO. 4.
EDISON MANUFACTURING COMPANY,
FACTORY, ORANGE, NEW JERSEY, U. S. A.
NEW YORK OFFICE, 83 CHAMBERS STREET.
CHICAGO OFFICE, 144 WABASH AVENUE.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co.....—
American Battery Co.....—
Amer. Electrical Heater Co...—
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Badt & Co., F. B..... 10
Baker & Company..... 3
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Beidler & Co , Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bossert El. Construction Co.. 1
Brooks, Hall L..... 17
Brown & Leasure..... 11
Buffalo Forge Co.....20
Bullock Electric Mfg. Co.....11
Bunnell Telegraph. & Elec.Co.—

Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co...—
Century Glass Co..... 1
Chase-Shawmut Company...11
Chicago & Alton Railroad....16
C. & N. W. R. R..... 7
Chicago Edison Company .4, 12
Chic. Fuse Wire & Mfg. Co....—
Chicago Insulated Wire Co...—
C., M. & St. P. R. R.....16
Chicago Pay Station Co.....14
Coit, Henry A..... 2
Columbia Telephone Mfg.Co.13
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 11
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ....—
Dicke Tool Company.....16
Diehl Manufacturing Co..... 7
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 3
Edwards & Company..... 5
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....17

General Electric Company... 4
General Incandescent Arc Light Company..... 2
General Incand. Lamp Co....—
Glass Wool Mfg. Company...—
Goodrich Line.....16
Great Western Smelting & Refining Company.... ...12
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co... 5
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....17
Holmes Fibre-Graph. Co..... 2
Hopkins & Co., A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....10, 15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 1

Machado & Roller.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co.. 2
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....—
Miscellaneous Advs.....12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....10
Munsell & Co., Eugene.....10

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 5
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Pennsylvania Lines.. 8
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17
Pratt Institute.....—

Reisinger, Hugo..... 7
Reliance Electric Company.. 7
Replogle Governor Works.. . 9
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....20
Roebling's Sons Co., J. A.....10
Rose Electric Company 12
Rose Polytechnic Institute...—

St. Louis Elec. Supply Co .. 20
Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 12
Schott, W. H. 5
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 9
Spies Electric Company.....11
Sprague Electric Company...10
Standard Electric Company..11
Standard Pole & Tie Co..... 17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 5
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The.... 5
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....—
Streeter, A. L..... 5
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Torrey Cedar Company..... .17
Triumph Electric Co.....20

Union Pacific R. R.... 7

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company....10
Vomacka & Mazenek .....—
Vulcanized Fiber Company. 20

Wagner Electric Mfg. Co..... 2
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co .....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 5
Wittenberg Cedar Co.....17
Worcester Company, C. H....17
Worcester Polytechnic Inst..—

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

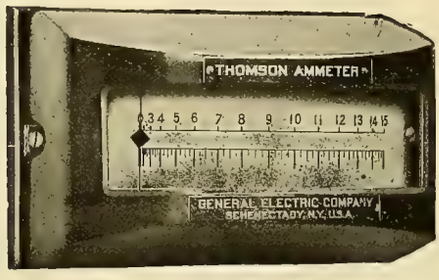
MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

THE GENERAL ELECTRIC COMPANY'S

Switchboard Instruments



Horizontal Edgewise Ammeters, Voltmeters, Wattmeters.

Standard Instruments for Alternating Current Measurements.

General Office: Schenectady, N. Y.

Chicago Office, Monadnock Building. **Sales Offices in all Large Cities.**

Ad. No. S—164

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

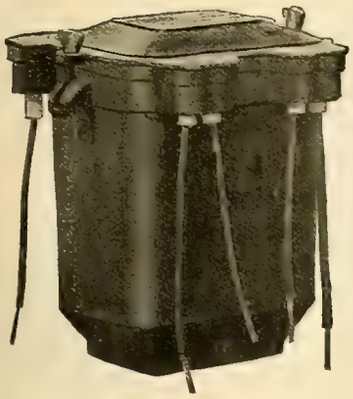
The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office, 15 Cortlandt St., New York.

(10928)



TYPE K TRANSFORMER.

A COMPLETE SET OF BULLETINS,

FULLY DESCRIBING THE

PITTSBURGH TRANSFORMER,

SENT ON APPLICATION.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS,

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS

AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary

Western Electrician

WANT ADS

Bring Results.

STREETER SPRING MOTOR FANS

173-75-77 SOUTH CLINTON STREET, CHICAGO.

FAN MOTORS FOR GENERAL USE.

No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.

FIRST COST THE LAST.
No expense whatever to maintain.

EASY TO WIND.

Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.

WRITE FOR CIRCULAR.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO.,
Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO.,
25 Colmore Row, Birmingham, England.

THE TELEPHONE HAND-BOOK

BY
HERBERT LAWS WEBB.
Price $1.00.

The only complete and practical work of its kind on the market.

PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties:
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants.

1220-21 Marquette Building,
CHICAGO.

EDWARDS AND CO.

ELECTRO-MECHANICAL GONG.

Is entirely encased in iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

NEW YORK N.Y

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Crimshaw** and **Competition Tapes** and **Splicing Compounds.**

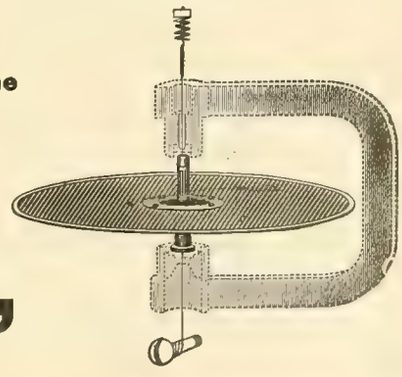
NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

DO YOU KNOW

the importance of magnetically floating the moving parts of a meter?

Send for description and book full of good information "ABOUT METERS."



STANLEY INSTRUMENT COMPANY,

General Sales Office, 158 Broadway, New York, N. Y.
Pacific Coast Agency, 33 New Montgomery St., San Francisco, Cal.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. **B. S. BARNARD, Vice-President and Secretary.**

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Bunnell Telegraph & Elec. Co.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Sples Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Bunnell Telegrap. & Elec. Co.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Sples Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Bullock Elec. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Bullock Elec. Mfg. Co.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Diehl Manufacturing Co.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Alarm Equipments.
Bunnell Telegrap. & Elec. Co.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Glass Wool.
Glass Wool Mfg. Company.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Rose Polytechnic Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Bunnell Telegrap. & Elec. Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telegraphic Supplies.
Bunnell Telegraph. & Elec. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Bunnell Telegraph. & Elec. Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

There are no Carbons better than the "Electra" and none "just as good."

DIEHL ELECTRIC FANS

Ceiling Fans
2 DISTINCT TYPES.
12 DESIGNS.
20 FINISHES.
2 OR 4 BLADE.

ELECTROLIER COLUMN. ELECTROLIER COLUMN.

Made in all varieties of designs and finishes to suit all conditions. Our Ceiling and Desk Fans make friends all over the world as they never give trouble.

DIEHL MANUFACTURING COMPANY,
Main Office and Works. ELIZABETHPORT, N. J.
NEW YORK. CHICAGO. BOSTON. PHILADELPHIA.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

UNION PACIFIC THE OVERLAND ROUTE WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
. . TO . .
California
VIA THE UNION PACIFIC.

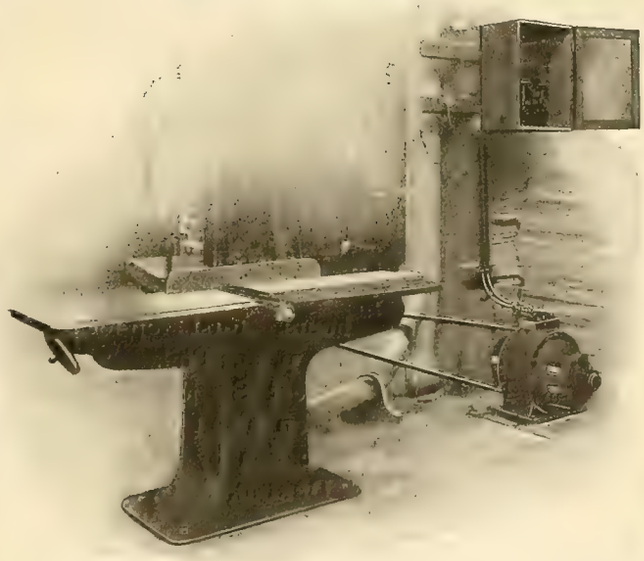
This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

MOTOR APPLICATIONS



A WESTERN ELECTRIC MOTOR BELTED TO JOINER.
WRITE FOR POWER MOTOR CATALOGUE.

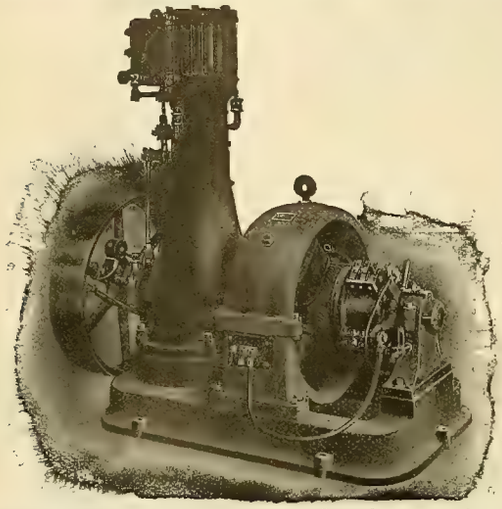
WESTERN ELECTRIC COMPANY,
CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

"RELIANCE"
GENERATORS AND MOTORS.
SEND FOR BULLETIN.
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

90% OF LABOR SAVED by using **DEARBORN BOILER COMPOUNDS.**
MADE TO SUIT THE WATER AS PER ANALYSIS.

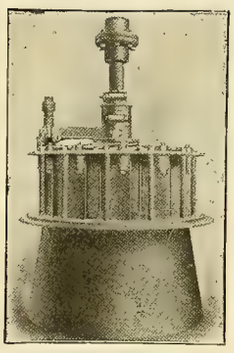
NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND. Write for Particulars.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.
GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.
W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

Mechanical Engineers
who are interested in electricity should write for our catalogue of . . . . . .
ELECTRICAL BOOKS.
Electrician Publishing Company,
Suite 510 Marquette Building,
CHICAGO.



SAMSON TURBINE UPRIGHT AND HORIZONTAL
ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.
These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.
Write Dept. "D" for Catalog.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

Spend All Morning in Chicago, Take Breakfast in New York.

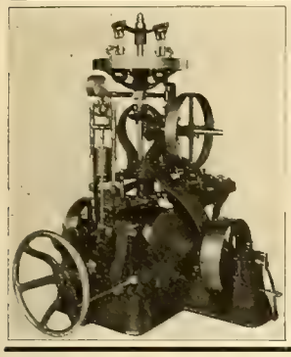
The Pennsylvania Special gives business men all morning in Chicago to clean up the day's work. They may leave on that train at 12 noon and be in New York before business begins next day, going through in 20 hours. First stop for passengers Pittsburg at 10:20 p. m.; Philadelphia 6:56 a. m., Twenty-third Street Station, New York, 9. a. m. Full information about fares, etc., may be obtained upon application by letter, telegram or in person to H. R. Dering, A. G. P. Agt., 248 South Clark Street, Chicago.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

GRAPHITE RESISTANCE.
Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.
JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

NOTICE.
TO THOSE INTERESTED IN ELECTRIC LIGHTING.
If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., Chicago.

REG. TRADE MARKS
"Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.



Water Wheel **Governors**

For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.

We are now prepared to

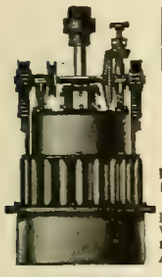
GUARANTEE ABSOLUTE SATISFACTION

Write for References in your Locality.

The Replogle Governor Works,

S. HIGH ST., AKRON, OHIO.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE
FOR
Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

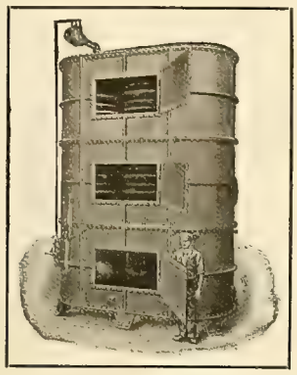
WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

When You Save Steam,



You Economize in Fuel, and

ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

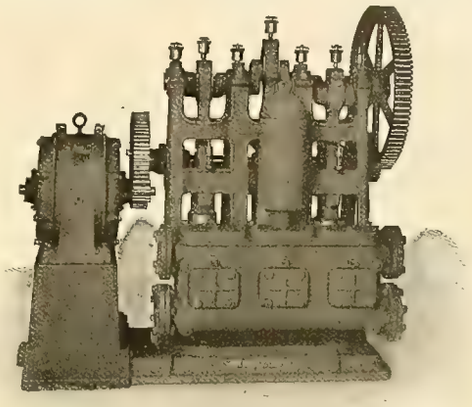
We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,

Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS



The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

NOW READY!!

WESTERN ELECTRICIAN'S MOONLIGHT SCHEDULE

FOR 1902.

ARRANGED IN BOOK FORM, POCKET SIZE.

10 Cents per Copy. Send for It.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

EAGO TAPE

A FRICTION TAPE

Superior because IT IS ONE-THIRD RUBBER.
It will not dry out IT IS AN INSULATING TAPE
And its sticktoitiveness is only one point among many
SAMPLES FREE
IT IS PUT UP IN A TIN BOX

ELECTRIC APPLIANCE COMPANY, CHICAGO

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

VOLT-AMMETERS,

POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

BEARDSLEE CHANDELIER M'F'G CO.

256 AND 257 SO CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

RESIN SOLDER

IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

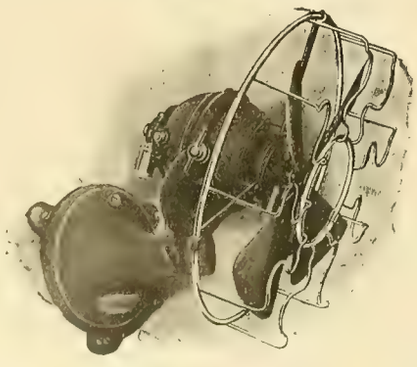
"YOU PRESS THE BUTTON,

THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to
ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

LUNDELL FANS



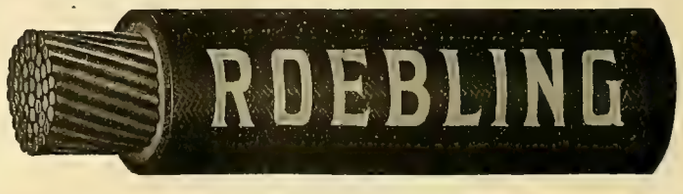
Superior in Design and Construction.

Cooling, Economical, Safe.

Catalogue No. 03304.

SPRAGUE ELECTRIC CO.,
GENERAL OFFICES: 527-531 WEST 34th STREET, NEW YORK.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.



POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

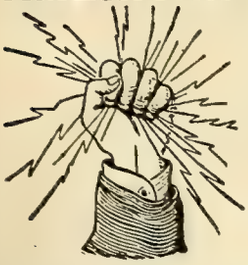
JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

FRANK N. PHILLIPS, President. S. N. WAGENHEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Bullock ELECTRIC MFG. CO. CINCINNATI O. U.S.A.

MULTIPLE VOLTAGE
SYSTEM OF POWER
(PATENTED)
411

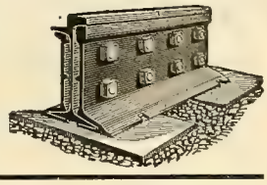
Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING,
NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.

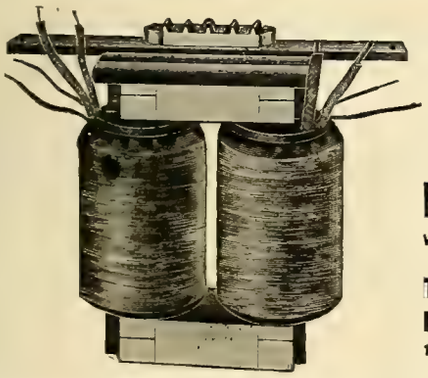


Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago. Ill.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

TRANSFORMERS.



OUR CLAIMS ARE:
LOW CORE LOSS,
CLOSE REGULATION,
HIGH INSULATION.

BEST TO OPERATE.
TO BUY.
We carry a complete stock on hand.

THE STANDARD ELECTRIC COMPANY,
113 W. Third St., Cincinnati, O.

BUY Your Electrical Books of the Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago. You will save TIME and MONEY by doing so. . . . . .

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

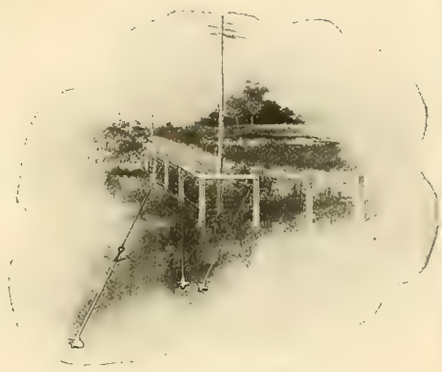
NONSENSE, WITH SENSE, FOR CENTS.

"A STANDARD REMEDY."

A pole to guy?
An Anchor try.
What Anchor, pray?
Stombaugh's we say.
It's proven best
From time and test.

Watch this space for change. —STOMBAUGH.

The installation of the
STOMBAUCH GUY ANCHORS
is simplicity itself. That is the reason they appeal so strongly to those who have anything to guy.



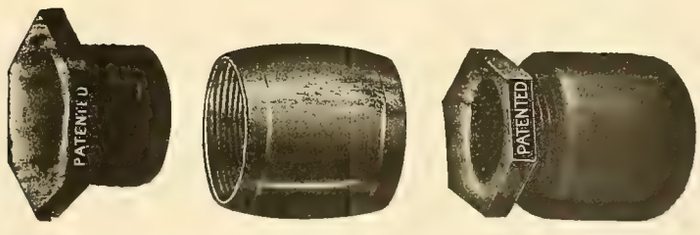
Write us for Information, Prices and Catalogue.

W. N. Matthews & Bro.
603 Carleton Bldg.
ST. LOUIS.

HOW THEY WORK.

TO CONTRACTORS

USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. C. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By an all around telephone man or electrical wireman. Address BOX 175, McComb, Ohio.

POSITION WANTED.

As engineer in power or light plant. Ten years' experience on engines, dynamos, rotaries and induction motors. References furnished if desired. Enquire of BOX 93 care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Experienced incandescent lamp maker, thoroughly skilled in all departments. Also one lamp blower. Positions at good wages in the laboratory of a new company. State full experience. P. O. BOX 153, Erie, Penn.

WANTED.

A 125 or 150 horsepower 25 cycle induction motor, two-phase. Address UNITED INDURATED FIBRE CO., Lockport, N. Y.

WANTED.

200-K. W., 250-Volt, Direct-connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

POSITIONS OPEN.

PER MONTH.

5 Draftsmen for Architectural, capable of designing entire buildings and figuring cost of materials, etc., $80 to $100 and Expenses
2 Draftsmen, Structural Steel $125
6 Draftsmen, Electrical ..... $70 up
1 Draftsman, Mechanical, especially good on screw machines $100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us free of charge.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.

ENGINE 40x72 inches, George H. Corliss.
" 38x72 inches, George H. Corliss.
" 32x44x60 inches, Allis Blowing.
" 28x48 inches, Allis Blooming Mill.
" 20x48 inches, Watts Campbell.
" 20x36x36 ins., MacIntosh & Seymour Compound.
" 17x30 inches, Buckeye Automatic.
" 14x24 inches, Buckeye Automatic.
PUMP 16x30x14x24 ins., Deane Com. Duplex.
" 16x2¾x10 inches, Worthington Hydraulic Duplex.
" 12x8x12 inches, Smith-Vaile Duplex.
" 10x5x10 inches, Hall Duplex.
" 20x9x14 inches, Blake Single.
" 16x10½x18 inches, Hughes Single.
" 12x7x10 ins., Cope & Maxwell Single.
" 10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.

45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse - 250 volt M. P.
1—125 K. W. Thompson-Ryan - 250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.
1— 55 K. W. Fuller - - - - - 250 volt M. P.
1—100 K. W. General Electric 500 volt M. P.
2— 90 K. W. General Electric - 500 volt M. P.
1— 62 K. W. T.-H. D 62 - - 500 volt M. P.
1—100 K. W. General Electric - 125 volt M. P.
1—100 K. W. Triumph - - - 125 volt M. P.
1— 80 K. W. Keystone - - - 125 volt M. P.
1— 65 K. W. Jantz & Leist - 125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 10, 1902. —Sealed proposals will be received at this office until 2 o'clock p. m. on the 14th day of August, 1902, and then opened, for the installation of a conduit and wiring system for the U. S. Postoffice Building at Hot Springs, Arkansas, in accordance with the drawings and specification, copies of which may be obtained at this office or at the office of the Superintendent of Construction at Hot Springs, Arkansas, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

One-third interest in a Telephone System in the West owning 150 miles Standard Toll line, Six Exchanges. Position as Manager or Manager and Electrician at a good salary goes with the Stock to the right kind of a man. Good paying business, well established, good rates. Controlling interest could be secured but owners prefer to hold. Address BOX 95, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K.W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. . Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY. Rochester N.Y.

I CAN SELL

Your Electric Light, Gas, Water, or Telephone Plant, no matter where it is. Send description and cash price and learn how. I have or can find the plant you want to buy. Tell me your requirements. A. M. BARRON, Desk F, South Bend, Ind.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

CORLISS ENGINE.

For Sale—125-H. P. Hamilton Corliss, 14x36 F. O. B Hamilton, Ohio., $1,000.
ROSE ELECTRIC CO., ST. LOUIS.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

WANTED TO LEASE.

An electric-light plant by an up-to-date man at the business. Must be in town of not less than 2,500 or 3,000 inhabitants and for five or ten years. Let me know what you have and terms—it will pay you. BOX 145, Waverly, Tenn.

A. G. SCHOONMAKER CO.

126A Liberty Street, New York City,

DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1 20x18¼ Harrisburg Ideal Engine.
1 14x13 Armington & Sims Engine.
1 16x16 Erie Ball Engine.
1 15x15 Erie Ball Engine.
1 12x12 Erie Ball Engine,
2 120-kw G. E. single phase Alternators.
1 100-kw Card M. P. 500-volt Generator.
1 200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.
2 60-kw G. E. Transformers.
497 Improved M. G. E. Arc Lamps.
2 15 hp M. P. 500-volt Motors.
2 10-hp M. P. 500-volt Motors.
2 8-hp M. P. 500-volt Motors.
2 5-hp M. P. 500-volt Motors.
3 3-hp M. P. 500-volt Motors.

SCRAP?

We pay highest market prices for

SCRAP COPPER, BRASS and PLATINUM, also Incandescent Lamp Bases, etc.

WRITE US.

We Manufacture
Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO.,
CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60 Geo. H. Corliss.
20x48 Harris Corliss.
20x48 Wheelock Corliss.
12x36 Harris Corliss.
18x24 Atlas Automatic.
16x32 Buckeye Automatic.
13x21 Buckeye Automatic.
13x20 Russell Automatic.
8½x9 Armington & Sims Automatic.
9x12 Atlas Automatic.

BOILERS.

1 250 H. P. Babcock & Wilcox Water Tube.
1 66x16 Horizontal Tubular.
2 60x18 Horizontal Tubular.
5 60x16 Horizontal Tubular.
1 56x16 Horizontal Tubular.
1 48x16 Horizontal Tubular.
1 36x8 Horizontal Tubular.
1 54x8 Vertical Tubular.
Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

NOW

IS THE TIME TO

SUBSCRIBE

TO THE

Western Electrician

WRITE FOR PARTICULARS.

CHICAGO EDISON COMPANY REPAIR SHOPS

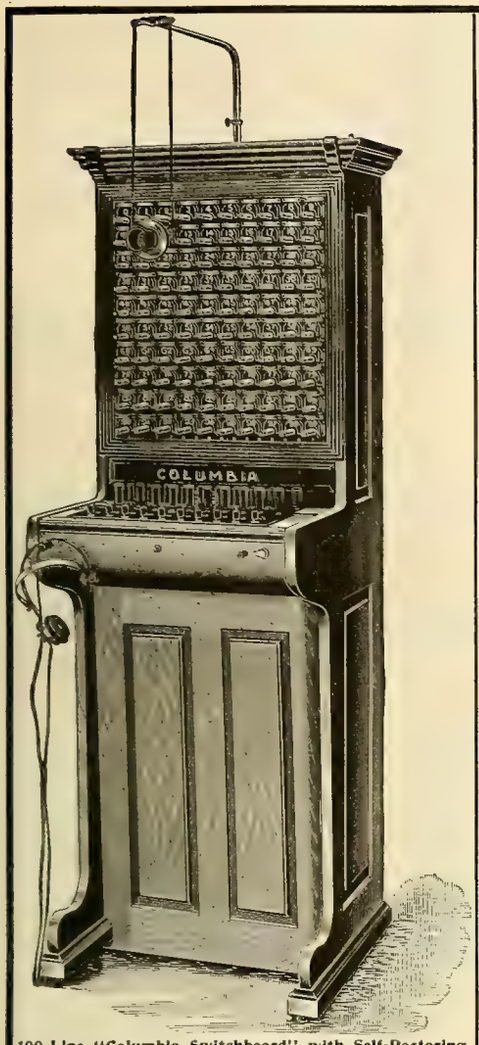
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1,200	lines	and	telephones
Ennis, Tex., . .	"	1,200	"		"
Norwalk, Ohio, .	"	2,400	"		"
Frankfort, Mich.,	"	250	"		"
Dundee, Mich., .	"	200	"		"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

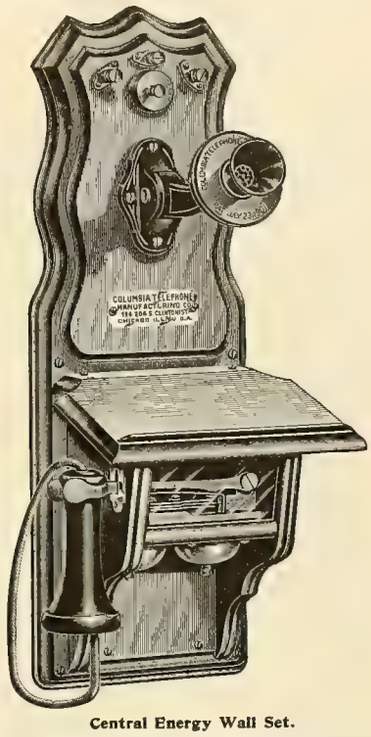
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,

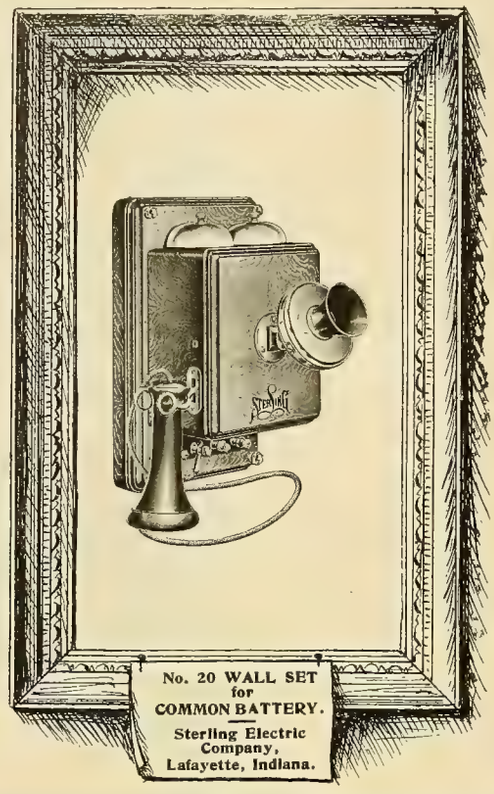
$1 A VOLUME.

Electrician Publishing Co.,

510 Marquette Building, Chicago.

ANOTHER OF OUR NEW PRODUCTIONS

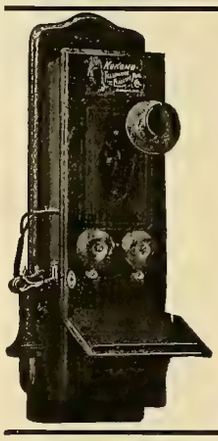
THE PERFECT COMMON BATTERY MULTIPLE SYSTEM



No. 20 WALL SET for COMMON BATTERY.
Sterling Electric Company, Lafayette, Indiana.

SINGLE RELAY, LAMP SIGNAL DOUBLE SUPERVISION

CONTINENTAL TELEPHONE CONSTRUCTION CO.
GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.
TACOMA BLDG., CHICAGO.



KOKOMO TELEPHONES
Always Up-to-Date.
WE MANUFACTURE
SWITCHBOARDS, TELEPHONES
AND EVERYTHING FOR COMPLETE EXCHANGE.
Write for Catalog and Prices.
KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger
for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.
No. 1. Light, 1¾x ⅜in.
No. 2. Medium, 1¾x⅛ in.
No. 3. Heavy, 2x⅛ in.
Nos. 2 and 3 always in stock.

DEAD END HANGER. Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.
Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties, and up-to-date. Tell us what you want.
Corner Brackets, Guy Shims, and Special Forgings made to order.

3-Bolt Guy Clamp.
Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.
BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.
Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
8th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

CHICAGO TELEPHONE PAY STATIONS and METERS
Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.
Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

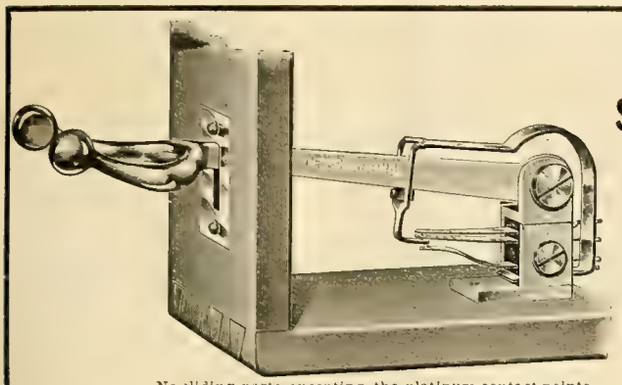
Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
510 Marquette Building,
CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. Co.**

Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. ...Prices Right.

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

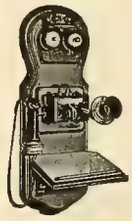
EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
CHICAGO, ILL.

TO SAY

A transmitter is the long-distance type amounts to very little now days since there are so many so called long-distance instruments on the market that will not talk 150 miles under the most favorable conditions.

GUARANTEED BETTER THAN THE "BELL SOLID BACK" IS AMPLE PROOF THAT KELLOGG TRANSMITTERS ARE REALLY LONG-DISTANCE INSTRUMENTS.

WRITE FOR GEN'L CATALOG.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 So. GREEN ST., CHICAGO.

REMOVAL NOTICE.

Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE **SIGNALING APPARATUS.**

Metropolitan Telephone and Electric Co.
CHICAGO.

Telephone Troubles

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

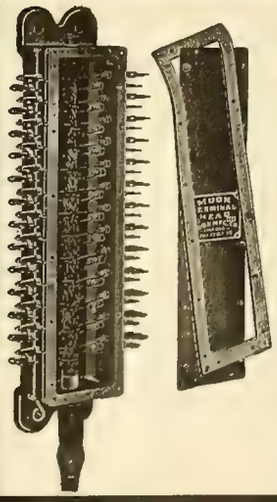
Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

No. 34 Central Energy Telephone.



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

AWARDED HIGHEST MEDAL ON TOOLS AT PARIS EXPOSITION OF 1900.

ASK FOR THIS

AWARDED HIGHEST MEDAL ON TOOLS AT PAN-AMERICAN EXPOSITION

THE DICKE TOOL COMPANY,
FACTORY: DOWNER'S GROVE, ILL.
Eastern Office: J. E. Way, Manager, 39 Cortlandt Street, New York.
Thos. G. Grier, Electrical Building, Chicago.
St. Louis Office: W. N. Matthews & Bros., 320 N. 6th Street.

---

4 Days Lake Trip
$13. Including Meals and Berths—Chicago to ESCANABA, Mich. and Return.
Leave Chicago Wed., Fri., & Sat. 8:00 p. m.

7 Days Lake Trip
$25. Including Meals and Berths—Chicago to Mackinac Island and Return.
Leave Chicago Saturdays 8:30 p. m.

Muskegon or Grand Haven
and RETURN **$2.75**
Leave Chicago 7:45 p. m., daily.

GOODRICH LINE STEAMERS

Finest Service on the Lakes

For complete information see local Railroad Agent or address

R. C. DAVIS, C. P. A., GOODRICH LINE,
Foot of Michigan Ave., - Chicago, Ill.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

A GLIMPSE AT OUR **WESTERN STOCK.**

1,700	pieces	40	feet, 7-inch	tops
1,700	"	40	" 8	"
1,750	"	45	" 7	"
1,250	"	45	" 8	"
1,750	"	50	" 7	"
750	"	50	" 8	"
3,000	"	55	" 7	"
750	"	55	" 8	"
750	"	60	" 7	"
300	"	60	" 8	"
250	"	65	" 8	"
200	"	70	" 8	"

Our Prices Will Interest You.

POLES POLES

30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR **TROLLEY LINE CONSTRUCTION** ALWAYS IN STOCK.

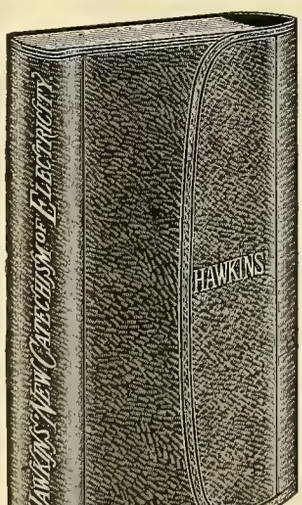
YARDS:

MENOMINEE,	MICH.
ESCANABA,	MICH.
NADEAU,	MICH.
CLOQUET,	MINN.
HERON,	MONT.
CABINET,	IDAHO.

OUR ADDRESS:
FRANCIS **BEIDLER** & CO.
W. 22d and Loomis Sts,
CHICAGO, ILL.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"TELEPHONE TROUBLES ...AND... HOW TO FIND THEM,"

BY
W. H. HYDE AND J. A. McMANMAN,
FORMERLY
HASKINS' TELEPHONE TROUBLES.

This Little Book is Strictly Up-To-Date on all Matters Pertaining to Telephone Troubles and their Remedies.

Sent Postpaid for 25c.

New (eighth) edition just out, 48 pages. Many diagrams showing connections. A complete hand-book for telephone inspectors.
Telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor.

Electrician Publishing Co.,
510 MARQUETTE BLDG., CHICAGO.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.
Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.,
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20 foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want **CEDAR POLES** POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PEBRIZO TSOMS DAGGETT MICH.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO., 229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

THE HOLCOMB-LOBB COMPANY CEDAR POLES & POSTS 745 MARQUETTE BLDG. CHICAGO ILL.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years. **TIES.**

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

POLES. WHITE CEDAR. IDARO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES LONG DISTANCE 'PHONE WRITE US A. P. HOPKINS & CO. ESCANABA, MICH.

CROSS ARMS.

Manufactured from the Best Long Leaf Yellow Pine.
In Carload or Less Carload Lots.

THE STANDARD POLE AND TIE CO., 44 BROAD ST., NEW YORK.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**

Large Stock Constantly on Hand.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance

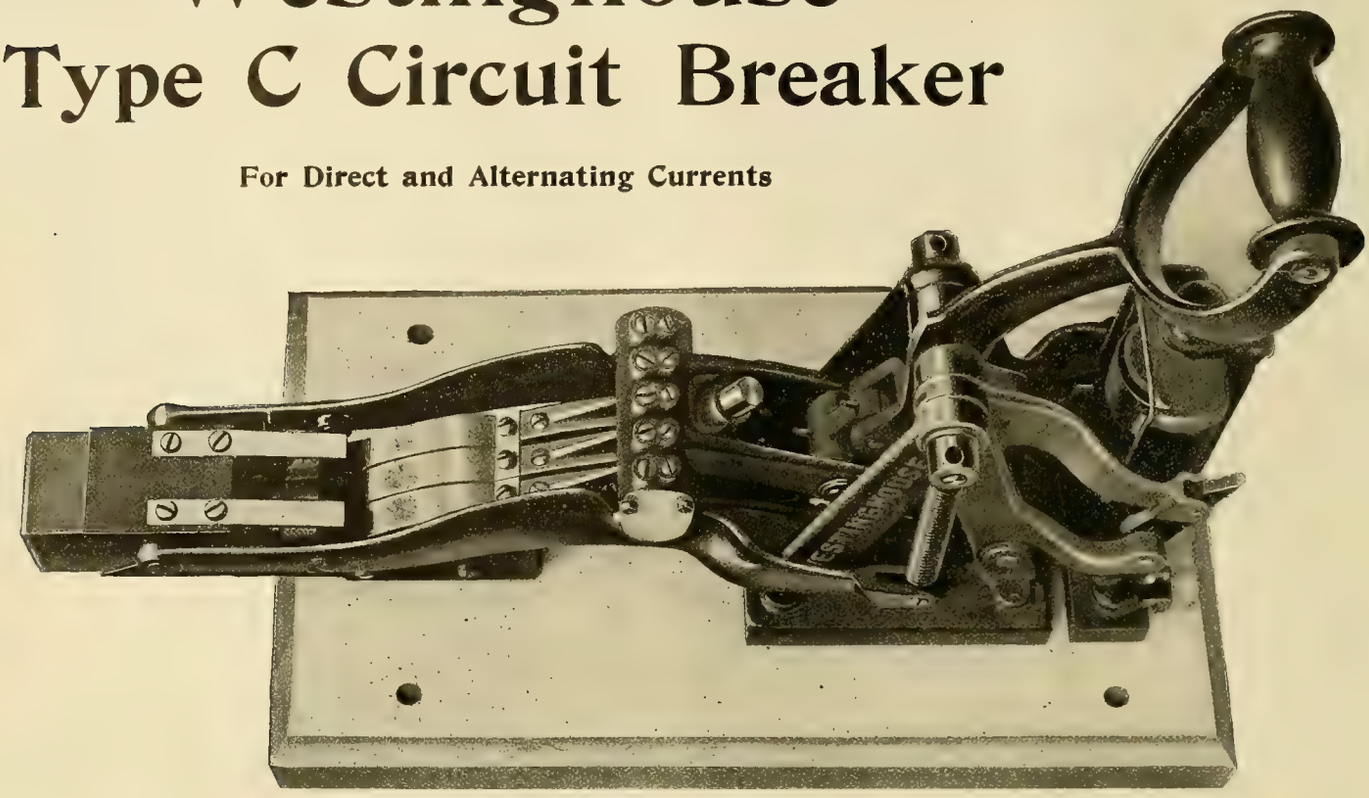
Electrician Publishing Co.,

Suite 510 Marquette Bldg., - CHICAGO

CEDAR POLES THE VALENTINE-CLARK CO., — 234 LA SALLE ST., CHICAGO YARDS: PINCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

Westinghouse
Type C Circuit Breaker

For Direct and Alternating Currents



Built in sizes of 200 to 10,000 amperes, in one, two, three and four pole combinations.

Write to nearest district office for illustrated booklet on Westinghouse Type C Circuit Breakers.

85d2

Manufactured by the

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Sales Offices in All Large Cities.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket: Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X; Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"WOOD" ARC LAMPS

FOR POWER CIRCUITS

High grade construction

with

High grade materials

makes

High grade arc lamps.

These are

"The best on the market."

FORT WAYNE ELECTRIC WORKS.

MAIN OFFICE AND FACTORY: FORT WAYNE, IND.

SALES OFFICES IN ALL LARGE CITIES.

THE LATEST BOOK.

"ELECTRIC LIGHTING,"

A PRACTICAL EXPOSITION OF THE ART FOR THE USE OF

Engineers, Students and Others Interested in the Installation or Operation of Electrical Plants.

BY FRANCIS B. CROCKER,

Professor of Electrical Engineering, Columbia University, New York.

Price $3, Prepaid. - Practical and Up-to-Date.

Just the Book you want. 450 Pages, over 150 Illustrations. Read the

TABLE OF CONTENTS:

Chapter I, Introduction; Chapter II, History of Electric Lighting; Chapter III, General Units and Measures; Chapter IV, Classification and Selection of Electric Lighting System; Chapter V, The Location and General Arrangement of Electric Lighting Plants; Chapter VI, Buildings for Electric Lighting Plants; Chapter VII, Possible Sources of Electrical Energy; Chapter VIII, The Steam Engine, History and General Principles; Chapter IX, Steam Boilers for Electric Lighting; Chapter X, Steam Engines for Electric Lighting, General Construction; Chapter XI, Typical Forms of Steam Engine for Electric Lighting; Chapter XII, Steam Engines for Electric Lighting, Selection, Installation and Management; Chapter XIII, Gas, Oil and Hot Air Engines; Chapter XIV, Water Wheels and Windmills; Chapter XV, Mechanical Connections between Engines and Dynamos, Direct Coupling, Belting and Shafting; Chapter XVI, Toothed, Friction and Other Gearing; Chapter XVII, Principles, Construction and Management; Chapter XXI, Applications of Accumulators in Electric Lighting; Chapter XXII, Switchboards, Including Switches, Fuses and Circuit-Breakers; Chapter XXIII, Electrical Measuring Instruments; Chapter XXIV, Lightning Arresters.

Every Engineer and Electrician who desires to thoroughly master the Art of Electric Lighting should have a copy of this book. Sent promptly.

ELECTRICIAN PUBLISHING COMPANY, Suite 510 Marquette Building, CHICAGO.

Wright Cable Hanger.

SEND FOR SAMPLES AND PRICES.

R. I. TELEPHONE & ELECTRIC CO.,
PROVIDENCE, R. I.

Mention this paper.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF

WIRES AND CABLES.

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY

PHILADELPHIA, PA.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

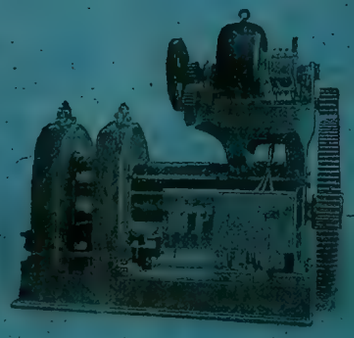
ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 Pine St., ST. LOUIS, MO.

Crocker-Wheeler Motors

ARE USED FOR THE ELECTRIC DRIVE OF A GREAT VARIETY OF MACHINE TOOLS.

Bulletin No. 24 Illustrates Some of Them.



THE CROCKER-WHEELER COMPANY,

MANUFACTURERS AND ELECTRICAL ENGINEERS.

SALES OFFICES IN ALL LARGE CITIES.

OFFICE AND WORKS: = = = AMPERE, N. J.

BUFFALO HIGH SPEED ENGINES

FOR ELECTRIC LIGHTING AND POWER SERVICE.

TYPES:
Horizontal,
Vertical,
Simple,
Compound,
Belted,
Direct Connected.

BUFFALO FORGE COMPANY,
BUFFALO, N. Y.
CHICAGO OFFICE, 22-24 RANDOLPH ST.

STURTEVANT ELECTRIC FANS

In 100 types and sizes.
Special designs for requirements.
We build both fan and motor.
Send for Bulletin H.

B. F. STURTEVANT CO. BOSTON.
NEW YORK · PHILADELPHIA · CHICAGO · LONDON.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 2, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

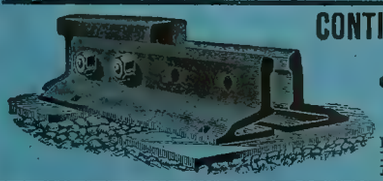
AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 93 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.


CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo, 1901.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

ERICSSON BI-POLAR SWEDISH RECEIVER
ALL METAL RECEIVER EXCEPTIONALLY STRONG. NEEDS NO ADJUSTING.
IT IS THE BEST. WHY NOT HAVE IT?
ERICSSON TELEPHONE CO. 296 B'WAY. N.Y.

ERICSSON SWITCHBOARDS
Of all sizes. Telephones for all uses. Write for particulars and tell your needs.
ERICSSON TELEPHONE CO.,
296 Broadway, NEW YORK.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

ESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Ammeter, Type F.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., No. 101 St. Martin's Lane.

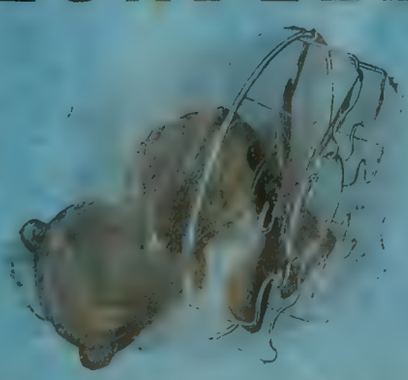
We desire to call attention to a line of **cheap** but excellent Switchboard Instruments for Direct Current Circuits, which we designate as

"Round Pattern," Style F.

These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

Mention the WESTERN ELECTRICIAN when writing for catalogue.

LUNDELL FANS



Superior in Design and Construction.

Cooling, Economical, Safe.

Catalogue No. 2...

SPRAGUE ELECTRIC CO.
GENERAL OFFICES: 527-531 WEST 34th STREET, ...

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market. It's good to look at and built to stand the most severe service. Never has been beaten in a competitive test.

Their Efficiency and Regulation are Perfect. Easiest lamp to trim made. Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. C. POMEROY,
No. 209 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
C. A. THOMSON,
No. 136 Liberty Street.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" *For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.*

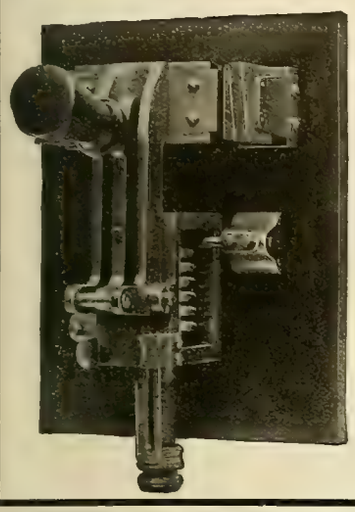
The "Exide Accumulator" *For Electric Vehicles.*

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 250 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: PHILADELPHIA, Allegheny Ave. & 19th St. NEW YORK, 100 Broadway. BOSTON, 60 State St. CHICAGO, Marquette Bld. BALTIMORE, Continental Trust Bld ST. LOUIS, Wainwright Bld. SAN FRANCISCO, Nevada Block. CLEVELAND, New England Bldg. DETROIT, Michigan Elec. Co. HAVANA, CUBA. F. G GREENWOOD. MGR. 34 Empedrado Street.

R 52



CIRCUIT BREAKERS

THE ELDEN DIRECT AND ALTERNATING CURRENT.

COMPACT and SUBSTANTIAL.

PERFECT PROTECTION. Oil and Air Break.

THE STANDARD ELECTRIC COMPANY,

CINCINNATI, - OHIO.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 Pine St., ST. LOUIS, MO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS. PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS. We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 2
Akron Smoking Pipe Co..... 1
American Battery Co.....11
Amer. Electrical Heater Co..10
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Badt & Co., F. B..... 10
Baker & Company..... 3
Barnett Company, G. & H....20
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg.Co.—
Beardsley Gravity Dam & Construction Co..... 7
Beidler & Co , Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bossert El. Construction Co..10
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...17
Central Telephone & El. Co...14
Century Glass Co.....10
Chase-Shawmut Company...11
Chicago & Alton Railroad....16
C. & N. W. R. R..... 9
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co.. 20
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....16
Chicago Pay Station Co.....14
Colt, Henry A..... —
Columbia Telephone Mfg.Co.—
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..16
Diamond Meter Company.... 4
Dicke Tool Company.....—
Dixon Crucible Co., Joseph..16

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....20
Edwards & Company.....10
Electrical Engineer Institute. 7
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....11
Fulmer Lumber Co., D. M....17

General Electric Company... 4
General Incandescent Arc Light Company..... 5
General Incand. Lamp Co....—
Glass Wool Mfg. Company... 9
Great Western Smelting & Refining Company.... ....—
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co...—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....—
Holmes Fibre-Graph. Co.....—
Hopkins & Co , A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H.....10

Illinois Electric Specialty Co.14
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools.... 5
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....11, 15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp.... 9
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller..... 7
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad.....16
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....10
Munsell & Co., Eugene.....—

National India Rubber Co....—
Naugle Tie Co., E. E 17
New York Ins. Wire Co..... 9
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 5
Pennsylvania Lines..... 7
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17
Pratt Institute..... 5

Reisinger, Hugo.....—
Reliance Electric Company.. 7
Replogle Governor Works.. ..—
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....—
Roebling's Sons Co., J. A.....10
Rose Electric Company 12
Rose Polytechnic Institute... 5

St. Louis Elec. Supply Co.... 3
Sargent & Lundy..... 7
Sawyer-Man Elec. Company.18
Schoonmaker Co., A. G.....—
Schott, W. H. 5
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Signaloid Chemical Works... 9
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 9
Spies Electric Company..... 1
Sprague Electric Company... 1
Standard Electric Company.. 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co..—
Standard Varnish Works 7
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 9
Sterling & Son, W. C.....17
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....11
Streeter, A. L..... 7
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Torrey Cedar Company.....17
Triumph Electric Co.....20

Union Pacific R. R.....16

Valentine-Clark Co., The....—
Varley Duplex Magnet Co....14
Vindex Electric Company....—
Vomacka & Mazenek .....—
Vulcanized Fiber Company. 20

Wabash R. R..... 7
Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co..... 8
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G..... 5
Wisconsin Central R. R.....16
Wittenberg Cedar Co.....17
Worcester Company, C. H....17
Worcester Polytechnic Inst.. 5

For Classified Index of Advertisements See Page 6.

Better than ever and a little the best of any on the market today—

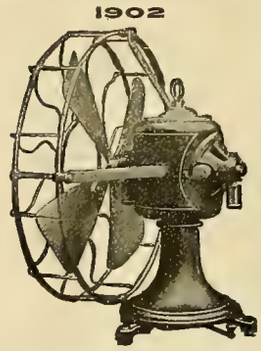
1902 PARAGON 1902

NOISELESS **FAN MOTORS** COMPACT

ALL STYLES AND SIZES EASY RUNNING RIGID CONSTRUCTION

—CALL AND SEE THEM OR WRITE FOR PRICES—

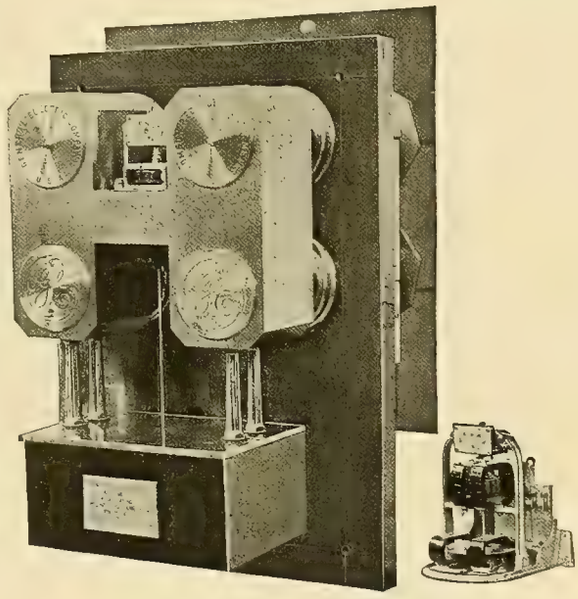
CHICAGO EDISON COMPANY, 139 ADAMS ST., CHICAGO.



PARACON DESK FAN

THE GENERAL ELECTRIC COMPANY

MANUFACTURERS



THOMSON RECORDING WATTMETERS

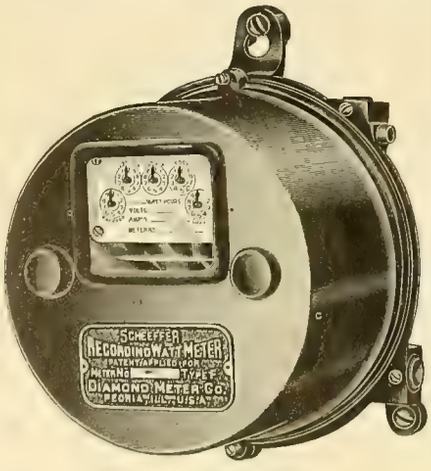
For all Classes of Service

and of all Capacities

FROM 3 AMPERES TO 30,000 AMPERES.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y.

Chicago Office, Monadnock Building. **Sales Offices in all Large Cities.**



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

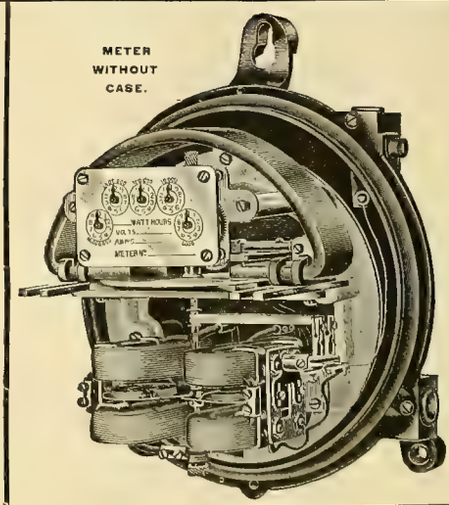
IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

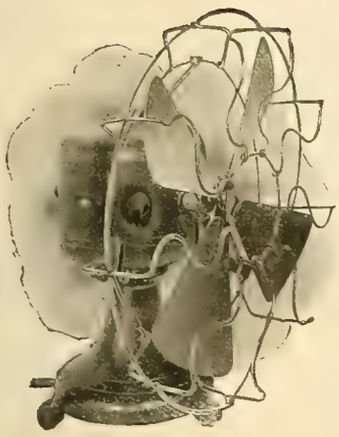
A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.



METER WITHOUT CASE.



The Largest Selection

of Fans for all Requirements. Desk, Bracket, Ceiling, Ventilating and Battery Fan Outfits.

SEND FOR FAN MOTOR CATALOGUE.

Central Electric Company, 264-266-268-270 FIFTH AVE., CHICAGO.

PRATT INSTITUTE

BROOKLYN, N. Y.

TWO-YEAR COURSES IN

APPLIED ELECTRICITY

AND IN

STEAM AND MACHINE DESIGN

Write for Catalogue and Particulars.

THE WORCESTER POLYTECHNIC INSTITUTE

EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

ROSE POLYTECHNIC INSTITUTE

A College of Engineering. Mechanical, Electrical, Civil Engineering; Chemical Courses; Architecture Extensive shops. Modernly equipped laboratories in all departments. Expenses low 26th year For catalog, address C. L. MEES, President, Terre Haute, Ind

---

The Franklin Model Shop

Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.

PARSELL & WEED, 129-131 W. 31st Street, New York.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: 1220-21 Marquette Building,

Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants. CHICAGO.

TEST INSTRUMENTS.

Portable Sets for Resistance, Faults, Etc.

Portable Sets for Insulation and Capacity.

Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.

11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.

We control patents and are sole makers of the

Caldwell Liquid Interrupter.

Cunningham Mercury Jet Interrupter.

Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.

Send for Catalogue No. 507 10c in stamps.

What the I. C. S. did for me

I owe much of my success to the I. C. S. The results obtained through my I. C. S. training were practical. I was a conductor when I first enrolled in the Schools, and, in eight months' time my employers made me Assistant Electrician with an increase in wages. A few months brought another advance in wages, and I was soon given my present position as Chief Electrician with another advance.

J. H. SWEETMAN,
76 Northumberland St., Guelph, Ont.

DO YOU WANT A BETTER SALARY AND POSITION?

Such evidence as the above is proof conclusive of the value of our training. Actual results is the best argument. We have hundreds of endorsements like the above—just as strong, just as convincing. Isn't this one convincing enough to induce you to cut out, fill in, and send us the attached coupon with X marked before the position for which you wish to be trained?

DO IT ANYWAY.

International Correspondence Schools,
Box 1002, Scranton, Pa.

Please explain how I can qualify for the position marked X below.

Electrical Engineer	Fire Underwriters' Inspector
Telephone Engineer	Interior Wireman
Telegraph Engineer	Foreman Dynamo Room
Erector of Electric Machinery	Foreman Electrical Repairs
Manager Electric Railway	Dynamo Tender
Manager Electric Light Plant	Electrical Lineman
Supt. Electric Light and Power Plant	Motorman

Occupation _____ *Age* _____

Name _____

Street and Number _____

City _____ *State* _____

TRADE G. I. MARK

GUARANTEE

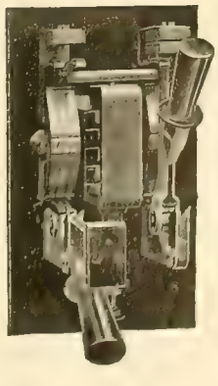
OF FULL

PATENT PROTECTION

TO

PURCHASERS

OF



DOUBLE POLE DOUBLE ARM G. I. CIRCUIT BREAKERS

MANUFACTURED BY

GENERAL INCANDESCENT ARC LIGHT CO.,

NEW YORK, N. Y. And All Large Cities.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. B. S. BARNARD, Vice-President and Secretary.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Glass Wool.
Glass Wool Mfg. Company.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Rose Polytechnic Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.
Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book,
"Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute,
Dept. K. 240-242 W. 23d St., New York.

SARGENT & LUNDY,
Engineers,
1000, 46 E. VAN BUREN ST., CHICAGO.
FREDERICK SARGENT. A. D. LUNDY

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

EXCURSIONS ABANDONED.

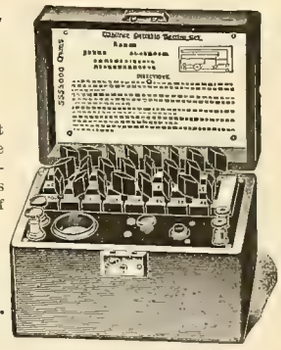
Excursions to New York City, Atlantic City and Montreal, advertised by the Wabash for July 31st, August 7th and 14th, have been abandoned.

STREETER SPRING MOTOR FANS
173-75-77 SOUTH CLINTON STREET, CHICAGO.
FAN MOTORS FOR GENERAL USE.
No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.
FIRST COST THE LAST.
No expense whatever to maintain.
EASY TO WIND.
Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.
WRITE FOR CIRCULAR.

THE WHITNEY TESTING SET

here illustrated contains one of the most sensitive D'Arsonval galvanometers made and its resistance coils are guaranteed adjusted to ⅛ of 1 per cent. The range is .01 ohm to 5 megohms. We make one of smaller capacity at a still lower price.
Write for details and discounts.

MACHADO & ROLLER
203 BROADWAY, NEW YORK, N. Y.
General Agents of Whitney Electrical Instrument Co.



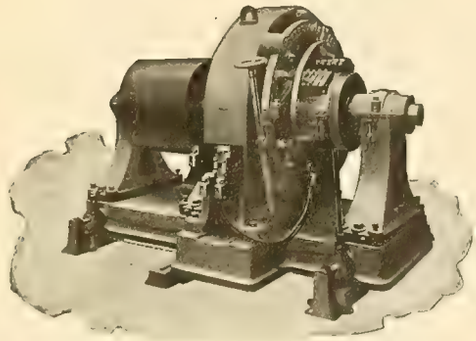
List Price $38.00.

BUY Your Electrical Books of the Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago. You will save TIME and MONEY by doing so. . . . . .

Spend All Morning in Chicago, Take Breakfast in New York.

The Pennsylvania Special gives business men all morning in Chicago to clean up the day's work. They may leave on that train at 12 noon and be in New York before business begins next day, going through in 20 hours. First stop for passengers Pittsburg at 10:20 p. m.; Philadelphia 6:56 a. m., Twenty-third Street Station, New York, 9. a. m. Full information about fares, etc., may be obtained upon application by letter, telegram or in person to H. R. Dering, A G. P. Agt., 248 South Clark Street, Chicago.

TYPE "L" GENERATORS
FOR
POWER AND LIGHTING.



WRITE FOR BULLETINS Nos. 2003--2004.

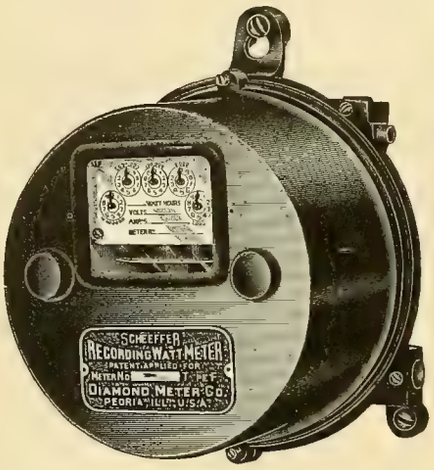
WESTERN ELECTRIC COMPANY,
CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

"RELIANCE"
GENERATORS AND MOTORS.
SEND FOR BULLETIN.
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

Scheefer Integrating Wattmeters

. . . FOR . . .

Direct or Alternating Currents.

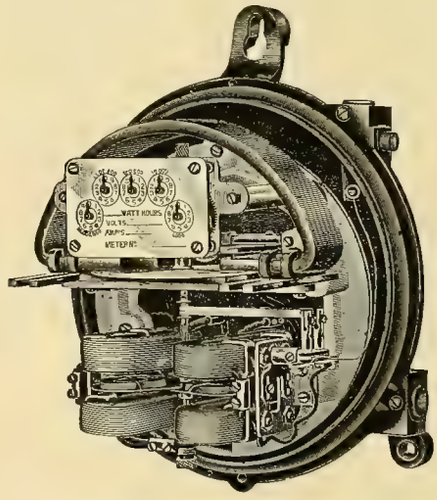


METER WITH CASE.

Improved Construction.

Dust and Bug Proof.

A highly sensitive and accurate Meter, unaffected by alternation or lag in current. . . . . .

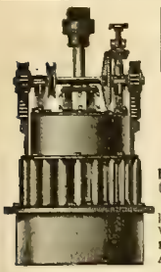


METER WITHOUT CASE.

Western Electrical Supply Co.

Prices and Descriptive Matter on application . . . . . .

St. Louis, U. S. A.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

SIGNALOID

THE MOST PERFECT AND RELIABLE

Coloring and Frosting Liquid

FOR

INCANDESCENT ELECTRIC LAMPS.

Will never peel, chip or crack, and the color will outlive the life of the lamp.

MANUFACTURED BY

SIGNALOID CHEMICAL WORKS

JERSEY CITY,

NEW JERSEY.

GLASS WOOL

FOR STORAGE BATTERIES AND LABORATORY WORK, FILTRATION PURPOSES, ETC.

$2 a lb. Discount furnished on application.

GLASS WOOL MFG. CO.,
207 W. Madison St., CHICAGO.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

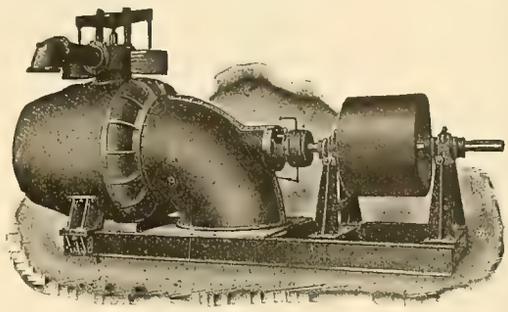
WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,

257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch St.
BOSTON, 73 Oliver St. CHICAGO, 311 Dearborn St.
NEW ORLEANS, 304 Hennen Bldg. LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

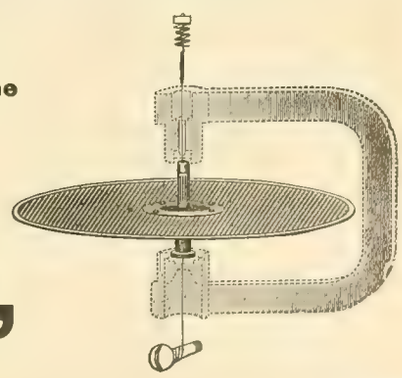
NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

DO YOU KNOW

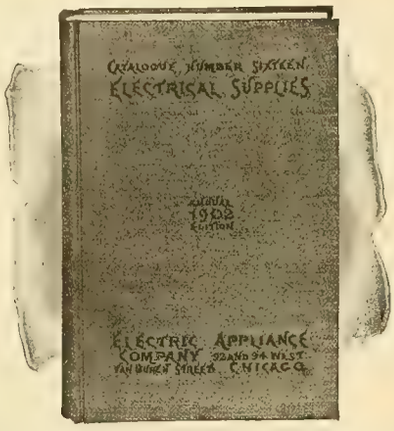
the importance of magnetically floating the moving parts of a meter?

Send for description and book full of good information "ABOUT METERS."



STANLEY INSTRUMENT COMPANY,

General Sales Office, 158 Broadway, New York, N. Y.
Pacific Coast Agency, 33 New Montgomery St., San Francisco, Cal.



EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles, Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

M. I. C. COMPOUND

HIGH INSULATOR FOR ARMATURES, FIELD COILS, SPOOLS, TRANSFORMERS, MOTOR FRAMES, CAR TRUCKS, ETC.

Four Grades to suit all Requirements. Non-Corrosive, no Carbon Bisulphide. Impervious to Moisture, Oil or Acid. Send for Price List and Samples.

MICA INSULATOR CO.,
NEW YORK. CHICAGO.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.
CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

SPARKING
Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Manufacturers, **909, 100 Washington St., Chicago.**

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

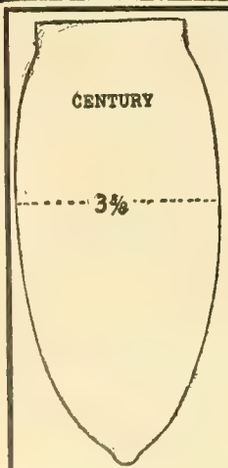
EDWARDS AND CO.
Lock Gravity Drop Annunciator.

Extra heavy, well finished case of ornamental design.
The drops being fastened to the back-board, the case may be removed without disconnecting wires.

NEW YORK N.Y

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances.
Write for catalogue. 193-197 River St. DETROIT MICH

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.



WE CAN PLEASE YOU
IN THE LINE OF
ELECTRICAL GLASSWARE
AND ARE PREPARED TO FURNISH YOU WITH GLOBES OR SHADES FOR ALL TYPES OF LAMPS.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. **LAMP CORD.**

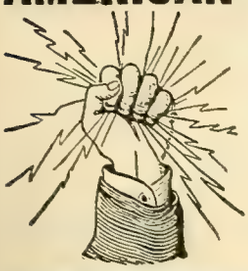
POWER CABLES.
TELEPHONE CABLES. **OFFICE WIRE.**

JOHN A. ROEBLING'S SONS CO.
NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

FRANK N. PHILLIPS, President. C. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



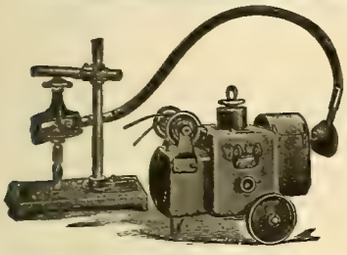
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1893. 171 S. Clinton St., Chicago, Ill.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

RESIN SOLDER
IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

It's No Secret...
That the proper illustration in an Ad. pays for itself and the entire space of the ad.
WE MAKE THE PROPER KIND ...
TRY THEM AND SEE
Real order fetchers
Full of force...
Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET. R. I.

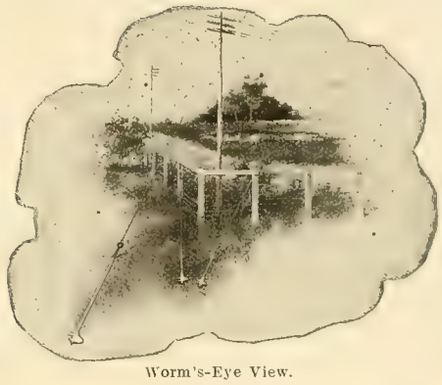
The breaking strain of a 3/8 strand is
5,000 lbs.
It requires a strain of over
8,000 lbs.
to pull out a 5-inch

STOMBAUGH GUY ANCHOR

When bored 4 feet in the ground.
The time required is about 5 minutes, and the cost 69 cents.

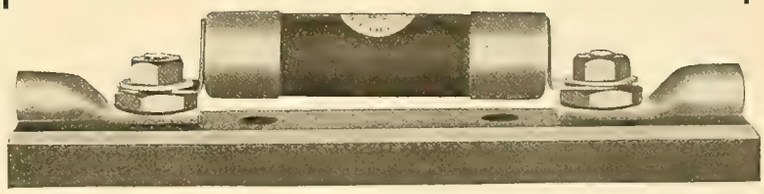
Write us for Information. We like to be asked questions.

W. N. MATTHEWS & BRO.,
603 CARLETON BLDG.
St. Louis.



Worm's-Eye View.

"SHAWMUT" ENCLOSED FUSES



RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.
THE NEW SHAWMUT INDICATING FUSE.
Shows whether blown by overload or short circuit.

Indicating Type P Fuse, intact.

Fuse blown by overload, showing auxiliary indicating patch white

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.
New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1 00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent or manager with telephone exchange of 1200 or larger; am at present superintendent for construction company; want permanent position where I can be with my family. Also capable of managing electric-light plant. Best references. Address BOX 98 care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A first-class troubleman, best of references required. Good wages and steady place to right party. Address BOX 96, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

A traveling telephone salesman to sell a staple article to electric light companies as a side line. No samples required. Good commission. Address BOX 97, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

200-K. W., 250-Volt, Direct-connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

POSITIONS OPEN.

	PER MONTH.
3 Draftsmen, Architectu al.....	$125
2 Draftsmen, Structural Steel.....	125
9 Draftsmen, Electrical	$70 up
1 Draftsman, Mechanical, especially good on designing screw machinery	

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,

No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,

140 S. Clinton St., Chicago.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse -	250 volt M. P.
1—125 K. W. Thompson-Ryan -	250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.	
1— 55 K. W. Fuller - - - - -	250 volt M. P.
1—100 K. W. General Electric	500 volt M. P.
2— 90 K. W. General Electric -	500 volt M. P.
1— 62 K. W. T.-H. D 62 - -	500 volt M. P.
1—100 K. W. General Electric -	125 volt M. P.
1—100 K. W. Triumph - - -	125 volt M. P.
1— 80 K. W. Keystone - - -	125 volt M. P.
1— 65 K. W. Jantz & Leist -	125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

I CAN SELL

Your Electric Light, Gas, Water, or Telephone Plant, no matter where it is. Send description and cash price and learn how. I have or can find the plant you want to buy. Tell me your requirements. A. M. BARRON, Desk F, South Bend, Ind.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,

204 Dearborn Street, Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

CORLISS ENGINE.

For Sale—125-H. P. Hamilton Corliss, 14x36 F. O. B Hamilton, Ohio., $1,000.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.

ENGINE	40x72 inches, George H. Corliss.
"	38x72 inches, George H. Corliss.
"	32x44x60 inches, Allis Blowing.
"	28x48 inches, Allis Blooming Mill.
"	20x48 inches, Watts Campbell.
"	20x36x36 ins., MacIntosh & Seymour Compound.
"	17x30 inches, Buckeye Automatic.
"	14x24 inches, Buckeye Automatic.
PUMP	16x30x14x24 ins., Deane Com. Duplex.
"	16x2¾x10 inches, Worthington Hydraulic Duplex.
"	12x8x12 inches, Smith-Vaile Duplex.
"	10x5x10 inches, Hall Duplex.
"	20x9x14 inches, Blake Single.
"	16x10½x18 inches, Hughes Single.
"	12x7x10 ins., Cope & Maxwell Single.
"	10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.

45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

On receipt of

10 CENTS

.....We will send you a

Western Electrician Moonlight Schedule

FOR 1902.

Every Lighting man should have one.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Bldg., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE.

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	48x16 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	36x8 Horizontal Tubular.
5	60x16 Horizontal Tubular.	1	54x8 Vertical Tubular.
			Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.

Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,

E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**

The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**

The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1.25.**

A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft.* 1 volume, 12mo, cloth, **50** cents. Fully illustrated.

This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft.* 1 volume, 12mo, illustrated, cloth, **50** cents.

The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.

The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft.* 1 volume, 12mo, cloth and gold, **75** cents.

The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

BOOKS IN STOCK.

The only really large stock of electrical books in the West is carried by us. Western buyers can save from one to four days' time by ordering here. Orders given the promptest attention and letters asking for information concerning any electrical work cheerfully answered. We issue a book catalogue in which are listed and described the important works on electrical subjects that have appeared to date. Send for it. It is free for the asking.

ELECTRICIAN PUBLISHING CO.

510 Marquette Building, CHICAGO.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

Before attachment.

PATENTED GALVANIZED STEEL CABLE HANGER.

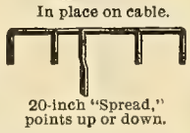
Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

In place on cable.

11½-inch "Spread," points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.



20-inch "Spread," points up or down.

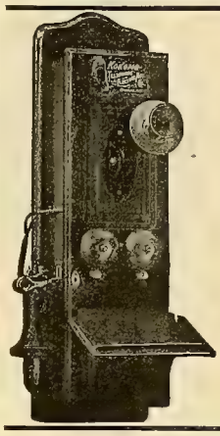
Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.

CONTINENTAL TELEPHONE CONSTRUCTION CO.

GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.

TACOMA BLDG., CHICAGO.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

No. 1. Desk Telephone.

Success

Comes only to those telephone exchanges which use the BEST material. If you use our goods success is assured.

We can supply EVERYTHING USED WITH TELEPHONES.

No order too small for attention or too large for our capacity. Rapid deliveries our rule and each order filled with care. Large stocks always on hand.

Telephones, every style and grade. Long and short backboards. Elegant finish and design. Prices that will suit. Hard rubber receivers. Oak or walnut woodwork. New ideas in magneto bells. Each instrument guaranteed.

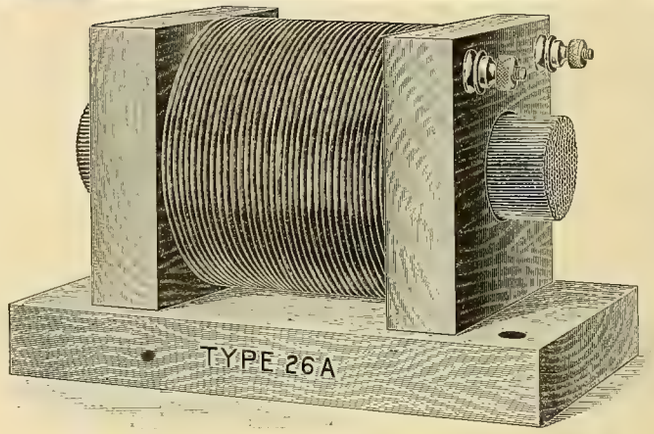
All kinds of telephone supplies. New parts for old telephones. Double-pole receivers.

Electricians' tools. Lightning arresters, carbon and fuse. Extension bells—standard and bridging. Circuit-closers. Transmitters of various styles. Repeating coils, induction coils, construction material of all kinds.

WRITE FOR CATALOGUE.

Central Telephone & Electric Co.,

909 MARKET STREET, ST. LOUIS, MO.



SPARK COILS

FOR EVERY PURPOSE.

VARLEY DUPLEX MAGNET CO.,

CHICAGO, ILL. PHILLIPSDALE, R. I.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

PLACE YOUR

"Want" and "For Sale" advertisements in the

WESTERN ELECTRICIAN.

Immediate Returns.

CHICAGO TELEPHONE PAY STATIONS and METERS

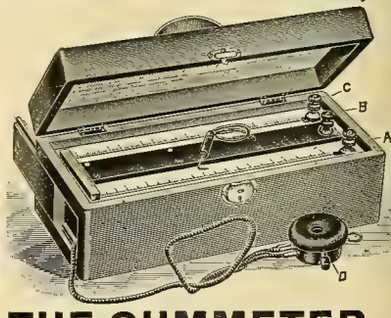
Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,

130 LA SALLE AVE., CHICAGO.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,

TACOMA BUILDING, CHICAGO.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

THAT FINISHED APPEARANCE

Characteristic of Kellogg Apparatus is a

TRANSMITTERS ABSOLUTELY UNIFORM AND GUARANTEED

BETTER THAN THE "BELL SOLID BACK."

Mark of Superiority.

WRITE FOR NEW GEN'L CATALOG.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 So. GREEN ST., CHICAGO.

Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

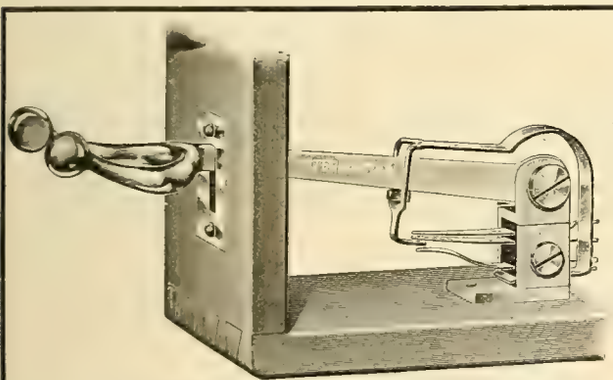
SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. ...Prices Right.

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

Telephone Troubles

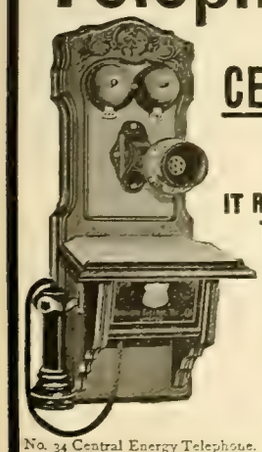
ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.



No. 34 Central Energy Telephone.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS

STROMBERG-CARLSON TELEPHONE MFG. CO.,
CHICAGO, ILL.

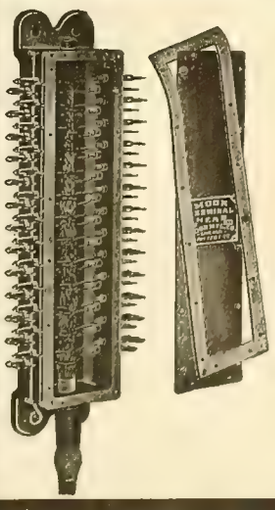
REMOVAL NOTICE.

Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE **SIGNALING APPARATUS.**

Metropolitan Telephone and Electric Co.
CHICAGO.



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

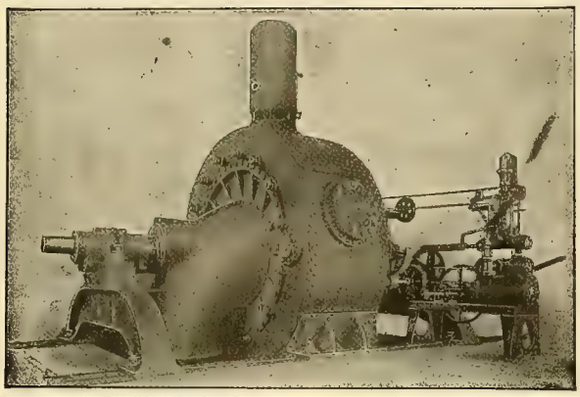
Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

10,000,000 TIMES BETTER TO HAVE CLEAN BOILERS
BY USING **DEARBORN BOILER COMPOUNDS**
MADE TO SUIT THE WATER AS PER ANALYSIS.

NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND. Write for Particulars.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



SAMSON TURBINE

UNEXCELLED FOR DRIVING

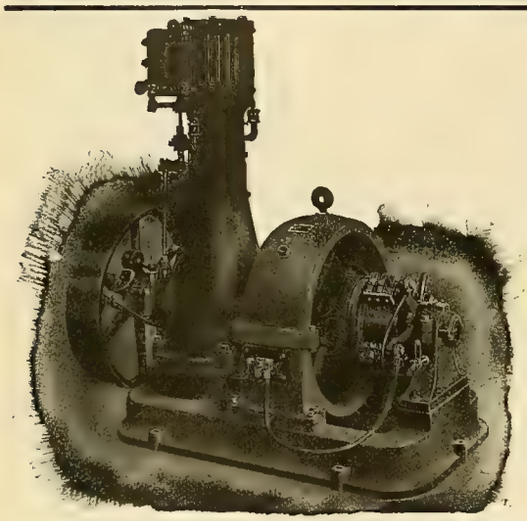
ELECTRICAL MACHINERY.

Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

MECHANICAL

Engineers interested in electricity should send for our 100-page Catalogue (mailed free to any address). Any electrical book published sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., - 510 Marquette Bldg., Chicago.

REG. TRADE MARKS
"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
—DELTA METAL—
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
. . TO . .
California
VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

MONON TRAINS FOR La Fayette, W. Baden Spr, Fr. Lick Spr, Louisville, Mammoth Cave, Chattanooga, New Orleans, All Southern Cities.
ANY TIME
MONON TRAINS FOR Indianapolis, Dayton, Cincinnati, Asheville, Atlanta, Jacksonville, St. Augustine, Tampa, Havana.

You travel between
CHICAGO
LOUISVILLE
INDIANAPOLIS
AND
CINCINNATI
GO VIA
MONON ROUTE
AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W. H. McDOEL, PRES. & GEN'L MGR. FRANK J. REED, GEN'L PASS. AGT. CHAS. H. ROCKWELL, TRAFF. MGR.
CHICAGO.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN
CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH.
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20 foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

CEDAR POLES OF ALL LENGTHS AND SIZES.

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

C. J. HUEBEL CO.

Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES AND TIES

WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1703-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO TSOMS DAGGETT MICH.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

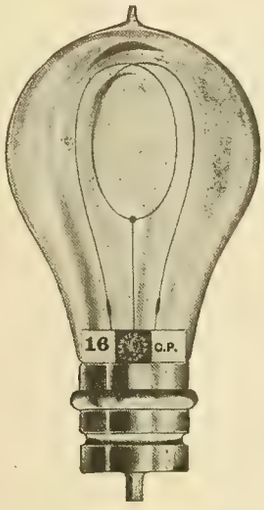
M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St. CHICAGO, ILL.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

S. P. T. When you see S. P. T. on the butt end of a pole, you are safe in banking on that pole. It means that our experts have inspected and accepted it.
THE STANDARD POLE & TIE CO. - - 44 BROAD STREET, N. Y.

CEDAR POLES
LONG DISTANCE PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

The Man Behind the Photometer

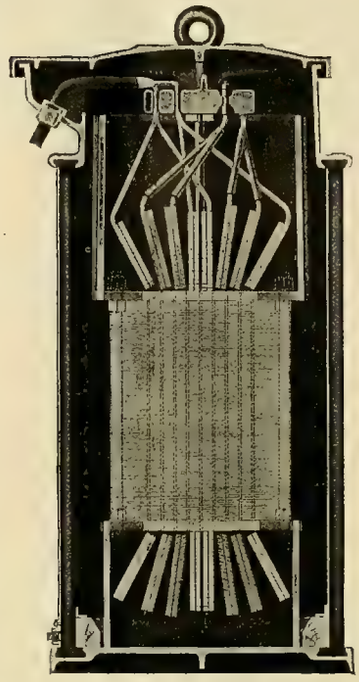


knows that our lamps are the best. Increased orders from our customers certify to the correctness of his tests. But we guarantee every lamp leaving our works to be perfect in every detail, and of the rated candle-power marked on bulb.

Sawyer-Man Electric Co.
New York

SALES OFFICES:
Chicago, Boston, San Francisco, Philadelphia, Pittsburg, Buffalo, St. Louis, Syracuse, Cincinnati, Detroit, Washington, Seattle, Atlanta, Dallas.

The Illustration



shows in cross-section a cool running transformer. Note the spread ends, which are immersed in oil. They are largely responsible for the low running temperature of the

Type N Transformer

Manufactured by the

Westinghouse Electric & Mfg. Co.
Pittsburg, Pa.

Write to nearest sales office for circular 1060.

85E2

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X; Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

FORT WAYNE ELECTRIC WORKS

(INCORPORATED)

Type K Wattmeters

Are direct reading and will register accurately the energy of alternating-current circuits regardless of power factor. They are permanent in calibration and are easily adapted to either 60 or 133 cycle circuits.

Form SAC

Is the switchboard wattmeter, enclosed in a strong brass-bound dust-proof glass case. It is back-connected and is secured to the board from the back. Finishes—polished brass, nickel or oxidized brass.

TYPE K, FORM SAC

INTEGRATING WATTMETER FOR SWITCHBOARD USE.

LIST OF SALES OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 616 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 New St.

JUST OUT

NEW CATALOGUE OF

ELECTRICAL BOOKS.

You Ought to Have One. Sent Free on Request.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

A NEW PAPER-WEIGHT.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

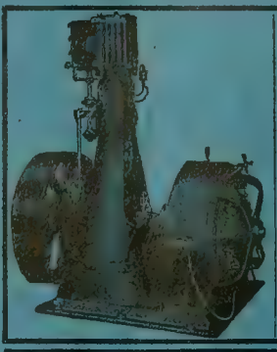
We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.
853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

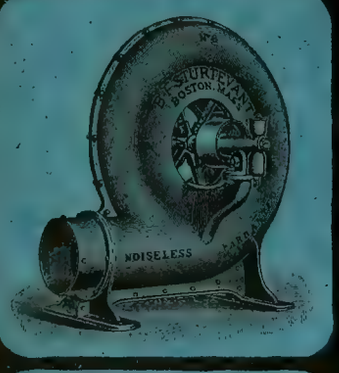
GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

STURTEVANT BLOWERS

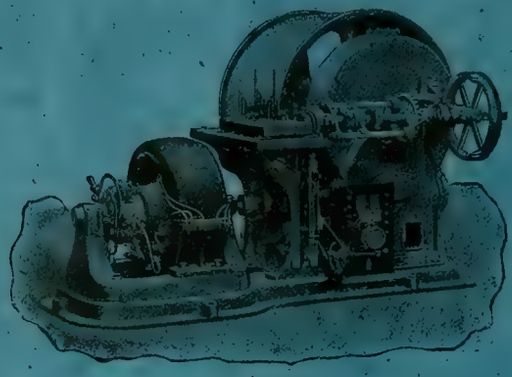


of every conceivable form for every conceivable purpose

B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK PHILADELPHIA CHICAGO
LONDON
175

ELECTRIC DRIVE

of a single tool or an entire shop means economy and convenience of operation.



Type D. Motor operating an elevator.

CROCKER-WHEELER COMPANY,

MANUFACTURERS AND ELECTRICAL ENGINEERS.

SALES OFFICES IN ALL LARGE CITIES.

Office and Works, - - - - AMPERE, N. J.

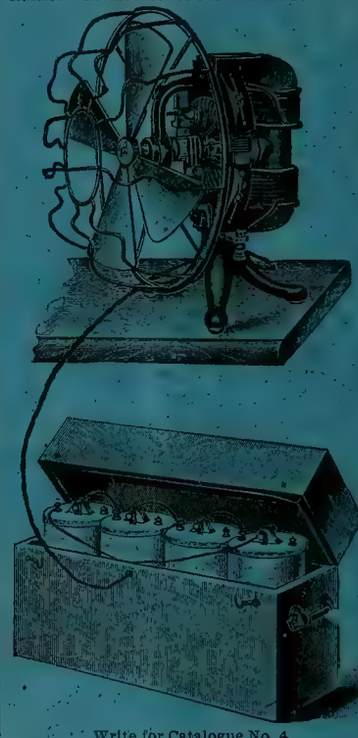
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

BUFFALO HIGH SPEED ENGINES

FOR ELECTRIC LIGHTING AND POWER SERVICE.

TYPES:

Horizontal,
Vertical,
Simple,
Compound,
Belted,
Direct Connected.

BUFFALO FORGE COMPANY,
BUFFALO, N. Y.
CHICAGO OFFICE, 22-24 RANDOLPH ST.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 9, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 6.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, M. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.

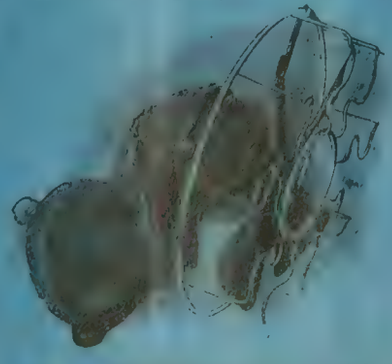
USED BY SIGNAL CORPS U. S. ARMY and ADOPTED AS THEIR STANDARD.
OUR TELEPHONES STAND EVERY TEST AND ARE ALWAYS SATISFACTORY. GIVE THEM A TRIAL AND BE CONVINCED. PARTICULARS FREE.
ERICSSON TELEPHONE CO., 296 BROADWAY, NEW YORK.

THE BEST VERMONT SLATE FOR Electrical Purposes.
It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Ammeter.
BERLIN—European Weston Electrical Instrument Co.
LONDON—Elliott Bros., 30 and 31 St. Martin's Lane.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in accuracy and lowest consumption of energy.
Mention the Western Electrician when writing for catalogue.

LUNDELL FANS

Superior in Design and Construction.
Cooling, Economical, Safe.
Catalogue No. 03304.
SPRAGUE ELECTRIC CO.,
GENERAL OFFICES: 527-531 WEST 34th STREET, NEW YORK

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. B. S. BARNARD, Vice President and Secretary.

STRIKE

THE IRON WHILE IT'S HOT

G. I. G. I.

AND WRITE FOR G. I. BULLETINS BEFORE YOU ORDER YOUR ARC LAMPS.

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

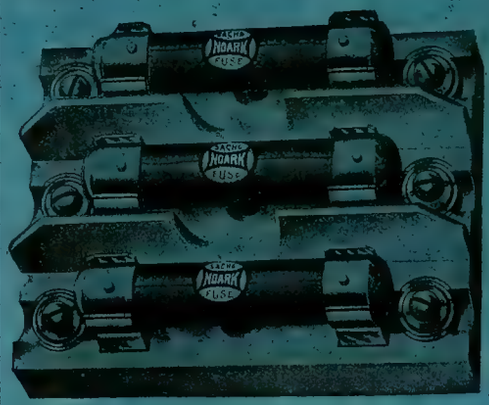
BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK, CHICAGO. TRENTON, N. J. CLEVELAND, SAN FRANCISCO.

SACH'S NOARK FUSES.



Ideal Protection
AGAINST
OVERLOAD AND SHORT CIRCUIT.

SAFETY AND ACCURACY ASSURED.

WRITE FOR PARTICULARS.

THE STANDARD ELECTRIC CO.,

113 W. 3rd St., CINCINNATI, OHIO.

ANTI-Doc

NO. SIX

A First-Class Medical Apparatus.

RETAIL PRICE, $2.50. SOLD BY ALL DEALERS.

MADE BY

MANHATTAN ELECTRICAL SUPPLY CO.,

32 Cortlandt Street, NEW YORK.
188 Fifth Avenue, CHICAGO.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" ***For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.***

The "Exide Accumulator" ***For Electric Vehicles.***

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 250 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: PHILADELPHIA, Allegheny Ave. & 19th St. NEW YORK, 100 Broadway. BOSTON, 60 State St. CHICAGO, Marquette Bld. BALTIMORE, Continental Trust Bld ST. LOUIS, Wainwright Bld. SAN FRANCISCO, Nevada Block. CLEVELAND, New England Bldg. DETROIT, Michigan Elec. Co. HAVANA, CUBA. F. G GREENWOOD, MGR. 34 Empedrado Street.

R 52

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago. Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

Federal Electric Co.
84 Market Street, CHICAGO, ILL.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 Pine St., ST. LOUIS, MO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Badt & Co., F. B.....10
Baird Manufacturing Co..... 9
Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg. Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Beidler & Co, Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 1
Bossert El. Construction Co..16
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co..—
Central Telephone & El. Co..—
Century Glass Co.....11
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R.....16
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co..—
Chicago Insulated Wire Co..—
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Colt, Henry A..... 4
Columbia Telephone Mfg.Co.13
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 7
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ...—
Dicke Tool Company.....16
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 4
Edwards & Company.....20
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 8
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company..... 2
General Incand. Lamp Co....—
Great Western Smelting & Refining Company... 12
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co... 8
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....17
Holmes Fibre Graph. Co..... 4
Hopkins & Co, A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....10, 15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 16

Machado & Roller.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co.. 2
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....14
Monon Railroad.....12
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....20
Munsell & Co., Eugene.....10

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 9
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed.....11
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17
Pratt Institute.....—

Rauscher, John 7
Reisinger, Hugo..... 7
Reliance Electric Company.. 7
Replogle Governor Works.. .—
Reynolds Electric Company. 6
R. I. Teleph. & Elec. Co.....20
Roebling's Sons Co., J. A..... 2
Rose Electric Company 12

St. Louis Elec. Supply Co ... 3
Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 12
Schott, W. H. 1
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 8
Spies Electric Company..... 1
Sprague Electric Company... 1
Standard Electric Company.. 2
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 2
Stanley Instrument Co..... 9
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....—
Streeter, A. L.....11
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F....20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co..... 4

Union Pacific R. R.... 8

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company....10
Vomacka & Mazenek .....—
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co..... 5
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst..10

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

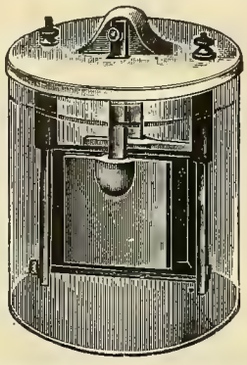
ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

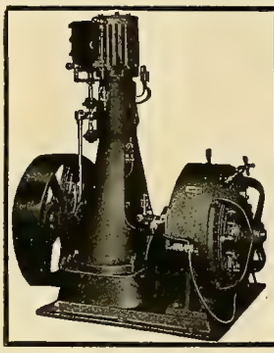
EDISON PRIMARY BATTERIES.
FORMERLY KNOWN AS EDISON-LALANDE.



FOR GAS ENGINES,
SLOT MACHINES,
AUTOMOBILES
RAILROAD SIGNALS,
CROSSING BELLS,
SMALL MOTORS,
ETC.

CONSTANT CURRENT
NO LOCAL ACTION.
WILL NOT FREEZE.
LIQUID TIGHT
CELLS FOR
PORTABLE
WORK.

FULL DESCRIPTION IN BOOKLET NO. 4.
EDISON MANUFACTURING COMPANY,
FACTORY, ORANGE, NEW JERSEY, U. S. A. NEW YORK OFFICE, 83 CHAMBERS STREET
CHICAGO OFFICE, 144 WABASH AVENUE.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

Don't Overlook a Good Thing.

I have something entirely new in motors. New principle, one-quarter to five horsepower. Direct and alternating current, any speed, any voltage, any frequency.

Half the Weight, Increased Efficiency,
Increased Durability, Perfect Ventilation,
Cost Less than any other Motor.

You had better drop me a line, and I will explain in detail, send cuts, etc.

HENRY A. COIT, Laclede Bldg., St. Louis.

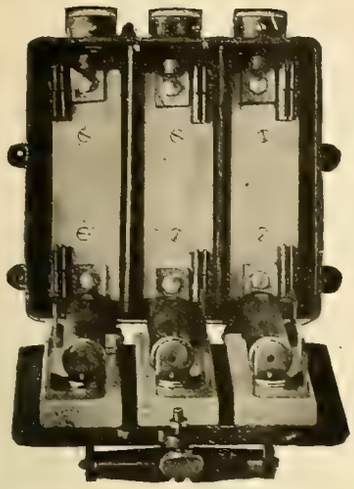
P. S.—Also something Startling and New in Electrical Specialties. Let me tell you about them.

NOW
IS THE TIME TO
SUBSCRIBE
TO THE
Western Electrician
WRITE FOR PARTICULARS.

FIBRE-GRAPHITE COMMUTATOR BRUSH
SELF-LUBRICATING NOISELESS

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than
HABIRSHAW.
Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.
The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
Sales Office,
15 Cortlandt St., New York.
YONKERS, N. Y.
(10928)



D. & W. SAFETY DEVICES

Cut-outs.
Subway Boxes of every variety.
Telephone, Burglar and Fire Alarm Cut-outs.
Service Boxes, two and three wire.

Junction Boxes.
Motor Cut outs.
Transformer Cut-outs.
Street Car Motor Cut-outs.
Street Car Heater Cut outs.

Service Switches, two and three wire.
Cut outs for your lightning system.
Feeder Block of any Capacity.

SEND FOR DESCRIPTIVE BULLETINS AND PRICES.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS,

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

THE GENERAL ELECTRIC COMPANY'S

FAN MOTORS FOR 1902.

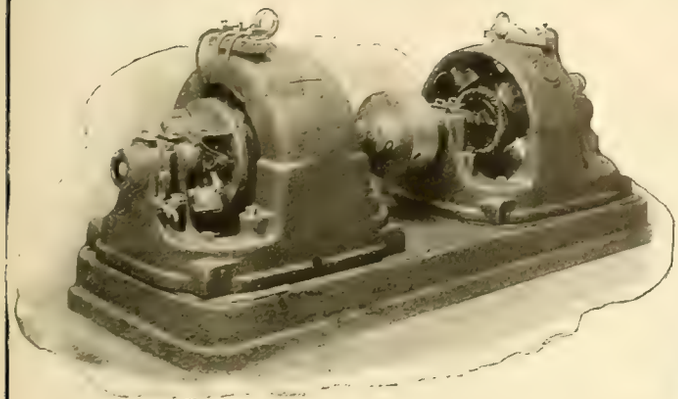
Now ready for Shipment.

Stock carried in the following cities:

Boston	New York	Chicago
Philadelphia	Cincinnati	Denver
Atlanta	New Orleans	San Francisco

GENERAL OFFICES: SCHENECTADY, N. Y.

AUTOMOBILE CHARGING OUTFIT



(4½-Kilowatts Capacity)

COMBINATION OF AN A. C. INDUCTION MOTOR AND A WAGNER D. C. GENERATOR.

The Alternate Current Motors are built to operate on 104-volt and 208-volt single-phase circuits with either 60 or 133 cycles, but can be operated also on two-phase or on three-phase circuits.

Motors can be wound for any voltage up to 500 and for any frequency desired.

It is important with these motors to specify accurately the frequency of the circuit when ordering, especially if considerable starting torque is required.

These are not synchronous motors, and **do not produce any appreciable variation or fluctuation in the voltage of the circuit upon which they are operated. They can be connected to the same mains as incandescent lamps, without affecting the latter.**

WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

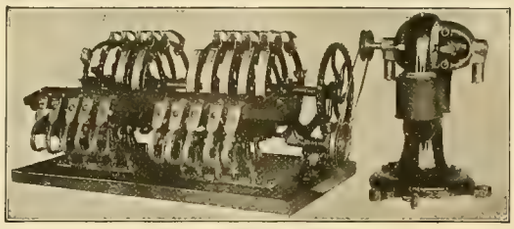
BUSINESS BRINGERS—MONEY MAKERS

For both YOU and YOUR Customers by Encouraging the Use of Our

ELECTRIC SIGN FLASHERS

You can increase the demand for Electric Current, Supplies and Construction Work, and open a NEW FIELD OF PROFIT.

The Most Simple and Only Practical Flasher in the World.



WE HAVE AN INTERESTING PROPOSITION FOR

Central Stations, Electrical Supply Houses and Contractors.

Patented Sept. 6, 1901.

Write us Now for Details. REYNOLDS ELECTRIC CO., Inc., 221 Fifth Avenue, - CHICAGO, ILL.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gauges, Battery.
Baird Mfg. Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS.
FOR DIRECT CURRENT.
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY, NEW YORK.

There are no Carbons better than the "Electra" and none "just as good."

THE BEST IS THE CHEAPEST

In the best there is more profit for Dealers and Contractors.

A Fine Push

MAKES ALL THE BELLS WORK NICE.

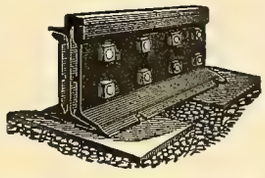
Write for Prices and Samples.

JOHN RAUSCHER, St. Paul, Minn.

CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building,
NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

NOW READY!!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1902.

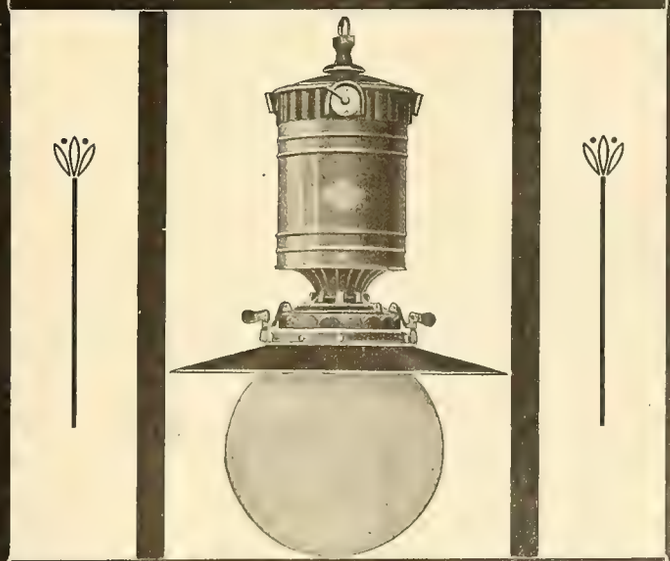
ARRANGED IN BOOK FORM, POCKET SIZE.

10 Cents per Copy. Send for It.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

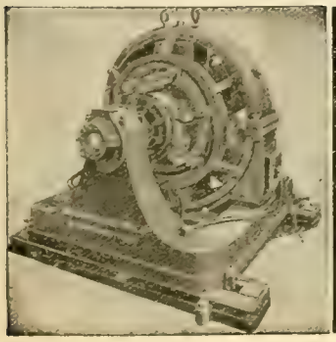
W. E. CO. ARC LAMPS DISPEL DARKNESS

WRITE FOR BULLETINS—7008—7010—7011.



WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK,
SAINT LOUIS, PHILADELPHIA.



"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

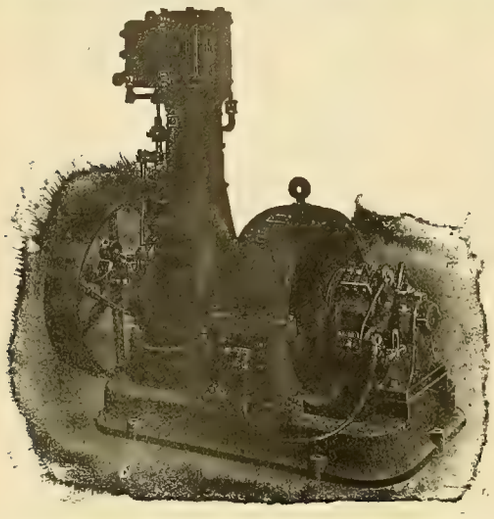
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

SCALE FORMATION PREVENTED by using **DEARBORN BOILER COMPOUNDS.** Made to suit the water as per analysis.

NEW BOILER COMPOUND FEEDER. WILL FEED ANY KIND OF COMPOUND. WRITE FOR PARTICULARS.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

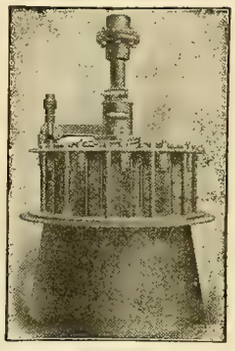
GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.



SAMSON TURBINE UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE
BETWEEN
CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.
THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.
IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.
GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

UNION PACIFIC THE OVERLAND ROUTE WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
. . TO . .
California
VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

GRAPHITE RESISTANCE.

Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

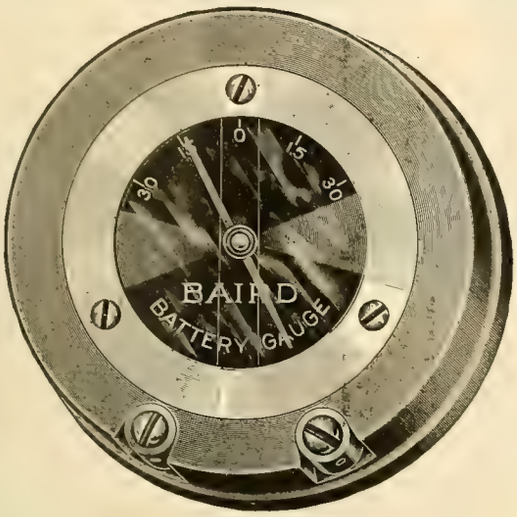
JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

THE BAIRD

$1.50 Battery Gauge.



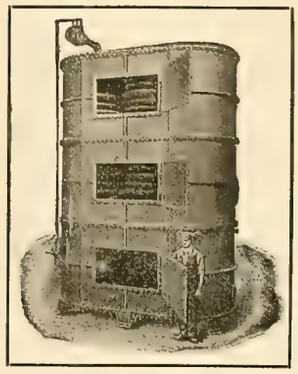
Above cut is full size. Weight, 4 oz.

CONVENIENT in size and shape and light weight to carry in pocket.
LONG INDICATOR NEEDLE giving large scale divisions.
SIMPLE AND DURABLE construction, involving only one moving part.
JEWELED in the most approved manner, giving a sensitive needle, equal to the best astatic galvanometers.
DAMPENED by a thick disc of pure copper, greatly reducing the oscillations of the needle.
BINDING POSTS are provided for the attachment of a cord with ordinary telephone tips, or a wire of No. 16 gauge or smaller.
SCALE is simple in the extreme, as only two points are marked upon it, viz.: the point to which the needle will be deflected by a single cell of dry battery in good condition, and the point to which the needle will be deflected by one cell of dry battery which may be considered as no longer fit for use.
DOUBLE SCALE, making it immaterial which poles of the battery be connected to the battery gauge, as the needle may be read with a deflection either way.
NEEDLE LOCK prevents injury to moving parts when the gauge is carried in the pocket.
SATISFACTION GUARANTEED or money refunded.

Price, $1.50. Subject to discount for quantities.

BAIRD MANUFACTURING CO.,
187 Ontario Street, CHICAGO.

When You Save Steam,



You Economize in Fuel, and

ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

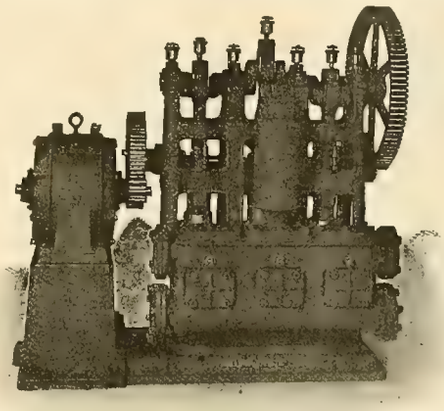
It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,

Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.



IF INTERESTED ADDRESS

The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Grimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

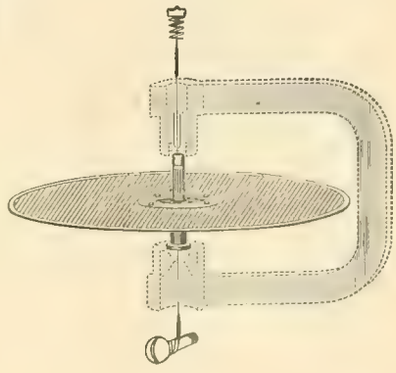
ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR **ALTERNATING CURRENT**
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. **NO LOST REVENUE.**
NO FRICTION. **ALL CURRENT USED RECORDED.**

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

SALES OFFICE, 158 BROADWAY, NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS, JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

THE PACKARD
MULTIPLE BURNING
SIGN LAMPS.

Designed especially for sign and decorative purposes.
Light concentrated in dome of bulb.
Range of voltage 45 to 130. Fitted with any of the standard bases.
Burns in multiple on regular lighting circuits.
Standard eight-candle power bulb. 4 or 8 candle filament.
Four-candle power consumes only 16 watts.
Eight-candle power consumes only 30 watts.
All bases porcelain insulated and attached with waterproof cement.
Furnished in natural or artificial colors, full or one-half frosted.
Price same as the regular 16 c. p. lamp.

ELECTRIC APPLIANCE CO.,
92 West Van Buren Street,
CHICAGO, ILL.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

INDIA MICA

We import directly from India and handle the output of the best mines. A large stock constantly on hand enables us to make prompt shipments. ALL OTHER QUALITIES. Prices low.

EUGENE MUNSELL & COMPANY,
NEW YORK AND CHICAGO.

ARC LAMPS

ARC LAMPS

39 CORTLANDT ST.

Arc Lamps, Like Steamships,

should be so built that *all* repairs may be made without going into port.

Toerring Arc Lamps are so made that *any and all* repairs may be made without taking the lamp from its hook. And you need not bother about any repairs until such a time when many other lamps would be past the possibility of repair.

CORRESPONDENCE WELCOMED.

19TH & ALLEGHENY AVE.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

ARE YOU CONSIDERING
An X Ray Installation?
IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.
CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1808-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street, CHICAGO.

BEARDSLEE CHANDELIER M'F'G CO.
256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

RESIN SOLDER
IN ANY QUANTITIES.
WRITE FOR PRICES.
KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St.
CHICAGO.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.

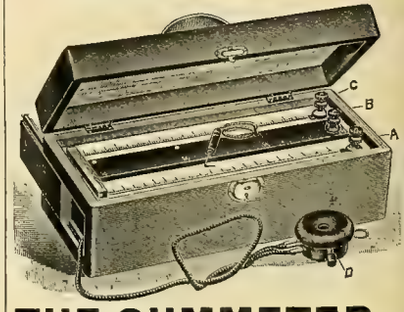
TRANSFORMERS.
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

THE WORCESTER POLYTECHNIC INSTITUTE
EDMUND A. ENGLER, Ph.D., LL.D., President.
Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address
J. K. MARSHALL, Registrar, Worcester, Mass.

"YOU PRESS THE BUTTON,

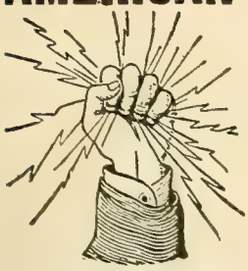


THE OHMMETER DOES THE REST."
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to
ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENBEIL, Treasurer. O. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.

3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50,$6,$8.50. Complete $12.50. Write for circular 16.

PARSELL & WEED,
129-131 W 31st Street, New York

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

STREETER SPRING MOTOR FANS

173-75-77 SOUTH CLINTON STREET, CHICAGO.

FAN MOTORS FOR GENERAL USE.

No Batteries. No Electric Current. No Wiring. Can Be Set Any Place. Wind it up in 25 seconds, runs 1¼ hours.

FIRST COST THE LAST.
No expense whatever to maintain.

EASY TO WIND.

Standard 12-inch Fan, 1,000 revolutions per minute. Throws a cool, refreshing breeze 20 feet. No hot, stuffy rooms if you use this fan. Children can handle this Fan with perfect safety.

WRITE FOR CIRCULAR.

BOOKS.

BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

7"

CENTURY
WESTERN ELECTRIC COMPANY
STYLE "M."

18"

WE CAN PLEASE YOU IN THE LINE OF

ELECTRICAL GLASSWARE

and are Prepared to Furnish you with Globes or Shades for all Types of Lamps.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

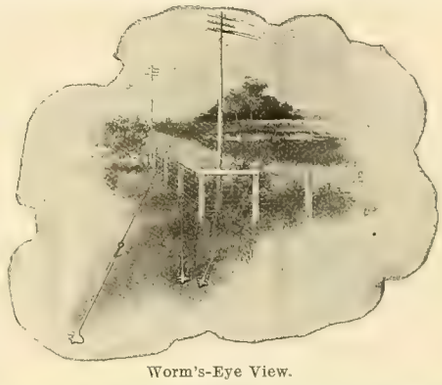
The breaking strain of a ⅜ strand is
5,000 lbs.
It requires a strain of over
8,000 lbs.
to pull out a 5-inch

STOMBAUGH GUY ANCHOR

When bored 4 feet in the ground.
The time required is about 5 minutes, and the cost 69 cents.

Write us for Information. We like to be asked questions.

W. N. MATTHEWS & BRO.,
603 CARLETON BLDG.
St. Louis.



Worm's-Eye View.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. C. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

General manager, plant 1,800 'phones. Large experience necessary. Must have first-class business qualifications. E. H. STAFFORD, 18 Van Buren St., Chicago, Ill.

WANTED.

A first-class armature winder capable of doing electrical repair work of all kinds and take charge of shop. Address BOX 101, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A traveling telephone salesman to sell a staple article to electric light companies as a side line. No samples required. Good commission. Address BOX 97, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

200-K. W., 250-Volt, Direct-connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Position by young man of 24, as manager or electrician of a telephone exchange of 100 to 500 phones; prefer one which is building or just completed. Technical education. References furnished. Address with particulars, BOX 100, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Electricians and mechanics to increase their income by congenial work in moments of leisure. The work requires so little time that you can do it whether you are employed or not. There is no expense whatever to be incurred by you. Write for full information, addressing BOX 99, care Western Electrician, 510 Marquette Building, Chicago.

POSITIONS OPEN.

	PER MONTH.
3 Draftsmen, Architectural.....	$125
2 Draftsmen, Structural Steel.....	125
9 Draftsmen, Electrical	$70 up
1 Draftsman, Mechanical, especially good on designing screw machinery	

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,

No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

Western Electrician

WANT ADS

Bring Results.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

1—120 K. W. Westinghouse -	250 volt M. P.
1—125 K. W. Thompson-Ryan -	250 volt M. P.
1— 62 K. W. T.-H. 250 volt self-oiler.	
1— 55 K. W. Fuller - - - - -	250 volt M. P.
1—100 K. W. General Electric	500 volt M. P.
2— 90 K. W. General Electric -	500 volt M. P.
1— 62 K. W. T. H. D 62 - -	500 volt M. P.
1—100 K. W. General Electric -	125 volt M. P.
1—100 K. W. Triumph - - -	125 volt M. P.
1— 80 K. W. Keystone - - -	125 volt M. P.
1— 65 K. W. Jantz & Leist -	125 volt M. P.

Large stock of alternators.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Fan motors for 100 and 104 volts, 16,000 alternations, in good running condition:

3 General Electric, 10-inch fans
2 General Electric, 12-inch fans.
3 Westinghouse . 12-inch fans.
4 Emerson . . . 12-inch fans.
3 Emerson . . . 15-inch fans.
5 Dayton . . . 16-inch fans.
3 Motors, incomplete, will consider offer.
2 Tuerk two-blade Ceiling Fans. for 14-ft. ceilings. Watt-Meters for 100 volts, 125 cycles. All in excellent running order. 50 Duncan 5 and 10 amperes. Send $5 each for the 10 and 12-inch fans; $6 each for the 15 and 16-inch; $12.50 each for the ceiling fans, and $6 each for the watt-meters. Add 50 cents to each order to cover packing and cartage. Also nearly complete list of apparatus suitable for a 37½ K. W. 16,000 A. C. plant. Excellent opportunity for cheap plant, or will sell separately.

JOHN HAY KUHNS,
419 First National Bank Building, Omaha, Neb.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

I CAN SELL

Your Electric Light, Gas, Water, or Telephone Plant, no matter where it is. Send description and cash price and learn how. I have or can find the plant you want to buy. Tell me your requirements. A. M. BARRON, Desk F, South Bend, Ind.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.

One large Switchboard and Instruments.

Brown Engine—One 18x48 C. H. Brown.

All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

CORLISS ENGINE.

For Sale—125-H. P. Hamilton Corliss, 14x36 F. O. B. Hamilton, Ohio., $1,000.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.

ENGINE	40x72 inches, George H. Corliss.
"	38x72 inches, George H. Corliss.
"	32x44x60 inches, Allis Blowing.
"	28x48 inches, Allis Blooming Mill.
"	20x48 inches, Watts Campbell.
"	20x36x36 ins., MacIntosh & Seymour Compound.
"	17x30 inches, Buckeye Automatic.
"	14x24 inches, Buckeye Automatic.
PUMP	16x30x14x24 ins., Deane Com. Duplex.
"	16x2¾x10 inches, Worthington Hydraulic Duplex.
"	12x8x12 inches Smith-Vaile Duplex.
"	10x5x10 inches, Hall Duplex.
"	20x9x14 inches, Blake Single.
"	16x10½x18 inches, Hughes Single.
"	12x7x10 ins., Cope & Maxwell Single.
"	10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.

45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

NOTICE TO CONTRACTORS.

Notice is hereby given that the City of Washington, Iowa, will erect a municipal electric lighting plant.

Sealed bids for the erection of said plant will be received by the City Clerk until noon of the 26th day of August, A. D. 1902, which date is set for the opening and canvassing of bids. The City Council of said City reserves the right to reject any and all bids. Plans and specifications may be had by bidders for said plant by application to Prof. G. W. Bissell, M. E., of Ames, Iowa, or Hugh H. McCleery, City Clerk, of Washington, Iowa.

All bids must comply with plans and specifications. Bids will be received on different sections, or on the entire plant. HUGH H. MCCLEERY, City Clerk.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,

140 S. Clinton St., Chicago.

A. C. SCHOONMAKER CO.

126A Liberty Street, New York City,

DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1	20x18½ Harrisburg Ideal Engine.
1	14x13 Armington & Sims Engine.
1	16x16 Erie Ball Engine.
1	15x15 Erie Ball Engine.
1	12x12 Erie Ball Engine.
2	120-kw G. E. single phase Alternators.
1	100-kw Card M. P. 500-volt Generator.
1	200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.	
2	60-kw G. E. Transformers.
497	Improved M. G. E. Arc Lamps.
2	15 hp M. P. 500-volt Motors.
2	10-hp M. P. 500-volt Motors.
2	8 hp M. P. 500-volt Motors.
2	5-hp M. P. 500-volt Motors.
3	3-hp M. P. 500 volt Motors.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	48x16 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	36x8 Horizontal Tubular.
5	60x16 Horizontal Tubular.	1	54x8 Vertical Tubular.
			Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,

E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

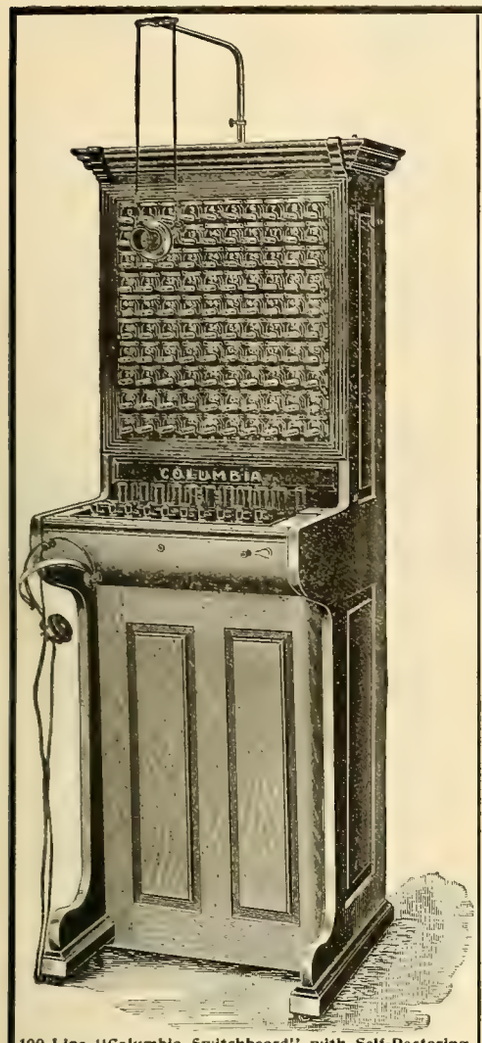
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1,200	lines	and	telephones
Ennis, Tex., . .	"	"	1,200	"	"
Norwalk, Ohio, .	"	"	2,400	"	"
Frankfort, Mich.,	"	"	250	"	"
Dundee, Mich., .	"	"	200	"	"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS. Equipped with superior solid back transmitters, non-packing and practically indestructible.

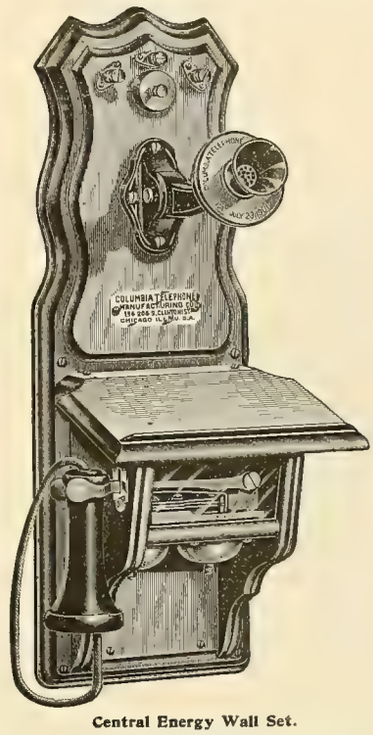
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

THE LATEST BOOK.

"ELECTRIC LIGHTING,"

A PRACTICAL EXPOSITION OF THE ART FOR THE USE OF

Engineers, Students and Others Interested in the Installation or Operation of Electrical Plants.

BY FRANCIS B. CROCKER,

Professor of Electrical Engineering, Columbia University, New York.

Price $3, Prepaid. - Practical and Up-to-Date.

Just the Book you want. 450 Pages, over 150 Illustrations. Read the

TABLE OF CONTENTS:

Chapter I, Introduction; Chapter II, History of Electric Lighting; Chapter III, General Units and Measures; Chapter IV, Classification and Selection of Electric Lighting System; Chapter V, The Location and General Arrangement of Electric Lighting Plants; Chapter VI, Buildings for Electric Lighting Plants; Chapter VII, Possible Sources of Electrical Energy; Chapter VIII, The Steam Engine, History and General Principles; Chapter IX, Steam Boilers for Electric Lighting; Chapter X, Steam Engines for Electric Lighting, General Construction; Chapter XI, Typical Forms of Steam Engine for Electric Lighting; Chapter XII, Steam Engines for Electric Lighting, Selection, Installation and Management; Chapter XIII, Gas, Oil and Hot Air Engines; Chapter XIV, Water Wheels and Windmills; Chapter XV, Mechanical Connections between Engines and Dynamos, Direct Coupling, Belting and Shafting; Chapter XVI, Toothed, Friction and Other Gearing; Chapter XVII, Principles, Construction and Management; Chapter XXI, Applications of Accumulators in Electric Lighting; Chapter XXII, Switchboards, Including Switches, Fuses and Circuit-Breakers; Chapter XXIII, Electrical Measuring Instruments; Chapter XXIV, Lightning Arresters.

Every Engineer and Electrician who desires to thoroughly master the Art of Electric Lighting should have a copy of this book. Sent promptly.

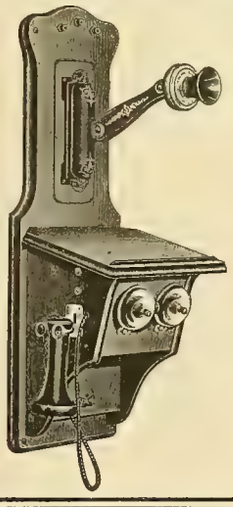
ELECTRICIAN PUBLISHING COMPANY, Suite 510 Marquette Building, CHICAGO.

FREE!

OUR PRESCRIPTION FOR TELEPHONE TROUBLES.

℞

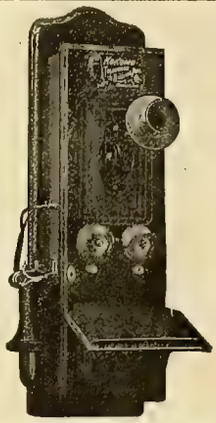
1 Sterling Common Battery Switchboard.
(Lamp Signal Multiple.)
1 Complete Power Plant.
1 Sterling Distributing Board and Protection.
New Sterling Telephones. (Quantity sufficient.)
Install and use with ordinary care 24 hours every day.



WE GUARANTEE THE ABOVE TO CURE ANY CASE—NO MATTER OF HOW LONG STANDING.

STERLING ELECTRIC COMPANY,

LAFAYETTE, - - IND.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

CONTINENTAL TELEPHONE CONSTRUCTION CO.

GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.

TACOMA BLDG., CHICAGO.

Kilfyre

DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance

Electrician Publishing Co.,

Suite 510 Marquette Bldg., - CHICAGO

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger

for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.

No. 1. Light, 1¾ x ⅜ in.
No. 2. Medium, 1¾ x ½ in.
No. 3. Heavy, 2 x ½ in.

Nos. 2 and 3 always in stock.

DEAD END HANGER.
Forged steel. Galvanized

Patented Galvanized Steel Cable Hanger.

Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties and up-to-date. Tell us what you want.

Corner Brackets, Guy Shims, and Special Forgings made to order.

In place on cable.

3-Bolt Guy Clamp.

Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ⅝-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.

CHAPTER 13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.

CHAPTER 28. Metallic Circuit.
29. Underground Wires.
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
42. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

Published and for sale by **ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago**

Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. ...Prices Right.

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

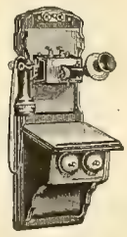
EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

THAT FINISHED APPEARANCE

Characteristic of Kellogg Apparatus is a

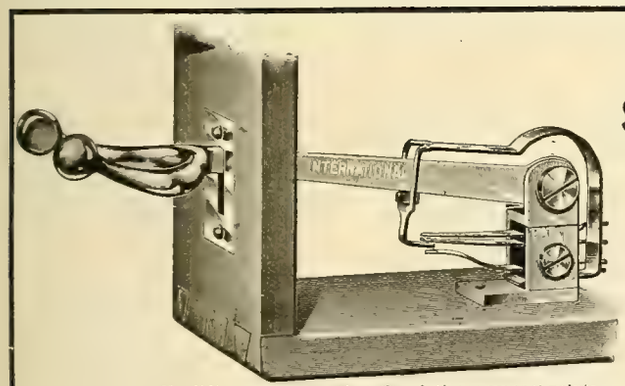
TRANSMITTERS ABSOLUTELY UNIFORM AND GUARANTEED

BETTER THAN THE "BELL SOLID BACK."

Mark of Superiority.

WRITE FOR NEW GEN'L CATALOG.

KELLOGG SWITCHBOARD & SUPPLY CO.,
229 So. GREEN ST., CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

REMOVAL NOTICE.

Owing to the increased demand for our Party Line Apparatus, we have found it necessary to seek larger quarters, and have moved to 610 Wilson Ave.

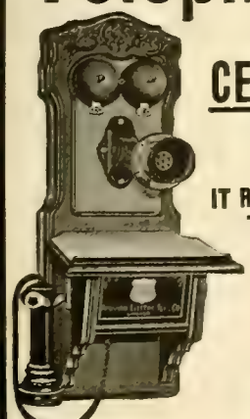
Write for descriptive matter of the

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING APPARATUS.

Metropolitan Telephone and Electric Co.

CHICAGO.

Telephone Troubles



ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

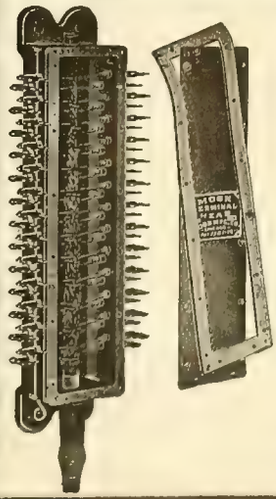
Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

No. 34 Central Energy Telephone.



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

M. KLEIN & SON

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Building, - CHICAGO.

Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ½ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,

510 Marquette Building, CHICAGO.

AWARDED HIGHEST MEDAL ON TOOLS AT PARIS EXPOSITION OF 1900.

ASK FOR THIS

AWARDED HIGHEST MEDAL ON TOOLS AT PAN-AMERICAN EXPOSITION

THE DICKE TOOL COMPANY,

FACTORY: DOWNER'S GROVE, ILL.
Eastern Office: J. E. Way, Manager, 39 Cortlandt Street, New York.
Times Building, Chicago.
St. Louis Office: W. N. Matthews & Bro., 320 N. 6th Street.

A GLIMPSE AT OUR **WESTERN STOCK**

1,700	pieces	40	feet, 7-inch	tops
1,700	"	40	" 8	"
1,750	"	45	" 7	"
1,250	"	45	" 8	"
1,750	"	50	" 7	"
750	"	50	" 8	"
3,000	"	55	" 7	"
750	"	55	" 8	"
750	"	60	" 7	"
300	"	60	" 8	"
250	"	65	" 8	"
200	"	70	" 8	"

Our Prices Will Interest You.

POLES

30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR **TROLLEY LINE CONSTRUCTION** ALWAYS IN STOCK.

YARDS:

MENOMINEE,	MICH.
ESCANABA,	MICH.
NADEAU,	MICH.
CLOQUET,	MINN.
HERON,	MONT.
CABINET,	IDAHO.

OUR ADDRESS:

FRANCIS BEIDLER & CO.

W. 22d and Loomis Sts, CHICAGO, ILL.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

GASOLINE MOTORS

—FOR—

BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO.,

NORTH CHELMSFORD, MASS.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

When in search of a position advertise in the WESTERN ELECTRICIAN.

AS SIMPLE AS ITS NAME.

A B C

—OF—

THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,

510 Marquette Building, Chicago, Ill.

Western Electrician WANT ADS Bring Results.

ARE YOU LOOKING FOR TROUBLE?

IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM

—IN—

BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

8th Edition Just Out. Price, 25c.

Electrician Publishing Co.,

510 Marquette Building, CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20 foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

John H. Fowler — CEDAR POLES POSTS, SHINGLES & TIES — 1703-7 FISHER BLDG. CHICAGO.

Write Us

If you want **CEDAR POLES** POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES.
SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

THE HOLCOMB-LOBB COMPANY
CEDAR POLES & POSTS
745 MARQUETTE BLDG. CHICAGO ILL.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

CEDAR POLES LONG DISTANCE 'PHONE — WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO SOLS DAGGETT MICH.

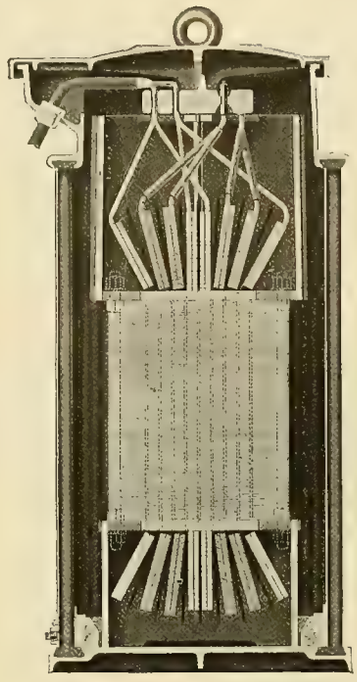
OCTAGONAL AND SQUARE PINE POLES
FOR ELECTRIC RAILWAY AND ELECTRIC LIGHT CONSTRUCTION.
We keep standard sizes in stock in our Southern stock yards, and can cut special sizes at short notice.
THE STANDARD POLE & TIE CO., - 44 Broad St., New York City.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

CEDAR POLES
THE VALENTINE-CLARK CO.
234 LA SALLE ST., CHICAGO.
YARDS: ANCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

A FEW FACTS ABOUT TRANSFORMERS



Low Running Temperature

A transformer with high running temperature is apt to burn out at any time, especially under overload. It cannot last. Its insulation soon becomes dry and brittle, breaks down and the transformer life ends. While the insulation is deteriorating, the iron is also aging, and core losses, like an increasing interest charge, eat into the profits of the company. This is particularly true in lighting service.

Of the features contributing to low running temperature, the most potent is the spread coil, a feature characteristic of the Westinghouse transformer. The illustration shows a Westinghouse transformer with its spread coils and gives also an idea of other elements which promote cool running; the large mass of exposed iron, the bath of oil, and the corrugated case. All these are common to both the

O. D. Transformer

and the

Type N Transformer

Manufactured by the

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

For Transformer Booklets, Address Nearest Sales Office.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated. Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

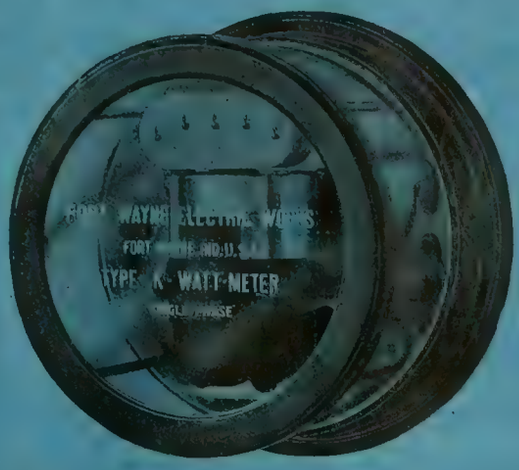
ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

FORT WAYNE ELECTRIC WORKS

(INCORPORATED)

Type K Wattmeters

Are direct reading and will register accurately the energy of alternating-current circuits regardless of power factor. They are permanent in calibration and are easily adapted to either 60 or 133 cycle circuits.



Form SAC

Is the switchboard wattmeter, enclosed in a strong brass-bound dust-proof glass case. It is back-connected and is secured to the board from the back. Finishes—polished brass, nickel or oxidized brass.

TYPE K, FORM SAC

INTEGRATING WATTMETER FOR SWITCHBOARD USE.

LIST OF SALES OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 616 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 New St.

Electric Lighting Plants,

THEIR COST AND OPERATION.

By W. J. Buckley. With numerous illustrations, diagrams, plans, tables, etc. 275 pages. Cloth. Price, $2.00, postage free. This work gives all necessary data for the erection of an electric light plant of any size. The cost of Arc Lighting. The cost of Incandescent Lighting.

READ THE TABLE OF CONTENTS:

Alternating Arc Lamps, Arc Plants, Belting, Boilers, Boiler Settings, Boiler Efficiencies, Books, Building, Cost of Arc Dynamos and Lamps, Cost of Arc Plants Erected, Cost of Alternating Dynamos, Cost of Alternating Plants Erected, Cost of Belts, Cost of Boilers, Cost of Brick Chimneys, Cost of Copper for Alternating Circuit, Cost of Corliss Engines, Cost of Compound Corliss Engines, Cost of Compound High Speed Engines, Cost of Condensers, Cost of Friction Clutch Pulleys, Cost of Heaters, Cost of High Speed Engines, Cost of Incandescent Dynamos, Cost of Idlers, Cost of Injectors, Cost of Meters, Cost of Motors, Cost of Operating Lamps per hour, Cost of Power Generators, Cost of Poles, Cost of Plain Pulleys, Cost of Pillow Blocks, Cost of Pumps, Cost of Shafting, Cost of Shaft Couplings, Cost of Stacks—iron, Cost of Stacks—brick, Cost of Steam, Cost of Transformers, Cost of Wire, Chimneys, Circuit Loss, Contract Blanks, Current Distribution, Circuits—overhead, Circular Mils of Wire, Depreciation, Direct Connected Apparatus, Dynamos, Dynamo Data, Economy of Condensing, Economy of Covering Steam Pipes, Economy of Heater, Efficiency of Engines, Engines, Equivalent of Current in Horse Power, Equivalent Rates of Lighting, Fuel, Horse Power of Belting, Horse Power of Motors, Horse Power of Shafting, Incandescent Arc Lamps, Instruments, Instructions for Employes, Insulation, Labor, Load Chart, Meter Connections, Municipal Ownership, Natural Gas, N.E.L.A. Standard Rules, Oil, Outcome of Practical Management, Pole Line, Pulleys, Rope Transmission, Resistance of Wire, Rules—Fire Underwriters, Report Com. on Data N. E. L. A., Reports of Cities Owning Plant, Reports of Cities Contracting, Stock Room, Shafting, Transformers, Transformer Curves, Wiring Tables—Primary Wiring, Wiring Tables—Secondary Wiring, Wiring Tables, Motor Wiring, Wire, Wire Formula, Water Power, Wood as Fuel. The only book of its kind in the English Language. **Price, $2.00.**

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette Building, Chicago.

Wright Cable Hanger.

SEND FOR SAMPLES AND PRICES.

R. I. TELEPHONE & ELECTRIC CO.,
PROVIDENCE, R. I.

Mention this paper

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER COVERED, WEATHERPROOF **WIRES AND CABLES.**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 60 Dey St CHICAGO OFFICE, 1201-2 Marquette Bldg

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

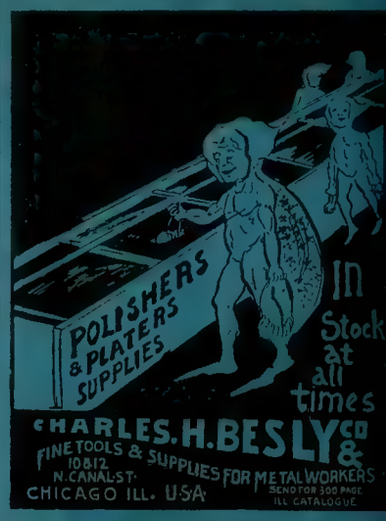
KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.



STURTEVANT ELECTRIC FANS

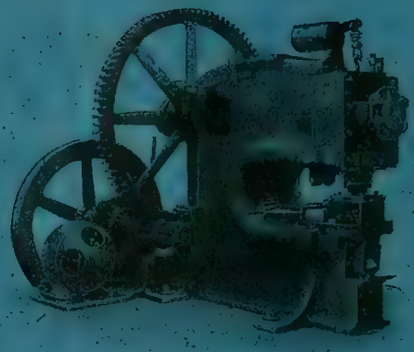
In 100 types and sizes Special designs for requirements ☞ We build both fan and motor ☜

B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK · PHILADELPHIA · CHICAGO
LONDON
172

3 POINTS OF SUPERIORITY

...IN...

CROCKER-WHEELER
GENERATORS AND MOTORS.



The best in electrical and mechanical **DESIGN** combined with proper **CONSTRUCTION** mean a high efficiency and steadiness in **OPERATION.**

SALES OFFICES IN ALL LARGE CITIES.

OFFICE AND WORKS: **AMPERE, N. J.**

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

EDWARDS AND CO.

DOOR SWITCH
(The Lungen).

Porcelain Insulation.
Wire Connections in Front.

Style A—Lights when door is open; out when door is closed.

Style B—Lights when door is closed; out when door is open.

THE ECONOMY SWITCH OPERATES LIGHTS "EVERY OTHER TIME."

Approved by the National Board of Underwriters.

NEW YORK N.Y.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

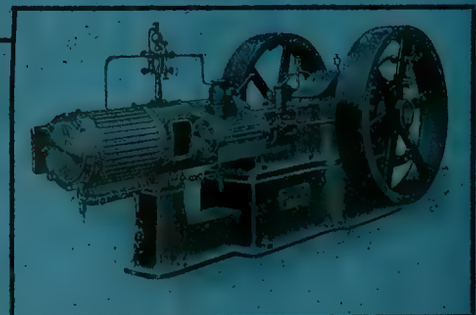
TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO
HIGH SPEED
ENGINES
FOR
ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 16, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 7.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT. M. R. HIXSON. 1137 Monadnock Block, CHICAGO.

Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT. HEADQUARTERS FOR ELECTRIC LIGHT LINE WIRE.

Chicago Insulated Wire Co. 152-158 LAKE ST.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, M. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 93 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

INDIANA RUBBER AND INSULATED WIRE CO.,

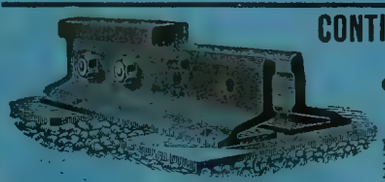
MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER TEN THOUSAND (10,000) MILES IN USE.

Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,

THE AKRON SMOKING PIPE CO., MOGADORE, OHIO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR.

Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.

1220-21 Marquette Building, CHICAGO.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

ERICSSON—Best. There are none "just as good". Made for over twenty-five years. Strictly guaranteed in every way. We have telephones of all kinds, for all purposes and for all kinds of people. Our telephones

ERICSSON

are used in every part of the world. Are always satisfactory. We have proven this to lots of people. Let us prove it to you.

ERICSSON TELEPHONE CO., 296 BROADWAY, NEW YORK CITY.

LIGHT

If you want light to see objects below the lamp

USE SHELBY LAMPS.

16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.

THE COIL DOES IT—IT'S FLATTENED.

LIFE

The Longest Life at Best Efficiency.

SHELBY USEFUL LIGHT LAMPS.

Pat. Oct. 20, 1900.

A TRIAL WILL PROVE OUR CLAIMS.

THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Voltmeter. Type F.

We desire to call attention to a line of cheap but excellent Switchboard Instruments for Direct Current Circuits, which we designate as

"Round Pattern," Type F.

These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

Mention the WESTERN ELECTRICIAN when writing for catalogues.

Bug-Proof Bell. Segerdahl Patent.

Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.

Write for our free Illustrated Book, "Can I Become an Electrical Engineer."

We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.

Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

ESTABLISHED 1870.

COMBINATION OF

Stow Flexible Shaft

AND

MULTI-SPEED MOTOR.

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

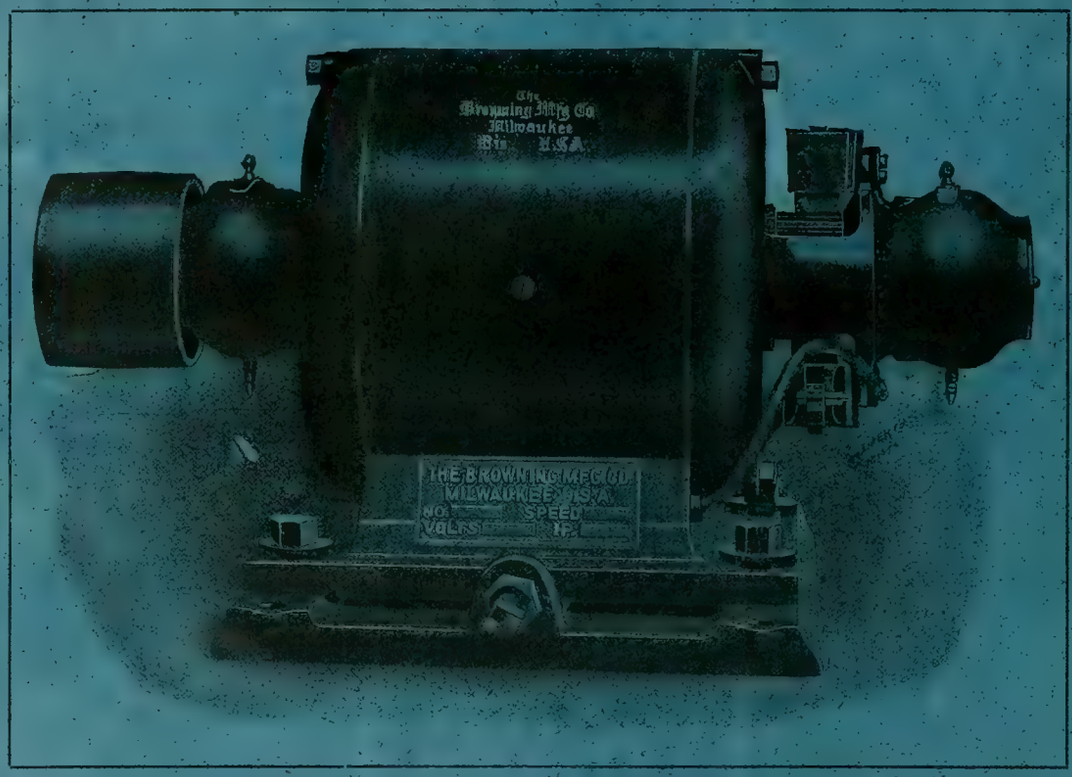
"WESCO." "WESCO."

Browning Small Generators and Motors

FOR

Direct Current Lighting and Power

We carry a very complete line in stock, and can ship promptly.



Made in sizes. Motors 1/40 to 10 H. P. Generators 1/4 to 8 1/2 K. W.

Made of the very best material, and all parts interchangeable. We guarantee this apparatus to be electrically and mechanically perfect.

WESTERN ELECTRICAL SUPPLY CO.

ST. LOUIS, U. S. A.

Descriptive Matter and Prices Upon Application.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" ***For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.***

The "Exide Accumulator" ***For Electric Vehicles.***

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 250 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: Philadelphia, Allegheny Ave. & 19th St. New York, 100 Broadway. Boston, 60 State St. Chicago, Marquette Bld. Baltimore, Continental Trust Bld St. Louis, Wainwright Bld. San Francisco, Nevada Block. Cleveland, New England Bldg. Detroit, Michigan Elec. Co. Havana, Cuba. F. G Greenwood Mgr. 34 Empedrado Street.

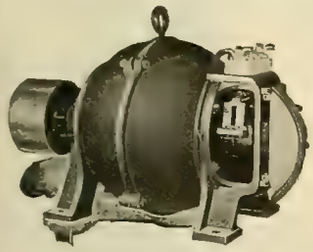
B 52

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES: 527 W. 34th St., New York.

CHICAGO OFFICE: Fisher Building.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 Pine St., ST. LOUIS, MO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS. PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS. We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co..... 1
American Battery Co.....12
American District Steam Co. 11
Amer. Electrical Heater Co..12
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....10

Badt & Co., F. B..... 10
Baird Manufacturing Co.....—
Baker & Company..... 3
Barlo Vacuum Co..... 10
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.—
Beardsley Gravity Dam & Construction Co..... 7
Beidler & Co, Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 20
Bossert El. Construction Co..20
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co.....5
Central Manufacturing Co...17
Central Telephone & El. Co..14
Century Glass Co..... 7
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R.....16
Chicago Edison Company..4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Colt, Henry A..... —
Columbia Telephone Mfg.Co.—
Continental Tel. Const. Co.. 14
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company 1

D. & W. Fuse Company 4
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company.... 5
Dicke Tool Company.....—
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....20
Edwards & Company..... 7
Electrical Engineer Institute. 1
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co.....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company..... 9
General Incand. Lamp Co....—
Great Western Smelting & Refining Company... ....—
Gregory Electric Company...12

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....—
Holmes Fibre-Graph. Co.....—
Hopkins & Co, A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company..... 15, 17
Klein & Son, Mathias.....16
Kohler Brothers..... 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....16
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller..... 7
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...14
Mica Insulator Company.....—
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad..... 12
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 7
Munsell & Co., Eugene.....10

National India Rubber Co....—
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 9
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed.....11
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17
Pratt Institute.....13

Rauscher, John .....—
Reisinger, Hugo.....—
Reliance Electric Company.. 7
Replogle Governor Works.. .—
Reynolds Electric Company.—
R. I. Teleph. & Elec. Co.....—
Roebling's Sons Co., J. A..... 7
Rose Electric Company 12

St. Louis Elec. Supply Co.... 3
Sargent & Lundy.....—
Sawyer-Man Elec. Company.18
Schoonmaker Co., A. G .....—
Schott, W. H. 1
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 8
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Electric Company.. 4
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co..—
Standard Varnish Works 4
Standard Vitrified Cond. Co. 2
Stanley Instrument Co..... 9
Sterling & Son, W. C.....17
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company..... 1
Streeter, A. L.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Telephone Green Bk. Pb. Co. 13
Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co..... 4

Union Pacific R. R..... 8

Valentine-Clark Co., The....—
Varley Duplex Magnet Co....14
Vindex Electric Company....—
Vomacka & Mazenek 4
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
West Shore Route..... 7
Western Electric Company... 7
Western El. Supply Co..... 2
Westinghouse Electric & Manufacturing Company..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G..... 4
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst..10

For Classified Index of Advertisements See Page 6.

Better than ever and a little the best of any on the market today—

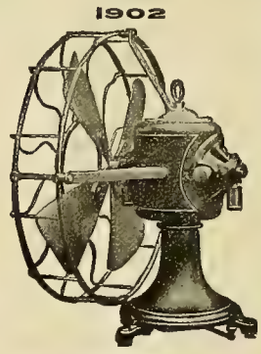
1902 PARAGON 1902

NOISELESS **FAN MOTORS** COMPACT

ALL STYLES AND SIZES EASY RUNNING RIGID CONSTRUCTION

—CALL AND SEE THEM OR WRITE FOR PRICES—

CHICAGO EDISON COMPANY, 139 ADAMS ST., CHICAGO.



PARAGON DESK FAN

SOLDERING SALTS.

VOMACKA & MAZANEK,

MANUFACTURERS OF

Tested Fuse Links, Fuse Wire and Specialties.

434-436 EAST 71ST STREET, NEW YORK CITY.

TEST INSTRUMENTS.

Portable Sets for Resistance, Faults, Etc.

Portable Sets for Insulation and Capacity.

Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.

11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.

We control patents and are sole makers of the

Caldwell Liquid Interrupter.

Cunningham Mercury Jet Interrupter.

Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.

Send for Catalogue No. 507 10c in stamps.

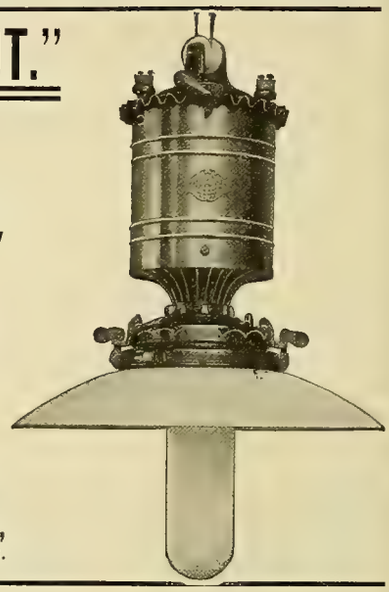
HERE'S A "BEAUT."

OUR PETITE ENCLOSED PATTERN

ARC LAMP.

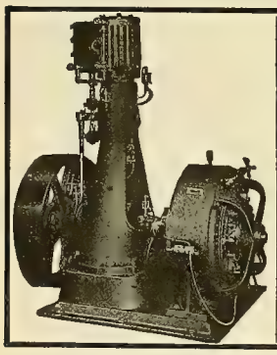
EQUIPPED WITH AUTOMATIC CIRCUIT OPENER.

110 AND 220 VOLTS AND SERIES.



THE STANDARD ELECTRIC CO.,

113 West Third Street, CINCINNATI, OHIO.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

FOR HIGH GRADE

INSULATING VARNISHES

ADDRESS

STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

PROTECT YOUR TELEPHONE AND FIRE ALARM

WITH

"D. & W." Combination Cut-Out.

A Fuse, Sneak Coil and Arrester Mounted on One Porcelain

ARRESTER ENCLOSED IN METAL CASING.

Either "AIR-GAP TYPE" or our new "MOISTURE PROOF FILM."

Write for PRICE LIST No. 8 and Circular No. 102.

D. & W. FUSE CO., PROVIDENCE, R. I.

OFFICES:

BOSTON Pettingell-Andrews Co. NEW YORK Western Electric Co. PHILADELPHIA Western Electric Co. CHICAGO Central Electric Co. ST. LOUIS Western Electric Co. SAN FRANCISCO California Electrical Works. LONDON, ENG. Imperial Electric Supplies, Ltd.

USE OKONITE WIRE

OKONITE
TRADE MARK.

In every place where an insulated wire is required and you will have no complaints that usually result from poor insulation.

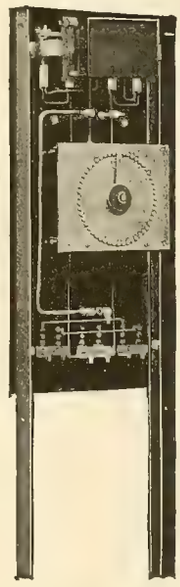
Central Electric Company,
GENERAL WESTERN AGENTS.

264-266-268-270 FIFTH AVENUE,
CHICAGO.

THE GENERAL ELECTRIC COMPANY

QUICK SHIPMENTS OF STANDARD SWITCHBOARDS

For Small Continuous Current Plants.

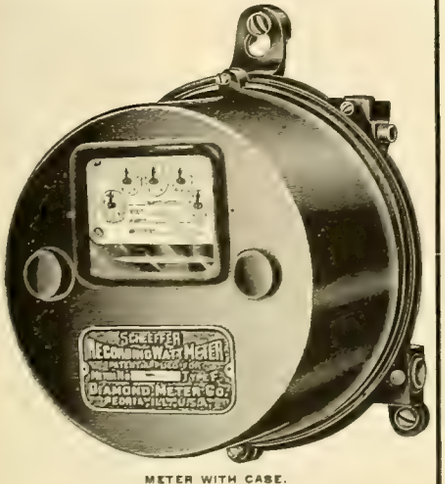


Bulletin No. 4252.

GENERAL OFFICES: Schenectady, N. Y.

Chicago Office, Monadnock Block.

Sales Offices in all Large Cities.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

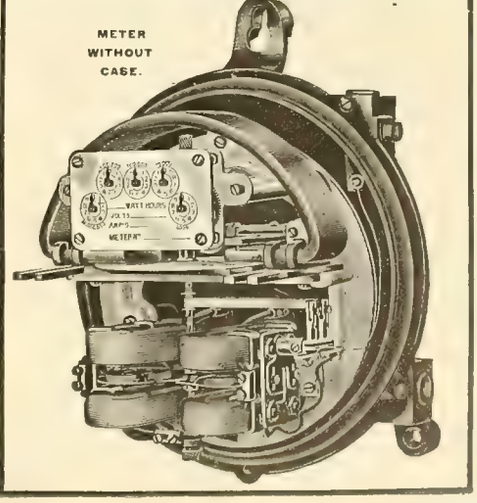
DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,
PEORIA, ILL., U. S. A.



METER WITHOUT CASE.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. B. S. BARNARD, Vice President and Secretary.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Streeter, A. L.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Vomacka & Mazanek.
Western Elect. Supply Co.
Western Electric Company.

Gauges, Battery.
Baird Mfg. Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephone Directory.
Telephone Green Bk. Pub. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Continental Tel. Const. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
R. I. Telephone & Elec. Co.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

For Testing Consumers' Meters

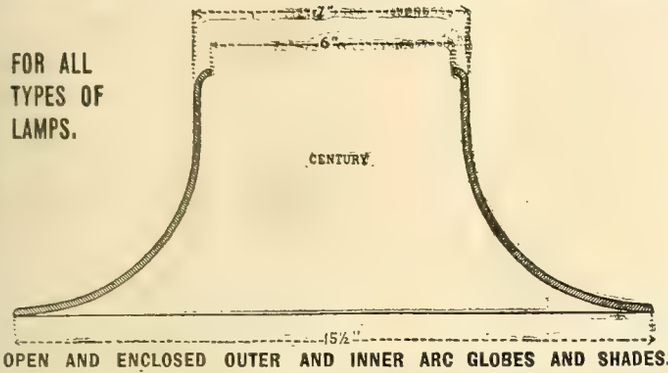
the WHITNEY Portable Watt-meters are the standard. They can be used on any frequency, are dead beat and absolutely accurate Send for Catalogue and Discounts to

Electric Appliance Co., Chicago, Ill.
Western Electrical Supply Co., St. Louis, Mo.
Electrical Engineering Co., Minneapolis, Minn.
Standard Electric Co., Cincinnati, Ohio.

MACHADO & ROLLER,
NEW YORK, N. Y.

COMPLETE STOCK ALWAYS ON HAND.

FOR ALL TYPES OF LAMPS.



OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES AND SHADES.
WRITE US.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

Chicago TO New York AND Boston

VIA THE POPULAR

West Shore Route

Through sleeping and dining car service via Nickel Plate or Wabash from Chicago.

Passengers via this favorite route arrive in New York at uptown station, Forty-second street, the center of the hotel and shopping district, or downtown at Franklin street station, in close proximity to all ocean steamship docks and Jersey City and Brooklyn. For tickets, sleeping car space and further information call on or address

JOHN W. COOK,
G. W. P. A.,
205 S. Clark Street, CHICAGO, ILL.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

EDWARDS AND CO.
New York, N.Y. U.S.A.

ELECTRO-MECHANICAL GONG

Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. **LAMP CORD.**

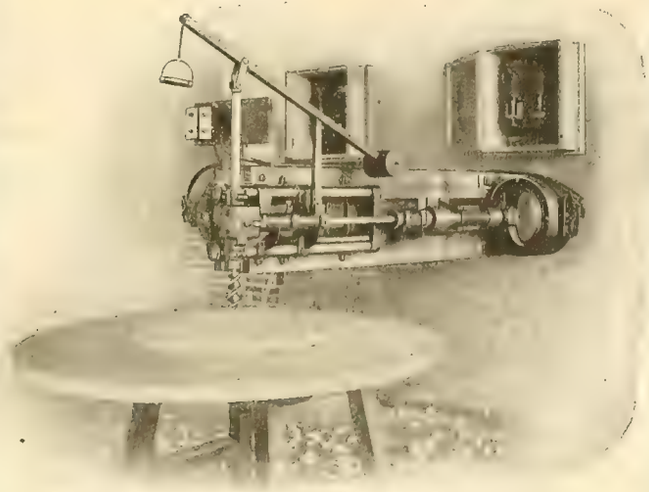
POWER CABLES.
TELEPHONE CABLES. **OFFICE WIRE.**

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

ANY FACTORY USING POWER SHOULD INSTALL OUR MOTORS.

WRITE FOR POWER MOTOR CATALOGUE.



W. E. CO. MOTOR DIRECT-CONNECTED TO BORING MACHINE.

WESTERN ELECTRIC COMPANY,

CHICAGO, SAINT LOUIS, NEW YORK, PHILADELPHIA.

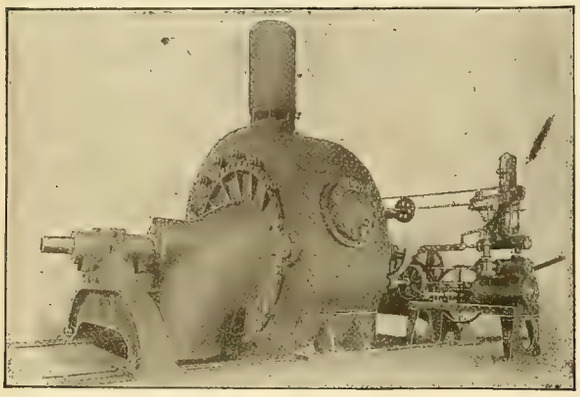
"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

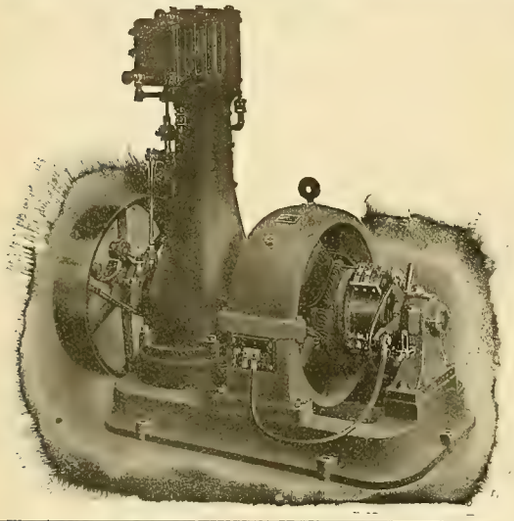
RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

2 CENTS PER 1,000 GALLONS WATER KEEPING BOILERS CLEAN
BY USING **DEARBORN BOILER COMPOUNDS.**
MADE TO SUIT THE WATER AS PER ANALYSIS.
DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



SAMSON TURBINE
UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.
Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.
We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.
WRITE DEPT. "D" FOR CATALOG.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

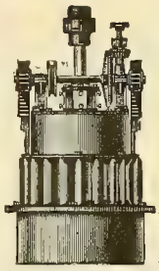


HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.
GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.
W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

Only 10 Cents Each
Practical Books ON Electricity.
How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.
These books are illustrated and will be sent prepaid on receipt of price.
Electrician Publ'g Co.,
510 Marquette Building, CHICAGO.

The Pioneer Limited. **Famous Train of the World.**
Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.
Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

TO THE GREAT NORTHWEST
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.
JAS. C. POND,
Gen'l Pass. Agent, Milwaukee, Wis.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.
Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.
Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.
S. MORGAN SMITH CO., York, Pa.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE
BETWEEN
CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.
THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER, Colo., TEXAS, FLORIDA, UTAH, CALIFORNIA AND OREGON.
IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.
GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

GRAPHITE BRUSHES
That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.
JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.
"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
.. TO ..
California
VIA THE UNION PACIFIC.
This train is really a FIRST-CLASS MODERN HOTEL, with
Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .
RUNS EVERY DAY IN THE YEAR.
E. L. Lomax, G. P. & T. A., Omaha, Neb.

REG. TRADE MARKS
"Phosphor Bronze"
DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

CUT IT OUT

AND SEND IT TO US

With your firm's full name and address written in the lined space and we will mail you an artistic booklet prepaid, which will aid you considerably in the selection of the most suitable arc lamp for your installation.

_____

_____

_____

_____

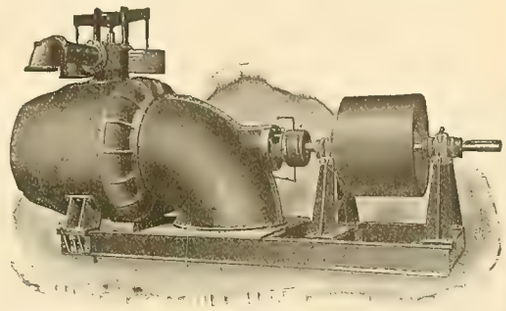
GENERAL INCANDESCENT ARC LIGHT CO.,

572 FIRST AVE., NEW YORK, N. Y.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,

257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch St.
BOSTON, 73 Oliver St. CHICAGO, 311 Dearborn St.
NEW ORLEANS, 304 Hennen Bldg. LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

Crimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

FLOTATION IN AIR

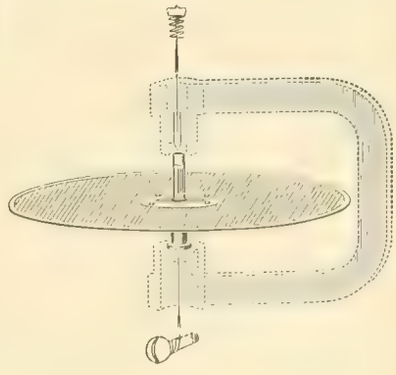
OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.



SALES OFFICE,
158 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

THE PUSH-BUTTON TELEPHONE.

LOOKS LIKE A PUSH BUTTON, ACTS LIKE A PUSH BUTTON WHEN DESIRED, AND IS A COMPLETE AND RELIABLE TELEPHONE AS WELL.

Designed particularly for interior work, inter-communicating, switch-board and straight line. For office, home, hotel and factory. :: :: Send for Special Booklet.

Electric Appliance Company,
ELECTRICAL SUPPLIES -- TELEPHONE MANUFACTURERS.
92-94 WEST VAN BUREN STREET, CHICAGO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

INDIA MICA

We import directly from India and handle the output of the best mines. A large stock constantly on hand enables us to make prompt shipments. ALL OTHER QUALITIES. Prices low.

EUGENE MUNSELL & COMPANY,
NEW YORK AND CHICAGO.

ARC LAMPS

You Won't Need a Machine Shop

WHEN YOU BUY TOERRING ARC LAMPS.

Some lamps are sold cheap because the manufacturer knows that he will make his profit on repairs. This may be profitable for him, but it is bad business for you.

Toerring lamps are profitable to us because they are profitable to you.

Highest Awards Philadelphia, 1899; Paris, 1900; Buffalo, 1901.

39 Cortlandt St. — 19th & Allegheny Ave.

NEW YORK CITY — TOERRING Co. — PHILADELPHIA

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

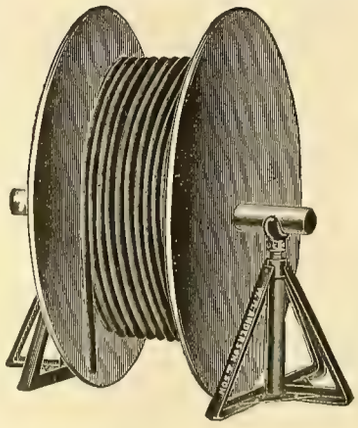
50 Cts. per Stick. $5.00 per Dozen.

For Sale by all Supply Houses, or

FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

CABLE REEL JACK.



Made in Two Styles.

No. 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No. 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,
Tool Manufacturers.
Established 1871.
St. Aubin Ave., DETROIT, MICH.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

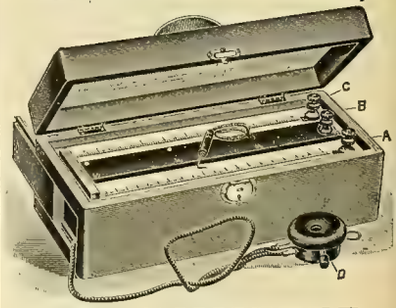
THE WORCESTER POLYTECHNIC INSTITUTE

EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

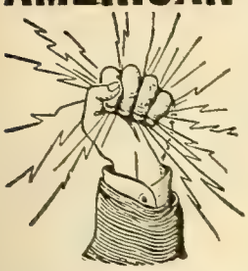
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres.
E. H. WAGENSEIL, Treasurer. E. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

The Franklin Gas Engine
One-Half Horsepower.
Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Shows whether blown by overload or short circuit.

Indicating Type P Fuse, intact.

Fuse blown by overload, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative:
WM. S. BROWN, 39 Cortlandt St., New York City.

Western Representative:
THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

NATIONAL CODE STANDARD

WEATHER-PROOF
TRADE MARK
"O.K."
LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

It is a fact that a 5-inch

STOMBAUGH GUY ANCHOR

will hold 3,000 lbs.

More than the breaking strain of a ⅜-inch galvanized strand when 4 ft. in ground.

It has been demonstrated that the average time required to install an anchor of this size is 5 minutes.

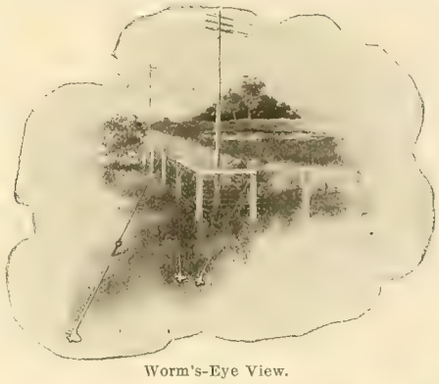
The cost is 69c. net when plain, and 83c. net when galvanized.

Look over your present methods of guying and see whether the first cost, labor of installation and simplicity compare with the

STOMBAUGH GUY ANCHORS

Write us for Information.
We like to be asked questions.

W. N. MATTHEWS & BRO.,
603 CARLETON BLDG.
St. Louis.



Worm's-Eye View.

Stop! Look! Listen!

There is danger in reckless driving. There is also danger in **reckless management.** You had better stop right now before it is too late. You had better look into the details of your business more closely and **find where the leakage is.**

Do you want to increase your electrical business?
Do you want to increase your receipts?
Do you want to furnish large blocks, which now have their own engines and dynamos, with heat, light and power?
If so, install our system of underground mains at once and sell your exhaust steam for enough to pay all running expenses and interest in the investment for steam mains.

We guarantee results.

AMERICAN DISTRICT STEAM CO., Lockport, N. Y.

MENTION WESTERN ELECTRICIAN.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

A first-class armature winder capable of doing electrical repair work of all kinds and take charge of shop. Address BOX 101, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A thoroughly competent man to take charge of a telephone exchange of 200 'phones. Must be able to do collecting also. Address, RICHWOOD TELEPHONE CO., Richwood, Union Co., Ohio.

WANTED.

Salesmen in any section of United States who personally visit manufacturing and lighting plants, to sell on commission a well advertised specialty which has no competition. Address, BOX 102, care Western Electrician, 510 Marquette Building, Chicago, Ill.

WANTED.

200-K. W., 250-Volt, Direct-connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

POSITIONS OPEN.

	PER MONTH.
6 Draftsmen, Electrical-Mechanical	$70 up
1 Draftsman, Structural Steel....	$125 up
1 Traveling Salesman who thoroughly knows the telephone business.	
2 Bridge Steel Draftsmen.....	$100
1 Armature Winder. One who understands repairs, meters, arc lamps of all kinds.	

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.
SEE NEXT ISSUE.

I CAN SELL

Your Electric Light, Gas, Water, or Telephone Plant, no matter where it is. Send description and cash price and learn how. I have or can find the plant you want to buy. Tell me your requirements. A. M. BARRON, Desk F, South Bend, Ind.

Western Electrician WANT ADS Bring Results.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2 120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
2— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

FOR SALE.

Fan motors for 100 and 104 volts, 16,000 alternations, in good running condition:

3 General Electric, 10-inch fans.
2 General Electric, 12-inch fans.
3 Westinghouse . 12-inch fans.
4 Emerson . . . 12-inch fans.
3 Emerson . . . 15-inch fans.
5 Dayton . . . 16-inch fans.
3 Motors, incomplete, will consider offer.
2 Tuerk two-blade Ceiling Fans, for 14-ft. ceilings. Watt-Meters for 100 volts, 125 cycles. All in excellent running order. 50 Duncan 5 and 10 amperes. Send $5 each for the 10 and 12-inch fans; $6 each for the 15 and 16-inch; $12.50 each for the ceiling fans, and $6 each for the watt-meters. Add 50 cents to each order to cover packing and cartage. Also nearly complete list of apparatus suitable for a 37½ K. W. 16,000 A. C. plant. Excellent opportunity for cheap plant, or will sell separately.

JOHN HAY KUHNS,
419 First National Bank Building, Omaha, Neb.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K. W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY, Rochester, N. Y.

FOR SALE.

ENGINE 40x72 inches, George H. Corliss.
" 38x72 inches, George H. Corliss.
" 32x44x60 inches, Allis Blowing.
" 28x48 inches, Allis Blooming Mill.
" 20x48 inches, Watts Campbell.
" 20x36x36 ins., MacIntosh & Seymour Compound.
" 17x30 inches, Buckeye Automatic.
" 14x24 inches, Buckeye Automatic.
PUMP 16x30x14x24 ins., Deane Com. Duplex.
" 16x2¾x10 inches, Worthington Hydraulic Duplex.
" 12x8x12 inches, Smith-Vaile Duplex.
" 10x5x10 inches, Hall Duplex.
" 20x9x14 inches, Blake Single.
" 16x10½x18 inches, Hughes Single.
" 12x7x10 ins., Cope & Maxwell Single.
" 10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.
45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

PLACE YOUR

"Want" and "For Sale" advertisements in the

WESTERN ELECTRICIAN.

Immediate Returns.

DYNAMOS FOR SALE.

One 45 and one 60 K. W. Edison Bi-polar Compound, self oiling, 125 volts.
One large Switchboard and Instruments.
Brown Engine—One 18x48 C. H. Brown.
All ready for delivery and guaranteed.

H. W. DYAR,
204 Dearborn Street, Chicago, Ill.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
		1	48x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	36x8 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	54x8 Vertical Tubular.
5	60x16 Horizontal Tubular.		Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

MODERN HEAT

ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances,
Write for catalogue. 195-197 River St. DETROIT MICH

PRATT INSTITUTE

BROOKLYN, N. Y.
TWO YEAR COURSES IN
APPLIED ELECTRICITY
AND IN
STEAM AND MACHINE DESIGN
Write for Catalogue and Particulars.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of **$1.00.** Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

MONON TRAINS FOR La Fayette, W. Baden Spr., Fr. Lick Spr., Louisville, Mammoth Cave, Chattanooga, New Orleans, All Southern Cities.

MONON TRAINS FOR Indianapolis, Dayton, Cincinnati, Asheville, Atlanta, Jacksonville, St. Augustine, Tampa, Havana.

ANYTIME

You travel between
CHICAGO
LOUISVILLE
INDIANAPOLIS
AND
CINCINNATI
CO VIA

MONON ROUTE

AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W. H. McDOEL, PRES. & GEN'L MGR. FRANK J. REED, GEN'L PASS. AGT. CHAS. H. ROCKWELL, TRAFF. MGR.
CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE TELEPHONE GREEN BOOK 1902.

A COMPLETE DIRECTORY of the Independent Telephone Companies in the States of Ohio, Indiana and Michigan, together with such state and company statistics as will be of interest to those concerned in the growth of the Independent movement, and THREE SPECIAL PAPERS, setting forth the history and describing the Independent conditions in each state, written especially for the Telephone Green Book by the following gentlemen: Ohio, by J. B. Hoge; Indiana, by S. P. Sheerin; Michigan, by J. B. Ware. The entire work compiled and edited by H. H. Robinson, Ass't General Manager of the United States Telephone Co., Cleveland, O.

SAMPLE ENTRY SHOWING INFORMATION FURNISHED.

LUDINGTON, Mich.

PERE MARQUETTE TELEPHONE COMPANY

Organized July, 1901. Capital $20,000. No Bonded Indebtedness.

Main Office at Ludington. Address correspondence to Company.

OFFICERS.

James Gleason, President. E. A. Fuller, Secretary.
Charles Goodrich, Treasurer. E. A. Fuller, General Manager.

EXCHANGES.

Ludington. Scottville.

TOLL STATIONS.

Wiley	Custer	Weldon Creek	Bachelor
Fountain	Branch	Tallman	Riverton
Merritt	Walkerville	Wesley	Freesoil
Fern	Amber	Pauleson	

Exchange Subscribers	244
Farm Line Subscribers	240
Estimated Increase in Subscribers for Year	112
Miles of Metallic Circuit Toll Lines	91
Miles of Grounded Circuit Toll Lines	224
Length of Franchises	30 years
Estimated Number of Subscribers Operated by the Bell Company in this Territory	457

PRICE.

Cloth $2.00
Leather 3.50

The Telephone Green Book will be forwarded upon receipt of price to any postoffice in the United States, carrying charges prepaid.

THE TELEPHONE GREEN BOOK PUBLISHING COMPANY,

Ajax Building, CLEVELAND, OHIO.

IT'S ALL RIGHT.

Webb's Telephone Hand-Book. A book for the expert as well as the novice. Price $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, Chicago.

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

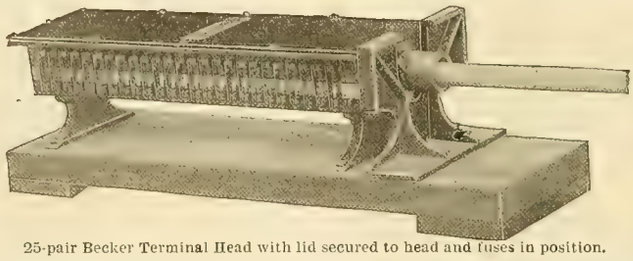
No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.
13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.
28. Metallic Circuit.
29. Underground Wires
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
42. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

Published and for sale by ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago

PROTECTION
THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Illinois Electric Co., Chicago Agents. Post-Glover Electric Co., Cincinnati Agents. W. G. Nagel Electric Co., Toledo (O.) Agents.

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table, 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

PATENTED GALVANIZED STEEL CABLE HANGER.

Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

Before attachment. In place on cable.

11½-inch "Spread." points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.

20-inch "Spread," points up or down.

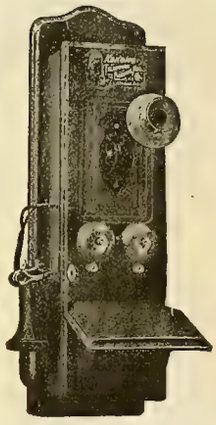
Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

CONTINENTAL TELEPHONE CONSTRUCTION CO.

GENERAL CONTRACTORS FOR TELEPHONE, ELECTRIC LIGHT, HEAT AND POWER PLANTS.

TACOMA BLDG., CHICAGO.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now. $3.00 per year, in advance.

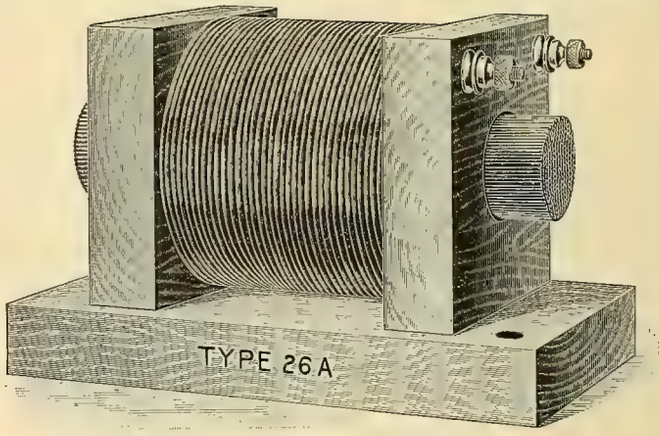
Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.



SPARK COILS

FOR EVERY PURPOSE.

VARLEY DUPLEX MAGNET CO., CHICAGO, ILL. PHILLIPSDALE, R. I.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 263 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

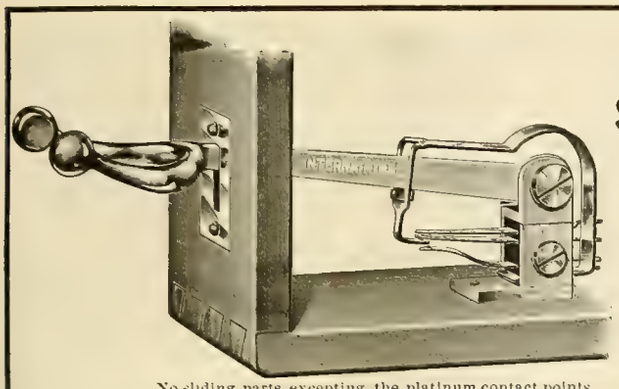
TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. INTERNATIONAL TELEPHONE MFG. Co.

TESTING

OF INSULATED WIRES AND CABLES.

By Herbert Laws Webb.

A New Book—Just What You Need.

A Practical Guide to the Testing of Electric Light, Electric Railway, Telephone and Telegraph Wires.

PRICE, POSTAGE PREPAID, $1.00.
SEND IN YOUR ORDER NOW.

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette Building, CHICAGO.

Telephone Troubles

ARE UNKNOWN WHEN OUR

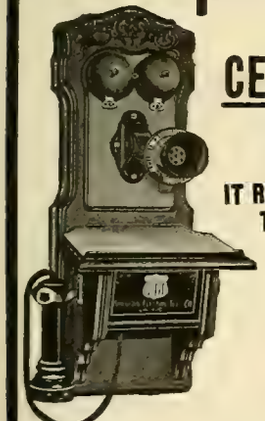
CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.



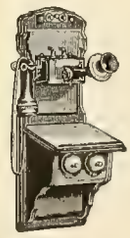
No. 34 Central Energy Telephone.

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

Have You Investigated the EUREKA No. 20 RECEIVER? It's a crackerjack.

SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. ...Prices Right.

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 30 Receiver Exposed.

EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., CHICAGO, U. S. A.

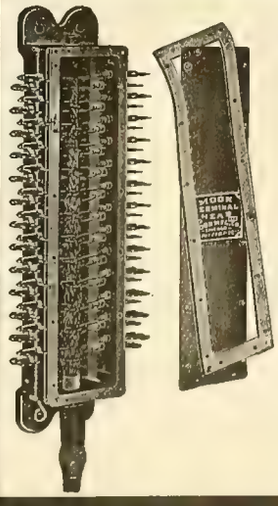
82950

Lines installed
in multiple boards ALONE, up to July 29th

All modern systems demand multiple boards. Each operator has every subscriber's line within her reach in exchanges up to 18000 lines capacity when Kellogg three-tenths inch center multiple jacks are installed. No transfers; straight through connections. Investigation and comparison invited.

KELLOGG SWITCHBOARD & SUPPLY CO.
229 South Green Street, Chicago

82950



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

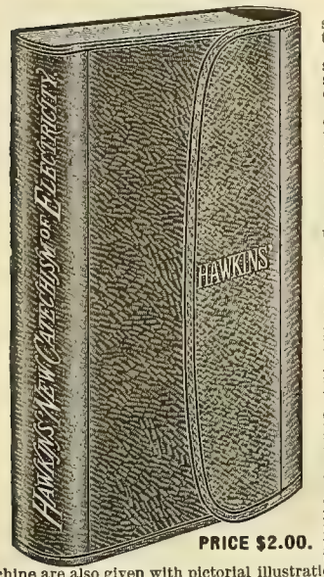
MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

CEDAR POLES.
WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
8th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

The Best of Everything
THE NORTH-WESTERN LINE
THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

JUST OUT

NEW CATALOGUE OF

ELECTRICAL BOOKS.

You Ought to Have One. Sent Free on Request.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20-foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.

Large Stock Constantly on Hand.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1703-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CROSS ARMS.

Manufactured from the Best Long Leaf Yellow Pine.
In Carload or Less Carload Lots.

THE STANDARD POLE AND TIE CO., 44 BROAD ST., NEW YORK.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**

Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.

Preserve Your Copies

OF THE **WESTERN ELECTRICIAN.**

BINDERS $1.00 EACH.

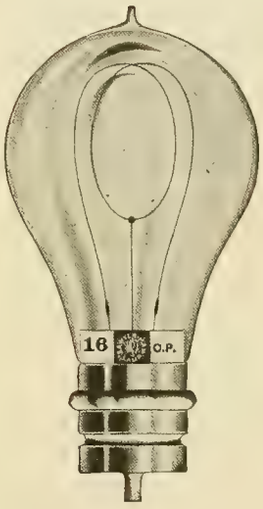
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, ... CHICAGO.

CEDAR POLES

LONG DISTANCE 'PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

The Man Behind the Photometer



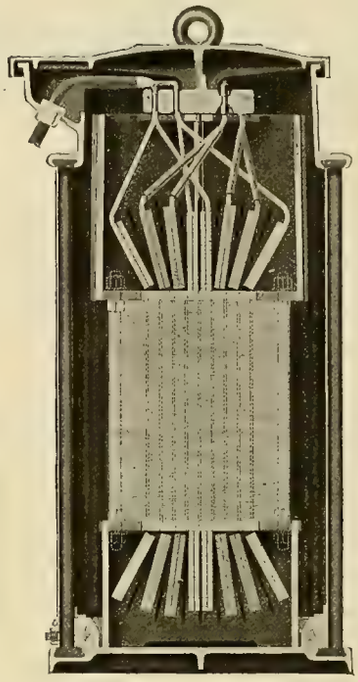
knows that our lamps are the best. Increased orders from our customers certify to the correctness of his tests. But we guarantee every lamp leaving our works to be perfect in every detail, and of the rated candle-power marked on bulb.

Sawyer-Man Electric Co.
New York

SALES OFFICES:

Chicago, Boston, San Francisco, Philadelphia, Pittsburg, Buffalo, St. Louis, Syracuse, Cincinnati, Detroit, Washington, Seattle, Atlanta, Dallas.

Westinghouse Transformers



O D Transformer
¼ to 50 K. W.; 7,200-16,000 and 3,000 Alternations.

Type N Transformer
½ to 50 K. W.; 7,200-16,000 Alternations.

In the Westinghouse Transformer each coil passes off its heat with equal facility and no unequal expansions occur to injure the insulation. : :

For Transformer Booklets, Address Nearest Sales Office of the

Westinghouse Electric & Mfg. Co.
Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

85G2

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated. Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

Monroeville, Ind., July 14, 1902.

Fort Wayne Electric Works,

Fort Wayne, Indiana.

Gentlemen:-

During the severe electrical storm at this place, lightning struck the line and entered one of your 30-light type "A" oil transformers, No. 40048. The discharge blew the fuse and burst the cast iron cover. I did not think it possible for a transformer to be good for anything after this severe discharge, but on having same tested out carefully I find that the coils are not injured in the least.

I cannot too highly recommend your type "A" Oil Transformers to central station men.

Very truly yours,

H. M. Davis

Supt. Electric Light Plant.

STRUCK BY LIGHTNING.

NOW READY!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1902.

TEN CENTS A COPY.

Electrician Publishing Co.,

510 MARQUETTE BUILDING,

CHICAGO.

A New Paper-Weight.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

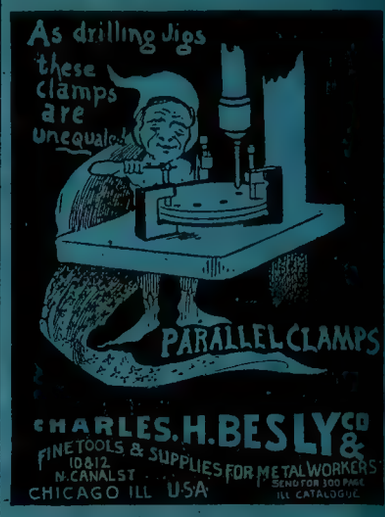
VULCANIZED FIBRE CO., - Wilmington, Del.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.



THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

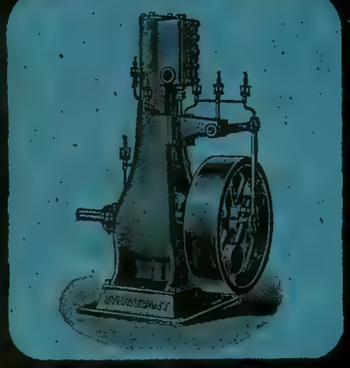
P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of **Slates for Electrical Purposes**

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

STURTEVANT ENGINES



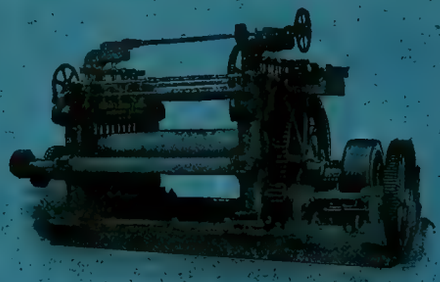
Our Specialty: High grade engines of medium capacity for high or low pressure. 60 sizes under 200 H.P.

B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK - PHILADELPHIA - CHICAGO
LONDON
173

—THE— CROCKER-WHEELER MOTOR

ACCURATE ELECTRICAL DESIGN, MECHANICAL STRENGTH AND PROPER METHODS OF CONSTRUCTION

INSURE A READINESS FOR CONSTANT HARD SERVICE.



If Interested in Electrical Machinery, write to us.

SALES OFFICES IN ALL LARGE CITIES.

Office and Works, - - - AMPERE, N. J.

EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.

Write for Catalogue No. 4.

EDISON MFG. CO.

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

Black Diamond File Works

Est. 1863. Inc. 1895.

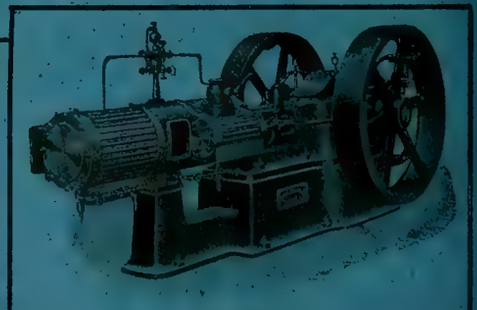
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO HIGH SPEED ENGINES FOR ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 23, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 8.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. MIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

THE BEST VERMONT SLATE FOR Electrical Purposes.
It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Mills Bldg., San Francisco. 101 Milk St., Boston.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

The Franklin Model Shop
Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 10.
FRANKLIN Model Shop
PARSELL & WEED, 129-131 W. 31st Street, New York.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg. Co., Troy, Ohio.

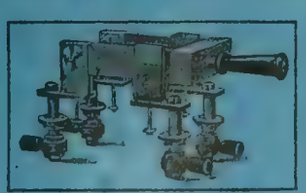
GASOLINE MOTORS
—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.

GENUINE SWEDISH COAL-GRAIN
ERICSSON MICROPHONE
THE PERFECT TRANSMITTER
NO PACKING, NO ADJUSTING, NO TROUBLE. ALSO COMPLETE LINE LONG DISTANCE TELEPHONES.
ERICSSON TELEPHONE CO. 296 BROADWAY N.Y.

EXCHANGE EQUIPMENT.
TELEPHONES—ALL KINDS. TEST SETS—DESK SETS. We help new companies to start right and old exchanges to improve.
ERICSSON TELEPHONE CO., 296 Broadway, New York.

Kilfyre
DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

KNIFE SWITCHES

WE HANDLE....
ALL SIZES and GRADES
AND CARRY ALL STYLES IN STOCK.
Prices in proportion.
ALL GOOD. SOME BETTER.
THE STANDARD ELECTRIC CO.,
113 W. 3rd Street, CINCINNATI, OHIO.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Voltmeter.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., No. 101 St. Martins Lane.
Mention the WESTERN ELECTRICIAN when writing for catalogues.

FOR HIGH GRADE
INSULATING VARNISHES
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

A MOST IMPORTANT POINT ON

"TYPE F" SWITCHBOARD INSTRUMENTS

Type F Voltmeter, Back Connection, One-Third Actual Size.

The pointers of many so-called dead beat instruments will oscillate back and forth, after a change of circuit conditions, for a minute or more before coming to rest. In type H, K and F instruments the pointers swing from their position of rest to a new position of rest when the current changes *without any intermediate oscillation.*

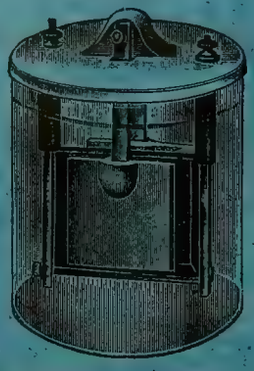
This quality has been obtained without sacrificing in the least the accuracy or the sensibility of the instrument.

OTHER VALUABLE FEATURES EXPLAINED IN DETAIL IN BULLETIN NO. 31, 2D EDITION.

WAGNER ELECTRIC MFG. CO., - - ST. LOUIS, MO.

EDISON PRIMARY BATTERIES.

FORMERLY KNOWN AS EDISON-LALANDE.



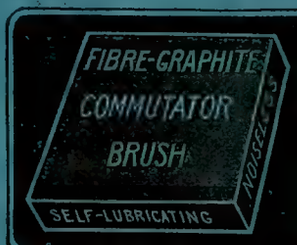
FOR GAS ENGINES, SLOT MACHINES, AUTOMOBILES, RAILROAD SIGNALS, CROSSING BELLS, SMALL MOTORS, ETC.

CONSTANT CURRENT, NO LOCAL ACTION, WILL NOT FREEZE, LIQUID TIGHT CELLS FOR PORTABLE WORK.

FULL DESCRIPTION IN BOOKLET NO. 4.

EDISON MANUFACTURING COMPANY,

FACTORY, ORANGE, NEW JERSEY, U. S. A. NEW YORK OFFICE, 83 CHAMBERS STREET.
CHICAGO OFFICE, 144 WABASH AVENUE.



There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

Don't Overlook a Good Thing.

I have something entirely new in motors. New principle, one-quarter to five horsepower. Direct and alternating current, any speed, any voltage, any frequency.

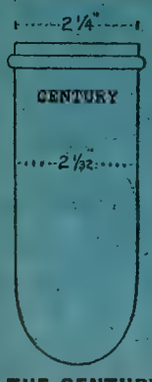
Half the Weight, Increased Efficiency, Increased Durability, Perfect Ventilation, Cost Less than any other Motor.

You had better drop me a line, and I will explain in detail, send cuts, etc.

HENRY A. COIT, Laclede Bldg., St. Louis.

P. S.—Also something Startling and New in Electrical Specialties. Let me tell you about them.

THE ONLY HOUSE IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.



WE CARRY GLOBES AND SHADES FOR ALL KINDS AND TYPES OF LAMPS.

OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES.

SEND FOR OUR ILLUSTRATED CATALOGUE.

THE CENTURY GLASS COMPANY, : : : BELLAIRE, OHIO.

"RELIANCE" GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - WIS.

AGENTS WANTED EVERYWHERE.

ANTI-Doc

No. SIX

A First-Class Medical Apparatus.

RETAIL PRICE, $2.50. SOLD BY ALL DEALERS.

MADE BY

MANHATTAN ELECTRICAL SUPPLY CO.,

32 Cortlandt Street, NEW YORK.

188 Fifth Avenue, CHICAGO.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" ***For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.***

The "Exide Accumulator" ***For Electric Vehicles.***

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 250 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: PHILADELPHIA, Allegheny Ave. & 19th St. R 52 — NEW YORK, 100 Broadway. — BOSTON, 60 State St. — CHICAGO, Marquette Bld. — BALTIMORE, Continental Trust Bld. — ST. LOUIS, Wainwright Bld. — SAN FRANCISCO, Nevada Block. — CLEVELAND, New England Bldg. — DETROIT, Michigan Elec. Co. — HAVANA, CUBA. F. G GREENWOOD, MGR. 34 Empedrado Street.

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago. Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

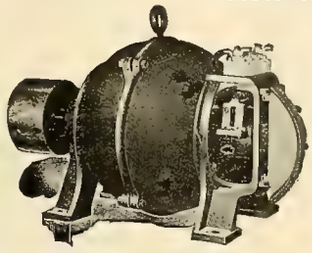
Federal Electric Co.
84 Market Street, CHICAGO, ILL.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co.....—
American Battery Co.....—
American District Steam Co. 11
Amer. Electrical Heater Co...—
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Badt & Co., F. B..... 10
Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg. Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Beidler & Co., Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 1
Bossert El. Construction Co.. 7
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co...—
Century Glass Co..... 2
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R..... 7
C., B. & Q. Ry. 7
Chicago Edison Company..4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co. —
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Coit, Henry A..... 2
Columbia Telephone Mfg. Co.13
Continuous Rail Joint Company of America..... 7
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co . 8
Diamond Meter Company —
Dicke Tool Company.....16
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 2
Edwards & Company.....20
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 4
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company ..12

Hartford Steam Boiler Inspection & Insurance Co...10
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co..... 17
Holmes Fibre Graph. Co..... 2
Hopkins & Co, A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co. 5
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company..... 15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 1

Machado & Roller.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co.. 2
Marinette Iron Wks. Mfg. Co. 9
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....20
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 5
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17
Pratt Institute..... —

Rauscher, John .....—
Reisinger, Hugo..... 7
Reliance Electric Company.. 2
Replogle Governor Works.. . 8
Reynolds Electric Company.—
Roebling's Sons Co., J. A.....12
Rose Electric Company 12

St. Louis Elec. Supply Co . 5
Sargent & Lundy... .....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G ... .12
Schott, W. H. 20
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 9
Spies Electric Company.....20
Sprague Electric Company... 3
Standard Electric Company.. 1
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 5
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The....10
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company.... .17
Triumph Electric Co.....10

Union Pacific R. R..... 8

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company.... 7

Vulcanized Fiber Company..20

Wabash Road.....7, 12
Wagner Electric Mfg. Co..... 2
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company....7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst. 20

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

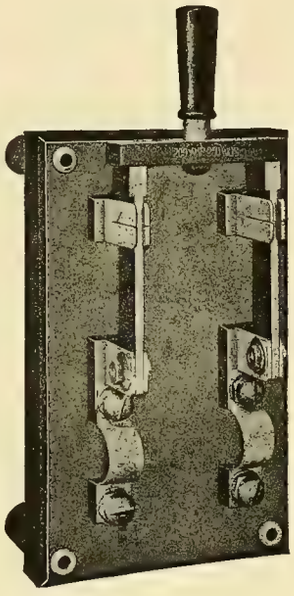
ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

GENERAL ELECTRIC COMPANY'S



LEVER SWITCHES

FORM D

Embody the good features of former products combined with improvements which fit them for modern conditions. They conform to the latest requirements of the underwriters.

SHIPMENTS MADE FROM STOCK. BULLETIN No. 4259.

GENERAL OFFICES: SCHENECTADY, N. Y.

CHICAGO OFFICE: Monadnock Block. Sales Offices in all large cities.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)

I.X.L. Weather-Proof Wire

Shipped Direct from Chicago Stock.

Send for Samples and Prices.

COLUMBIA LAMPS IN CHICAGO STOCK.

Central Electric Company,

GENERAL WESTERN AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

On receipt of

10 CENTS

.....We will send you a

Western Electrician Moonlight Schedule

FOR 1902.

Every Lighting man should have one.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Bldg., CHICAGO.

There'll be a Hot Time All Summer

UNLESS YOU WAKE UP AND BUY A

COLONIAL FAN

We can sell you Direct Current Ceiling or Desk Colonial Fans

Cheaper than you can Buy Elsewhere. Try us. Large Stock. Quick Shipment.

ST. LOUIS ELECTRICAL SUPPLY CO.,

1118 Pine St., ST. LOUIS, MO.

"YOU PRESS THE BUTTON,

THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINIOS ELECTRIC SPECIALTY COMP'Y,

TACOMA BUILDING, CHICAGO.

Crimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

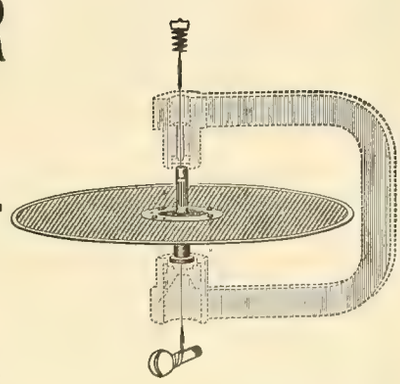
ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. NO FRICTION. NO LOST REVENUE. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

SALES OFFICE, 158 BROADWAY, NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS, JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. **B. S. BARNARD, Vice-President and Secretary.**

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electrical Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, G. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

There are no Carbons better than the "Electra" and none "just as good."

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

Boston and Return $19.00 VIA THE WABASH.

On account of the meeting of the Brotherhood of St. Andrew, the Wabash road will sell excursion tickets from Chicago to Boston, October 7 to 11, at one fare ($19) for the round trip. By deposit and payment of 50 cents the limit may be extended to November 12. Write for maps and time-tables. F. A PALMER, A. G. P. A., 97 Adams Street, Chicago, Ill.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of **$1.00.** Address

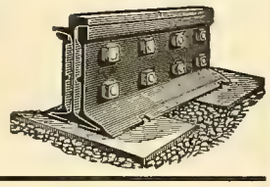
ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building,

NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

A BOOK ABOUT CALIFORNIA.

It Is Easy and Inexpensive to Go There Now That the Railroads Have Reduced Their Ticket Fares.

During the winter months, while those in most parts of the country are suffering from extreme cold and disagreeable weather, California, the land of sunshine, is radiant with fruits and flowers and everything that is green and beautiful.

Formerly a trip to California was an expensive luxury, but now that the railroads have very greatly reduced the price of tickets, and particularly since we have introduced the "Personally Conducted Excursion" idea, you can go to California in a comfortable through car by the choicest route and for a very moderate sum.

Is it worth while to fight through the winter at home when you can so easily go where the perfect climate will keep you strong and vigorous? The saving in doctor's bills likely will pay for a California trip. Send six cents in postage for our handsome little book about California. It is intensely interesting and is beautifully illustrated. Address P. S. Eustis, Passenger Traffic Manager, Chicago, Burlington & Quincy Ry. Co., Chicago.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

NOTICE.

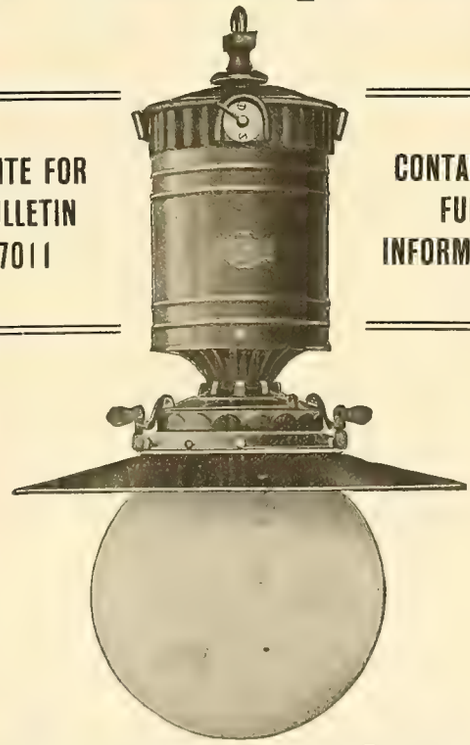
TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., Chicago.

SERIES ALTERNATING ARC LIGHTING SYSTEMS

WRITE FOR BULLETIN 7011



CONTAINING FULL INFORMATION.

WESTERN ELECTRIC COMPANY,
CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

PITTING CAN BE STOPPED BY USING DEARBORN BOILER COMPOUNDS

MADE TO SUIT THE WATER AS PER ANALYSIS

NEW BOILER COMPOUND FEEDER WILL FEED ANY KIND OF COMPOUND.

WRITE FOR PARTICULARS.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H. EDGAR, President Telephone: Harrison 3930 and 3931.

SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING

ELECTRIC LIGHTING AND POWER PLANTS,

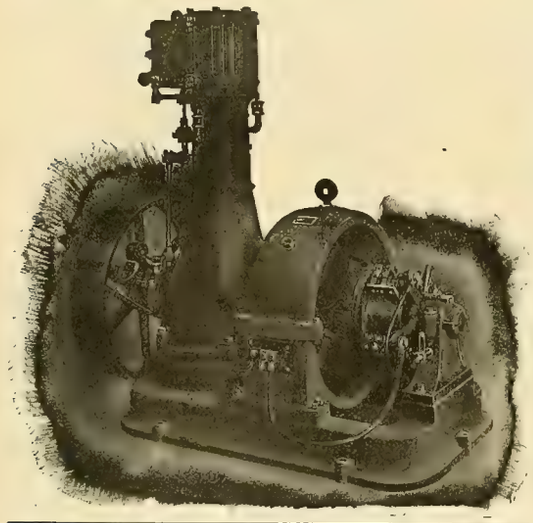
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,

SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

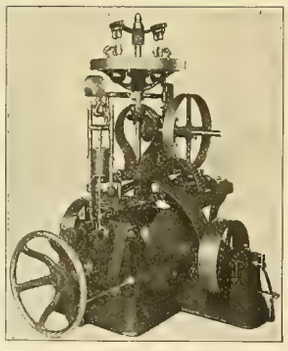
W. BAYLEY & SONS CO.,

MILWAUKEE, WIS., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



Water Wheel **Governors**

For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.

We are now prepared to

GUARANTEE ABSOLUTE SATISFACTION

Write for References in your Locality.

The Replogle Governor Works,

S. HIGH ST., AKRON, OHIO.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"

ELECTRIC LIGHTED

. . TO . .

California

VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra. Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

GRAPHITE RESISTANCE.

Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
610 Marquette Building,
CHICAGO.

The Pioneer Limited. Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

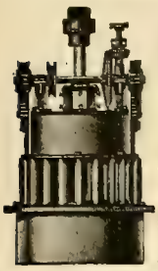
CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo., TEXAS, FLORIDA, UTAH, CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.



M'CORMICK TURBINE.

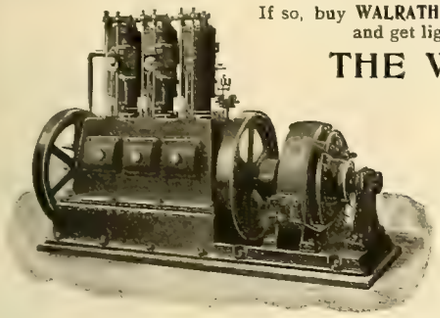
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

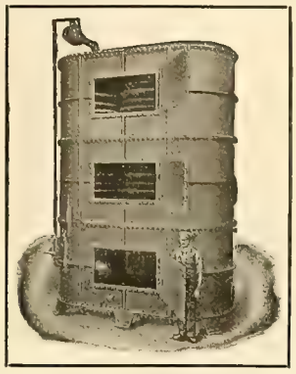
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

When You Save Steam,



You Economize in Fuel, and

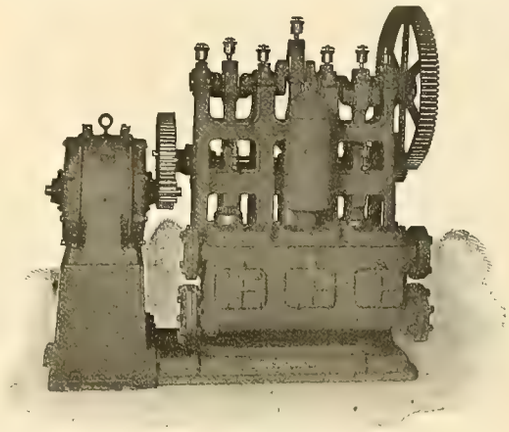
ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,



Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS

The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**
The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**
The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth. **$1 25.**
A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.
This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.
The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.
The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.
The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

TRY PACKARDS

If you have never used *Packard* Incandescent Lamps you owe it to your customers and to yourselves to give them a trial. They will solve the lamp question for you.

**NO BLACKENING OF BULB—
LONG LIFE—HIGHLY EFFICIENT**

Electric Appliance Company,
92 and 94 West Van Buren St., CHICAGO

EDISON MINIATURE LAMPS

Dry Battery Lamps

For use in portable lighting devices—electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

**All types supplied—
Accurately rated—
Carefully selected.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
Chicago Office: Monadnock Block. Sales Office all large cities.

MICANITE CLOTH

**HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.**

MICA INSULATOR CO.
"ORIGINATORS."
CHICAGO. NEW YORK.

ARC LAMPS | SPEAKING OF ARC LAMPS | ARC LAMPS

39 Cortlandt St. | 19th & Allegheny Ave.

DID IT EVER OCCUR TO YOU

When you buy arc lamps merely because they are the cheapest **that you may be buying a white elephant** in the shape of a lot of repair bills?

The cheapest can never be the best, but you may prove to yourself that the best is the cheapest by using Toerring 200-hour arc lamps.

HIGHEST AWARDS—Philadelphia, Paris and Buffalo.

NEW YORK CITY. **C. J. TOERRING CO.** PHILADELPHIA.

ARE YOU CONSIDERING
An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,
POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.
CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

SPARKING
Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided If you use

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

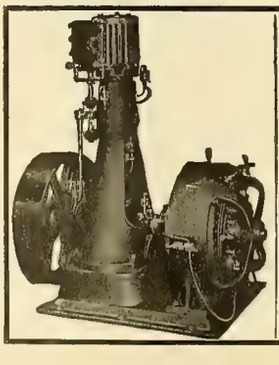
50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Manufacturers, **909, 100 Washington St., Chicago.**

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.
**Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.**

THE STERLING VARNISH CO.,
Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO.,
25 Colmore Row, Birmingham, England.



TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

THOROUGH INSPECTIONS
AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. H. WAGENSEIL, Treasurer. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

When in search of a position advertise in the
WESTERN ELECTRICIAN.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. C. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHORS

THEY ARE { Easy to install. Cheaper than other guys. One piece. No moving parts. Necessary for well guyed poles. Operated like a corkscrew. Mechanically correct. Indestructible by fire or frost. Carefully made. Anchors that pay dividends. Labor savers.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHORS

Write for prices, to

W. N. MATTHEWS & BRO.

603 Carleton Building,
ST. LOUIS.

Worm's-Eye View.

Stop! Look! Listen!

There is danger in reckless driving. There is also danger in **reckless management.** You had better stop right now before it is too late. You had better look into the details of your business more closely and **find where the leakage is.**

Do you want to increase your electrical business?
Do you want to increase your receipts?
Do you want to furnish large blocks, which now have their own engines and dynamos, with heat, light and power?
If so, install our system of underground mains at once and sell your exhaust steam for enough to pay all running expenses and interest in the investment for steam mains.
We guarantee results.

AMERICAN DISTRICT STEAM CO., Lockport, N. Y.

MENTION WESTERN ELECTRICIAN.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As salesman or agent for electrical supply house or manufactory. Have had five years' experience in large supply house as stockman and two years as traveling salesman. Address BOX 103, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

200-K. W., 250-Volt, Direct-connected Generator, complete with engine. Will pay spot cash. Address BOX 89, care Western Electrician, 510 Marquette Building, Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

POSITIONS OPEN.

PER MONTH.

6 Draftsmen, Electrical-Mechanical $70 up
1 Draftsman, Structural Steel.... $125 up
1 Traveling Salesman who thoroughly knows the telephone business.
2 Bridge Steel Draftsmen..... $100
1 Armature Winder. One who understands repairs, meters, arc lamps of all kinds.

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

FOR SALE.

One of the best paying telephone exchanges in Kansas; 325 phones and 40 miles of toll lines. Connection with principal towns of the state. Will be sold on NET per cent. earning power. Bargain will bear closest investigation. If you mean business, write BOX 104, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

In good operative condition, now being removed to make room for larger machinery.

4—72 inch x 16 feet tubular boilers.
2—9 and 16x12 inch tandem compound Ball engines.
1—8 and 13x12 inch tandem compound Ball engine.
1—500-H. P. Buffalo condenser.
1—500-H. P. Dean condenser.
69 T. H., Stanley & Wood transformers, 10 to 250 lights each, 1,000 volt primary, 100 and 50 volt secondary.
About 3,008 of 12 inch, and 100 feet of 18 inch double leather belting, in good condition.
All the above for immediate delivery.

Fond du Lac Street Railway and Light Co.,
FOND DU LAC, WIS.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
2— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct current machines.
Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K. W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY, Rochester, N. Y.

FOR SALE.

ENGINE 40x72 inches, George H. Corliss.
" 38x72 inches, George H. Corliss.
" 32x44x60 inches, Allis Blowing.
" 28x48 inches, Allis Blooming Mill.
" 20x48 inches, Watts Campbell.
" 20x36x36 ins., MacIntosh & Seymour Compound.
" 17x30 inches, Buckeye Automatic.
" 14x24 inches, Buckeye Automatic.
PUMP 16x30x14x24 ins., Deane Com. Duplex.
" 16x2¾x10 inches, Worthington Hydraulic Duplex.
" 12x8x12 inches, Smith-Vaile Duplex.
" 10x5x10 inches, Hall Duplex.
" 20x9x14 inches, Blake Single.
" 16x10½x18 inches, Hughes Single.
" 12x7x10 ins., Cope & Maxwell Single.
" 10x6x16 inches, Titusville Single.

Send for Complete Monthly Stocklist.

WICKES BROS., Saginaw, Mich.

45th Street and A. V. R. R. Pittsburg, Pa.
No. 95 Liberty Street, New York City.
No. 1214 Marquette Bldg., Chicago, Ill.

Half Rate to TORONTO EXPOSITION AND FAIR.

Route, Wabash and Canadian Pacific. Rate from Chicago, $12.40 for the round trip. Dates of sale, August 30 to September 2, inclusive. Return limit, September 15, inclusive. Write for maps and time-cards. F. A. PALMER, A. G. P. A., 97 Adams Street, Chicago.

A. G. SCHOONMAKER CO.

126A Liberty Street, New York City,

DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1 20x18½ Harrisburg Ideal Engine.
1 14x13 Armington & Sims Engine.
1 16x16 Erie Ball Engine.
1 15x15 Erie Ball Engine.
1 12x12 Erie Ball Engine,
2 120-kw G. E. single phase Alternators.
1 100-kw Card M. P. 500-volt Generator.
1 200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.
2 60-kw G. E Transformers.
497 Improved M. G. E. Arc Lamps.
2 15 hp M. P. 500-volt Motors.
2 10-hp M. P. 500-volt Motors.
2 8 hp M. P. 5 0-volt Motors.
2 5-hp M. P. 500-volt Motors.
3 3-hp M. P. 500-volt Motors.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

When in search of a position advertise in the WESTERN ELECTRICIAN.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60 Geo. H. Corliss.
20x48 Harris Corliss.
20x48 Wheelock Corliss.
12x36 Harris Corliss.
18x24 Atlas Automatic.
16x32 Buckeye Automatic.
13x21 Buckeye Automatic.
13x20 Russell Automatic.
8½x9 Armington & Sims Automatic.
9x12 Atlas Automatic.

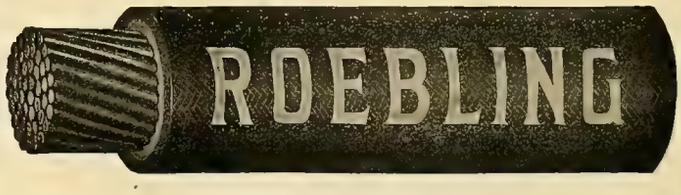
BOILERS.

1 250 H. P. Babcock & Wilcox Water Tube.
1 66x16 Horizontal Tubular.
2 60x18 Horizontal Tubular.
5 60x16 Horizontal Tubular.
1 56x16 Horizontal Tubular.
1 48x16 Horizontal Tubular.
1 36x8 Horizontal Tubular.
1 54x8 Vertical Tubular.
Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.



POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

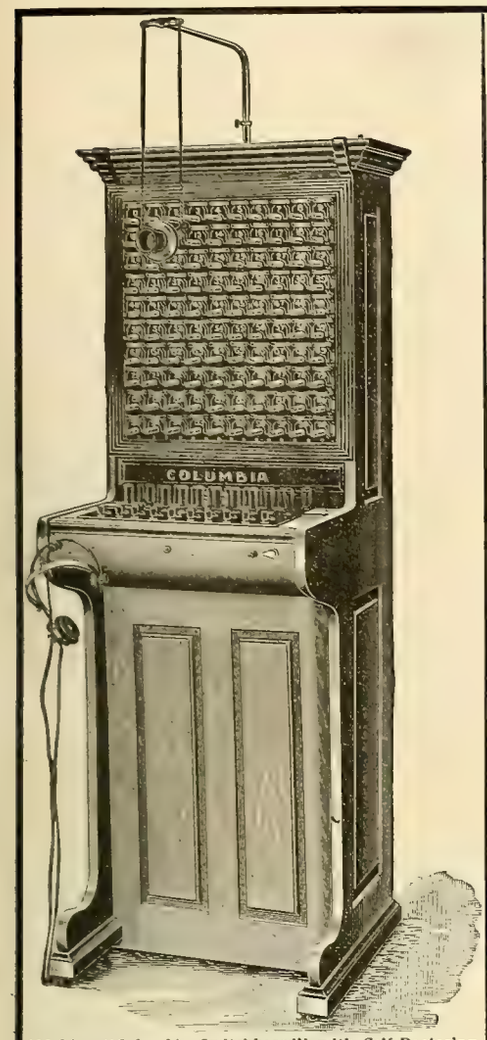
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,		1 200	lines and	telephones
Ennis, Tex., . .	"	"	1,200	"	"
Norwalk, Ohio, .	"	"	2,400	"	"
Frankfort, Mich.,	"	"	250	"	"
Dundee, Mich., .	"	"	200	"	"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

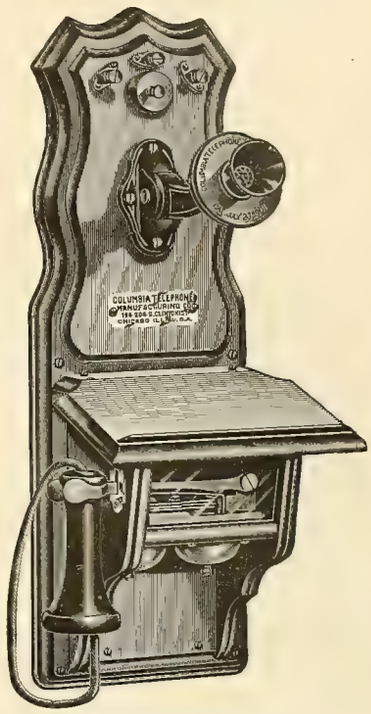
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,

$1 A VOLUME.

Electrician Publishing Co.,

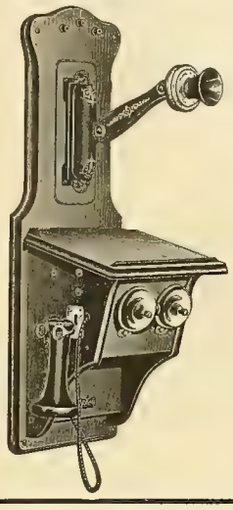
510 Marquette Building, Chicago.

FREE!

OUR PRESCRIPTION FOR TELEPHONE TROUBLES.

℞

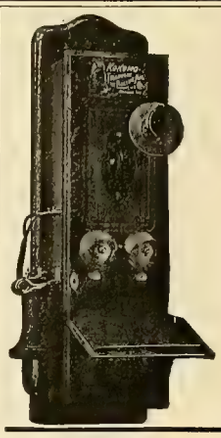
1 Sterling Common Battery Switchboard.
(Lamp Signal Multiple.)
1 Complete Power Plant.
1 Sterling Distributing Board and Protection.
New Sterling Telephones. (Quantity sufficient.)
Install and use with ordinary care 24 hours every day.



WE GUARANTEE THE ABOVE TO CURE ANY CASE—NO MATTER OF HOW LONG STANDING.

STERLING ELECTRIC COMPANY,

LAFAYETTE, - - IND.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

THE TELEPHONE HAND-BOOK

BY

HERBERT LAWS WEBB.

Price $1.00.

The only complete and practical work of its kind on the market.

PUBLISHED BY

THE ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, Chicago

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,

130 LA SALLE AVE.,

CHICAGO.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger

for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.

No. 1. Light, 1¾ x ⅜ in.
No. 2. Medium, 1¾ x ½ in.
No. 3. Heavy, 2 x ½ in.

Nos. 2 and 3 always in stock.

DEAD END HANGER.

Forged steel. Galvanized

Patented Galvanized Steel Cable Hanger.

Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties and up-to-date. Tell us what you want.

Corner Brackets, Guy Shims, and Special Forgings made to order.

In place on cable.

3-Bolt Guy Clamp.

Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

New and Revised Edition JUST ISSUED.

American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

CHAPTER I.—History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V.—Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., *510 Marquette Building, CHICAGO, ILLINOIS.*

Have You Investigated the **EUREKA** No. 20 RECEIVER? It's a crackerjack.

SWITCHBOARDS AND TELEPHONES
of Every Description for Common Battery and Magneto Systems.

Samples cheerfully submitted. ...Prices Right.

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

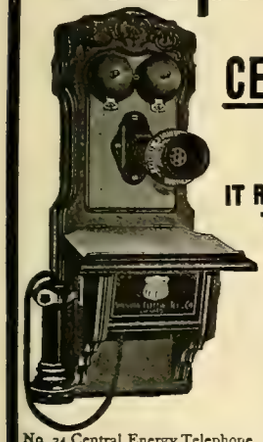
EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., **CHICAGO, U. S. A.**

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

Telephone Troubles



No. 34 Central Energy Telephone.

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg,. Chicago.

82950

Lines installed

in multiple boards ALONE, up to July 29th

All modern systems demand multiple boards. Each operator has every subscriber's line within her reach in exchanges up to 18000 lines capacity when Kellogg three-tenths inch center multiple jacks are installed. No transfers; straight through connections. Investigation and comparison invited.

KELLOGG SWITCHBOARD & SUPPLY CO.

229 South Green Street, Chicago

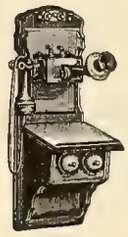
82950

IMPROVED TELEPHONE APPARATUS.

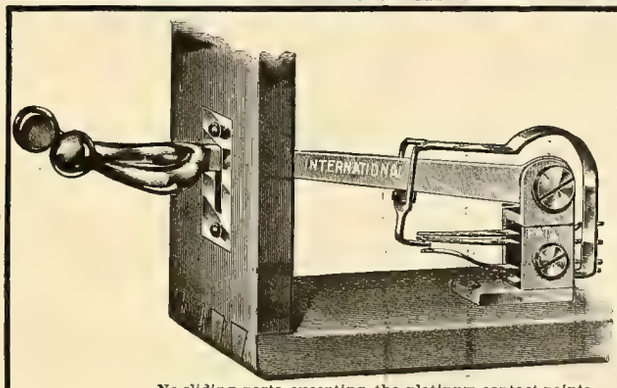
"CENTRAL ENERGY"

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

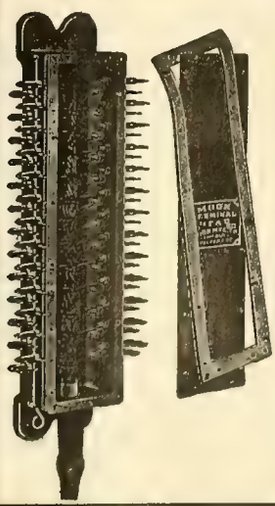


A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

AS SIMPLE AS ITS NAME.
A B C
—OF—
THE TELEPHONE
By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.
An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.
Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

A GLIMPSE AT OUR WESTERN STOCK.

1,700	pieces	40	feet, 7-inch	tops
1,700	"	40	" 8	"
1,750	"	45	" 7	"
1,250	"	45	" 8	"
1,750	"	50	" 7	"
750	"	50	" 8	"
3,000	"	55	" 7	"
750	"	55	" 8	"
750	"	60	" 7	"
300	"	60	" 8	"
250	"	65	" 8	"
200	"	70	" 8	"

Our Prices Will Interest You.

POLES
30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR TROLLEY LINE CONSTRUCTION
ALWAYS IN STOCK.

YARDS:
MENOMINEE, MICH.
ESCANABA, MICH.
NADEAU, MICH.
CLOQUET, MINN.
HERON, MONT.
CABINET, IDAHO.

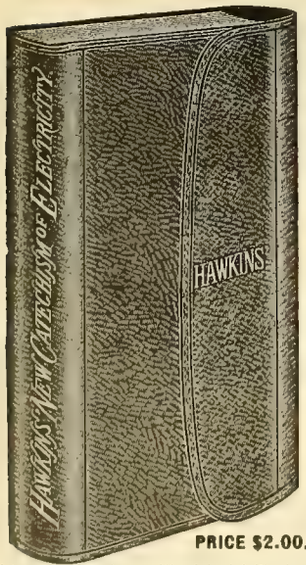
OUR ADDRESS:
FRANCIS BEIDLER & CO.
W. 22d and Loomis Sts,
CHICAGO, ILL.

CEDAR POLES.
WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

O. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

New Dynamo Tenders' Hand-Book.
By F. B. BADT.
226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.
This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.
Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

HAWKINS' NEW CATECHISM OF ELECTRICITY.
Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.
The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.
It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.
It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.
The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.
The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.
Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.
The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.
The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.
The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.
In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.
ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

NOW
IS THE TIME TO
SUBSCRIBE
TO THE
Western Electrician
WRITE FOR PARTICULARS.

ELECTRICITY MADE SIMPLE.
233 Pages. 108 Illustrations. By CLARK CARYL HASKINS. Cloth $1.00. Paper .50.
A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.
There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.
This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.
Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.
The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text book for schools and colleges.
FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS.
FOR STUDY OR REFERENCE.
ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20-foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want **CEDAR POLES** POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

CEDAR POLES OF ALL LENGTHS AND SIZES.
SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand.

CEDAR POLES STREET RY. TIES PERRIZ & SONS DAGGETT MICH.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

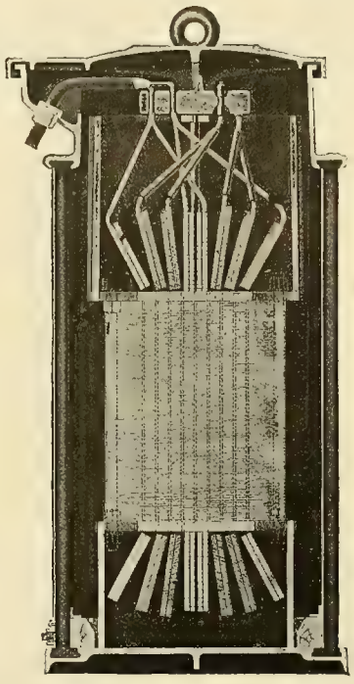
THE HOLCOMB-LOBB COMPANY
CEDAR POLES & POSTS
745 MARQUETTE BLDG. CHICAGO ILL.

"Practical and to the Point"
IS ALL THAT NEED BE SAID OF
THE TELEPHONE HAND-BOOK
By HERBERT LAWS WEBB.
160 Pages, 133 Illustrations, Cloth, Price $1.00.
The book for those interested in telephony.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., CHICAGO.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

CEDAR POLES
THE VALENTINE-CLARK CO.,
234 LA SALLE ST., CHICAGO.
YARDS: PINCONNING, Mich. — GREEN BAY, WIS. — NEW LONDON, WIS.

Westinghouse Transformers



O D Transformer

¼ to 50 K. W.; 7,200-16,000 and 3,000 Alternations

Type N Transformer

½ to 50 K. W.; 7,200-16,000 Alternations

In the Westinghouse Transformer each coil passes off its heat with equal facility and no unequal expansions occur to injure the insulation : : : :

For Transformer Booklets address nearest sales office of the

Westinghouse Electric & Mfg. Co.,

Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

85H2

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket: Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

FORT WAYNE ELECTRIC WORKS

(INCORPORATED)

DIRECT CURRENT SERIES WOOD ARC LAMPS

A complete illustrated description of these new lamps is given in Bulletin No. 1026. A postal to the nearest office will bring it to your address.

MAIN OFFICE AND FACTORY
FORT WAYNE, IND.

BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.

Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 616 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.

Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 New St.

NOW READY!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1902.

TEN CENTS A COPY.

Electrician Publishing Co.,

510 MARQUETTE BUILDING,

CHICAGO.

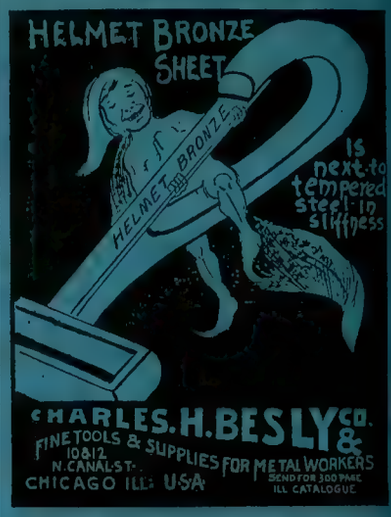
Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 60c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices: Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren-Street, Chicago, Ill.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.
Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

KARTAVERT.
HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE.
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.
HIGH-GRADE RUBBER-COVERED, WEATHERPROOF **WIRES AND CABLES.**
MAGNET, OFFICE, ANNUNCIATOR WIRE.
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg



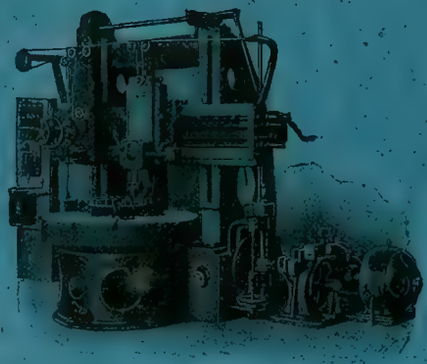
Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building.
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

STURTEVANT ELECTRIC MOTORS

In small and medium sizes
Completely enclosed
Readily portable

B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK · PHILADELPHIA · CHICAGO
LONDON
176

A MOTOR
Running satisfactorily under a continuous full load at high efficiency and with but slight attention defines the
CROCKER-WHEELER
MACHINE.



SALES OFFICES IN ALL LARGE CITIES.
OFFICE AND WORKS: **AMPERE, N. J.**

EDWARDS AND CO.
THE "RECTI" BELL
FOR AUTOMOBILES AND ELECTROMOBILES.

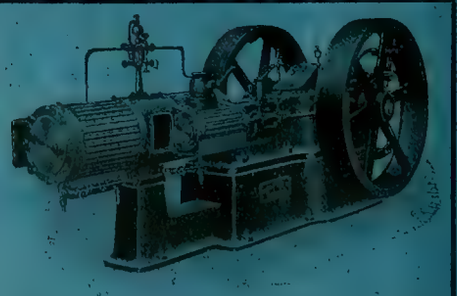
No. 100.
This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.
NEW YORK N.Y.

THE WORCESTER POLYTECHNIC INSTITUTE
EDMUND A. ENGLER, Ph.D., LL.D., President.
Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address
J. K. MARSHALL, Registrar, Worcester, Mass.

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO
HIGH SPEED
ENGINES
FOR
ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.
SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.
BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 30, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No 9.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

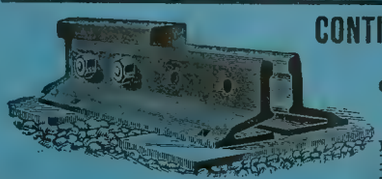
AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office. 63 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

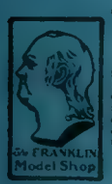

CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago. Ill.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.


The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.
3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50, $6.50, $8.50. Complete $12.50. Write for circular 16.
The FRANKLIN Model Shop
PARSELL & WEED, 129-131 W. 31st Street, New York.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO. PHILADELPHIA.

AN ERICSSON ?

YES, AND "UNCLE SAM" USES THEM, TOO.
Read why the Signal Corps U. S. War Department adopted our make. We can please you. Ask for particulars.
ERICSSON TELEPHONE CO., 296 BROADWAY, NEW YORK.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters,
Ground Detectors and Circuit Testers,
Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Bil-Ammeter.

Our portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in portable switchboard accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., No. 101 St. Martins Lane.
Mention the WESTERN ELECTRICIAN when writing for catalogues.

ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnentag & Co., 86 Queen Victoria Street, London, England.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK

The Man Behind the Order

is the man you want to reach. You can reach him through the

WESTERN ELECTRICIAN'S ANNUAL FALL TRADE NUMBER

This number will be dated September 13, 1902, and its principal object will be to awaken interest in the Fall and Winter trade which, competent judges prophesy, will be exceptionally large.

You can obtain a share of this business by being largely represented in the advertising columns of this important issue. Place the merits of your product before the buyers of the world through an attractive announcement and you will secure much business which you would not obtain otherwise.

Give us an idea of what you wish to advertise and we will get up something striking for you.

Reserve your space early and obtain a choice location.

Western Electrician,

510 Marquette Building, Chicago.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.

The "Exide Accumulator" For Electric Vehicles.

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 260 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: PHILADELPHIA, Allegheny Ave. & 19th St. NEW YORK, 100 Broadway. BOSTON, 60 State St. CHICAGO, Marquette Bld. BALTIMORE, Continental Trust Bld. ST. LOUIS, Wainwright Bld. SAN FRANCISCO, Nevada Block. CLEVELAND, New England Bldg. DETROIT, Michigan Elec. Co. HAVANA, CUBA. F. G GREENWOOD MGR. 34 Empedrado Street.

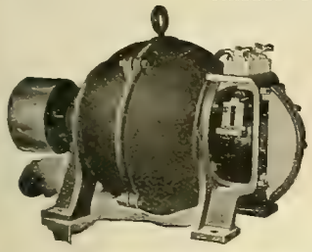
R 52

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES: 527 W. 34th St., New York.

CHICAGO OFFICE: Fisher Building.

LARGE STOCK

NO DELAYS IN SHIPPING.

I. X. L. Weatherproof, or Grimshaw Rubber Covered Wire. Any size or quantity.

Electro Galvanized Conduit—American Circular Loom. Peerless Transformers. Columbia Carbons. Edison Leland Battery.

The best direct current Arc Lamp on the market, the "ANDERSON."

TRY US ON AN ORDER.

ST. LOUIS ELECTRICAL SUPPLY CO.,

NO. 1118 PINE ST., ST. LOUIS, MO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS. PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.

We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co..... 1
American Battery Co.....20
American District Steam Co. 13
Amer. Electrical Heater Co.. 7
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Badt & Co., F. B..... 10
Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.—
Beardsley Gravity Dam & Construction Co..... 4
Beidler & Co , Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 20
Bossert El. Construction Co..20
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...17
Central Telephone & El. Co..14
Century Glass Co.....10
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R..... 4
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co....—
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Coit, Henry A..... —
Columbia Telephone Mfg.Co.—
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .20
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company .. 13
Dicke Tool Company.....—
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....20
Edwards & Company..... 4
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....15

Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Frantzen Company, Arthur.. 6
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... ....—
Gregory Electric Company...12

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Holcomb-Lobb Co.....—
Holmes Fibre Graph. Co.....—
Hopkins & Co , A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company..... 15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....11
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.13
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Metropolitan Tel. & El Co...15
Mica Insulator Company.....—
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad..... 7
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....20
Munsell & Co., Eugene.....10

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 7
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17
Pratt Institute.....13

Rauscher, John .....—
Reisinger, Hugo.....—
Reliance Electric Company.. 7
Replogle Governor Works.. .—
Reynolds Electric Company.—
Roebling's Sons Co., J. A.....12
Rose Electric Company 12

St. Louis Elec. Supply Co ... 3
Sargent & Lundy.....10
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Scholl, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 7
Smith Co., S. Morgan..... 8
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Electric Company..11
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co..—
Standard Varnish Works 1
Standard Vitrified Cond. Co. 7
Stanley Instrument Co..... 5
Sterling & Son, W. C.....17
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company.....13
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co.....11

Union Pacific R. R..... 8

Valentine-Clark Co., The.....—
Varley Duplex Magnet Co... 14
Vindex Electric Company....—
Vulcanized Fiber Company..20

Wabash Road..... 4, 12
Wagner Electric Mfg. Co..... 4
Walsh's Sons & Company....12
West Shore Route..... 7
Western Electric Company... 7
Western El. Supply Co..... 9
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....18
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst.. 7

For Classified Index of Advertisements See Page 6.

Better than ever and a little the best of any on the market today—

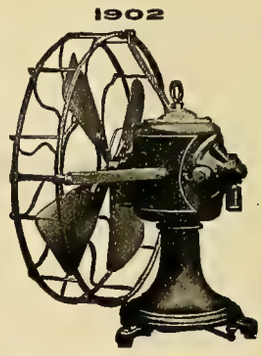
1902 PARAGON 1902

NOISELESS **FAN MOTORS** COMPACT

ALL STYLES AND SIZES EASY RUNNING RIGID CONSTRUCTION

—CALL AND SEE THEM OR WRITE FOR PRICES—

CHICAGO EDISON COMPANY, 139 ADAMS ST., CHICAGO.



PARAGON DESK FAN

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.

Dam Builders and Hydraulic Engineers, Etc. ILKHART, INDIANA.

EDWARDS AND CO.

The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.

All springs made of Phosphor Bronze and so formed that there is least possible strain.

Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.

Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.

The hammer entirely concealed by gong and cannot be tampered with.

It is especially adapted for use on street cars, as, in addition to the advantages mentioned, it is dust, insect and moisture proof.

NEW YORK N.Y

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

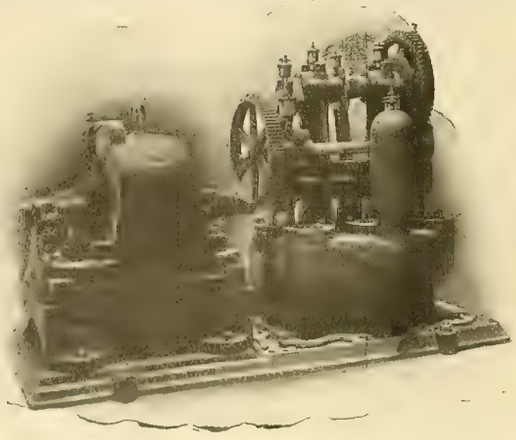
If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette Bldg., Chicago.

Boston and Return
$19.00
VIA THE WABASH.

On account of the meeting of the Brotherhood of St. Andrew, the Wabash road will sell excursion tickets from Chicago to Boston, October 7 to 11, at one fare ($19) for the round trip. By deposit and payment of 50 cents the limit may be extended to November 12. Write for maps and time-tables. F. A PALMER, A. G. P. A., 97 Adams Street, Chicago, Ill.



30 H. P., 60 Cycle, 208 Volt. Single Phase Motor Geared to Triplex Pump.

OUR **SINGLE PHASE MOTORS** ARE

Particularly Suited for Pump Operation.

THEY WILL **START UNDER FULL LOAD** BY

Simply Closing the Primary or Secondary Circuit at any point. However distant from the motor

ONLY ONE TRANSFORMER REQUIRED.

If interested we would be pleased to have you inform us of your requirements.

WAGNER ELECTRIC MFG. CO.

ST. LOUIS, MO., U. S. A.

COLUMBIA LAMPS

Absolute uniformity in initial candle-power
Highest maintenance of candle-power
Candle-power, voltage and efficiency guaranteed
Shipments from Chicago stock

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

THE GENERAL ELECTRIC COMPANY'S

Street Car Recording Wattmeter.

Furnishes a positive record of the power used on each car and provides the only practical means for education of motormen in economy of operation.

General Office: Schenectady, N. Y.

Sales Offices in All Large Cities. New York Office, 44 Broad Street.

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, - - - CHICAGO.

FLOTATION IN AIR

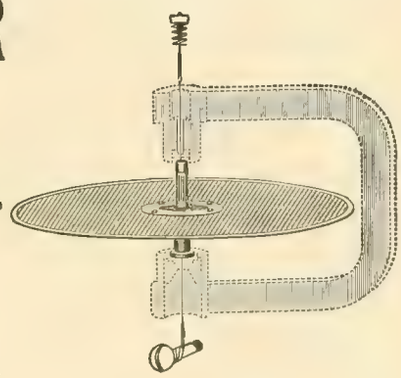
OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.



SALES OFFICE,
158 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., { San Francisco, Cal. / Los Angeles, Cal. / Seattle, Wash.

W. H. RATTENBURY, Pres. R. D. JONES, Vice-Pres. ARTHUR FRANTZEN, E. E. M. E., Secy. and Treas.

ARTHUR FRANTZEN COMPANY,

INCORPORATED.

ELECTRICAL CONTRACTORS.

BRANCH OFFICE.
Room 409 Citizens Bank Building,
DES MOINES, IA.

Rooms 12-14, 225 Dearborn Street,
CHICAGO, ILL.

BUILDINGS RECENTLY EQUIPPED BY US

Hotel Gayoso, Memphis, Tenn.
Bush Temple of Music, Chicago.
Iowa Hospital for Insane, Cherokee, Ia.

Oliver Chilled Plow Works, South Bend, Ind.
Citizens Bank Building, Des Moines, Ia.

Press and Gymnasium Building, Chicago University.
J. Hobart Moore Residence, Lake Geneva, Wis.

Estimates furnished for complete Electric Light Plants, Power Wiring, Switchboards and Panel Boards.
Write for details on our new Underground System of Electric Switch Lighting in Railway Yards.
Estimates and Specifications furnished for Experimental Laboratory Equipments for High Schools.

Experimental equipments installed by us in Waller High School, English High and Manual Training, School of Ed. Chicago University and South Division High School.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Coit, Henry A.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Frantzen Company, Arthur.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Pratt Institute.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. **B. S. BARNARD, Vice-President and Secretary.**

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Grimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

Chicago TO New York AND Boston

VIA THE POPULAR

West Shore Route

Through sleeping and dining car service via Nickel Plate or Wabash from Chicago.

Passengers via this favorite route arrive in New York at uptown station, Forty-second street, the center of the hotel and shopping district, or downtown at Franklin street station, in close proximity to all ocean steamship docks and Jersey City and Brooklyn. For tickets, sleeping car space and further information call on or address

JOHN W. COOK,
G. W. P. A.,
205 S. Clark Street, CHICAGO, ILL.

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances,
Write for catalogue. 193-197 River St. DETROIT MICH

THE WORCESTER POLYTECHNIC INSTITUTE

EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

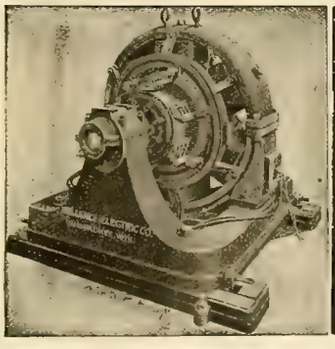
J. K. MARSHALL, Registrar, Worcester, Mass.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.



"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - - WIS.
AGENTS WANTED EVERYWHERE.

Western Electrician WANT ADS Bring Results.

MONON TRAINS FOR
La Fayette
W. Baden Spr.
Fr. Lick Spr.
Louisville
Mammoth Cave
Chattanooga
New Orleans
All Southern Cities.

MONON TRAINS FOR
Indianapolis
Dayton
Cincinnati
Asheville
Atlanta
Jacksonville
St. Augustine
Tampa
Havana.

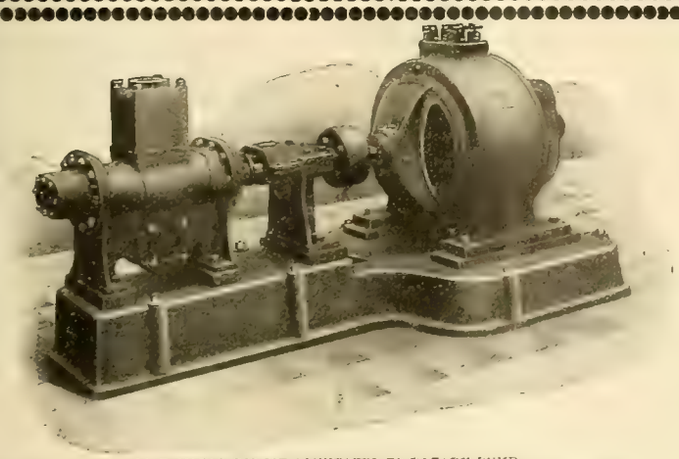
ANYTIME

You travel between
CHICAGO
LOUISVILLE
INDIANAPOLIS
AND
CINCINNATI
GO VIA

MONON ROUTE
AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W H McDOEL, PRES & GEN'L MGR. FRANK J REED, GEN'L PASS & AGT. CHAS H. ROCKWELL, TRAFF MGR.
CHICAGO.



W. E. MOTOR DIRECT CONNECTED TO ROTARY PUMP.

MOTOR APPLICATIONS

WRITE FOR POWER MOTOR CATALOGUE.

Our motors are made from the best materials obtainable, by the most skilled and experienced mechanics and are subjected to the most careful tests before shipping.

WESTERN ELECTRIC COMPANY,
CHICAGO. SAINT LOUIS. PHILADELPHIA. NEW YORK.

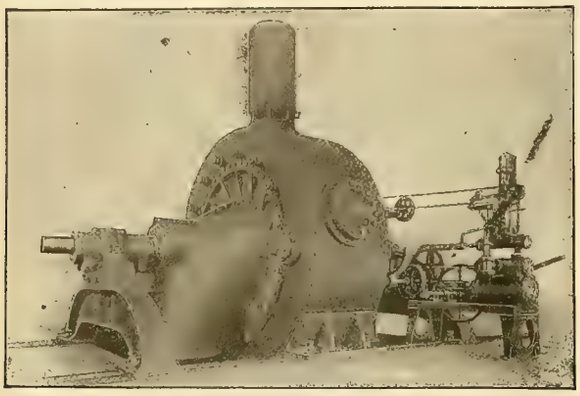
KEEP YOUR BOILERS CLEAN

By using **DEARBORN BOILER COMPOUNDS.**

MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



SAMSON TURBINE

UNEXCELLED FOR DRIVING

ELECTRICAL MACHINERY.

Special Features:

HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

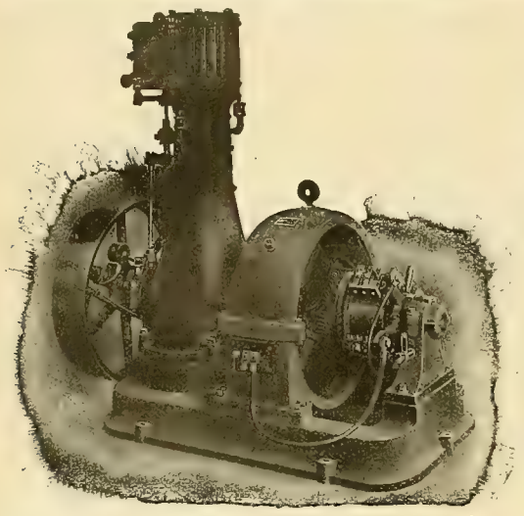
Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
610 Marquette Building,
CHICAGO.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

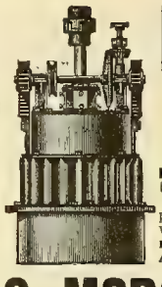
Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent,
Chicago, Ill.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"

ELECTRIC LIGHTED

. . TO . .

California

VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS

"Phosphor Bronze"

DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

WESCO

Is the trademark of the **only** supply house in the United States carrying a **complete line of everything** pertaining to the construction, maintenance and equipment of

Electric Light and Power Plants, Electric Railways, Telephone Lines and Exchanges.

The largest **stock supplies** and **construction material** in the country.

Why shouldn't we be able to give you the best prices and prompt shipments?

Western Electrical Supply Co.,

WRITE US TO-DAY.

ST. LOUIS, U. S. A.

PROVE IT FIRST

In the din of a busy plant a lamp buyer's judgment is sometimes fixed by a mere noise. Every lamp is the best lamp. But the ***Packard*** proves its place—proves it so that you know it's the lamp you want.

Take up the matter as you should. Test them all. Get the story of managers who are using the ***Packard***. You will find it popular in the A1 plants. Learn the lamp and we'll sell to you.

Electric Appliance Company,

92 and 94 West Van Buren St., CHICAGO.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles, Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

Genera Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.,

218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

YOU HAVE SEEN

alternating arc lamps that hum, and others which were full of bugs, and still others which were humbugs,

BUT

you have not seen the best alternating current arc lamp if you have not seen the Toerring. It neither dances, sings nor hums—it merely burns, and does it well.

39 CORTLANDT ST. — 19th & ALLEGHENY AVE.

NEW YORK CITY. **S. TOERRING CO.** PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,

156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

Send for Circular.

L. M. PIGNOLET,

78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,

1504 Monadnock Block,

TELEPHONE HARRISON 745. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.

1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building,

CHICAGO.

HENRY H. HUMPHREY,

Consulting, Electrical and Mechanical Engineer.

CENTRAL LIGHTING STATIONS,

ELECTRIC POWER TRANSMISSION.

Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

Gale's Commutator Compound.

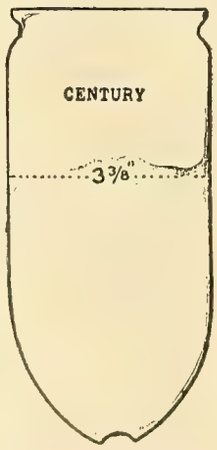
The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

50c. per stick. $5.00 per dozen. Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street, CHICAGO.



ALL STYLES OF

GLOBES AND SHADES

FOR ALL TYPES OF LAMPS.

WE ARE THE ONLY HOUSE IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.

WE CAN MAKE ANY STYLE YOU DESIRE.

WRITE FOR CATALOGUE.

THE CENTURY GLASS COMPANY, BELLAIRE, OHIO.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. CHICAGO.

SARGENT & LUNDY,

Engineers,

1000, 46 E. VAN BUREN ST., CHICAGO.

FREDERICK SARGENT. A. D. LUNDY

"YOU PRESS THE BUTTON,

THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

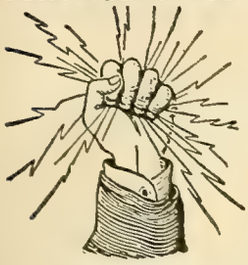
ILLINOIS ELECTRIC SPECIALTY COMP'Y,

TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENBEIL, Treasurer. O. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



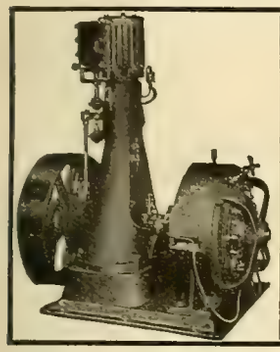
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

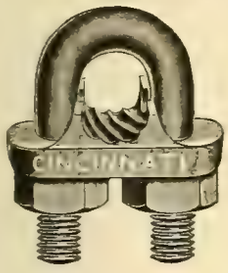
WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

Best On The Market.



THE CINCINNATI WIRE CLIP
IS WITHOUT DOUBT
THE BEST ON THE MARKET.

GRIPS FIRMLY.
NO POSSIBILITY OF SLIPPING.
LOW IN PRICE.

Write us now for particulars.
THE STANDARD ELECTRIC CO.,
113 West Third Street, *CINCINNATI, OHIO.*

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
Easy to install.
Cheaper than other guys.
One piece. No moving parts.
Necessary for well guyed poles.
Operated like a corkscrew.
Mechanically correct.
Indestructible by fire or frost.
Carefully made.
Anchors that pay dividends.
Labor savers.

STOMBAUCH GUY ANCHOR

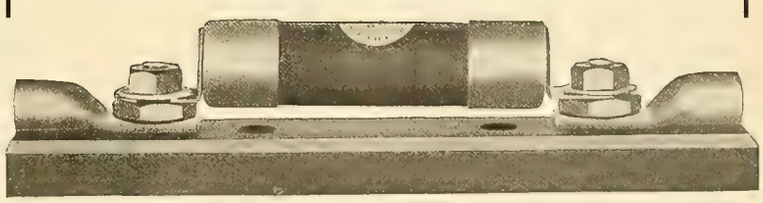
STOMBAUCH GUY ANCHORS

Write for prices, to

W. N. MATTHEWS & BRO.
603 Carleton Building,
ST. LOUIS.

Worm's-Eye View.

"SHAWMUT" ENCLOSED FUSES



RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Shows whether blown by overload or short circuit.

Indicating Type P Fuse, intact.

Fuse blown by overload, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Electrical and mechanical engineer, thirty years old, and a technical graduate, having had six years experience, is familiar with steam machinery and electrical apparatus of both direct and alternating current, wishes to correspond with a concern in need of an operating engineer. Address BOX 107, care Western Electrician, 510 Marquette Building, Chicago, Ill.

POSITION WANTED.

Position by young man of 24, as manager or electrician of a telephone exchange of 100 to 500 phones; prefer one which is building or just completed. Technical education. References furnished. Address with particulars, BOX 100, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

First-class solicitor for light and power business Salary and commission. City of 60,000. Address BOX 106, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

To purchase a majority of the capital stock of a non-paying electric-light plant in a town of not less than 10,000 inhabitants. Address BOX 105, Western Electrician, Chicago, Ill.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

POSITIONS OPEN.

	PER MONTH.
5 Draftsmen, Electrical	$100
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
1 Electrical Superintendent	$85
1 Electrical Superintendent	$50
2 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.

SEE NEXT ISSUE.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

BUSINESS CHANCES.

We can sell or trade your electric-light plants every time. Consult us.

THE SCIENTIFIC EXCHANGE
Room 60, No. 6 Sherman St., CHICAGO, ILL.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
2— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Two 250 K. W. 10,000 volt, 60 cycle, three-phase, revolving field type, belted General Electric alternators, in service two years. PORTLAND LIGHTING & POWER COMPANY, Portland, Me.

FOR SALE.

Good second hand transformers, General Electric Type F, 125 cycle, primary 1,040V, secondary 52V and 104V. All sizes from 800 to 3,500 Watts. PEOPLE'S LIGHT COMPANY, Davenport, Iowa.

FOR SALE.

We have several brand new motors for sale at bargain prices. Sizes from 10 H. P. down. In stock ready for quick delivery. Write, WAGNER-HATCH MOTOR CO, 308 Dearborn St., Chicago, Ill.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

One 1,000-K. W. direct-connected vertical cross-compound side-crank McIntosh & Seymour engine, now nearly completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26/100. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at McIntosh & Seymour's factory, Auburn, N. Y. Address ELECTRIC DEPARTMENT, ROCHESTER GAS AND ELECTRIC COMPANY, Rochester, N. Y.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa, Saginaw, 95-97 Liberty St., New York City, Mich.
1214 Marquette Bldg., Chicago, Ill.

FOR SALE.

12 x 20 Rice Automatic Engine, 1,000-light National Alternator with exciter, switchboard and instruments, heater, hot and cold water pumps, two 50-horsepower boilers, belts, tools, etc.

The City of Kendallville, Ind., recently put in a larger plant at a new location and now desires to dispose of all the apparatus of its former electric-light plant.

JAMES GRAVES, Mayor,
Kendallville, Ind.

Half Rate to TORONTO EXPOSITION AND FAIR.

Route, Wabash and Canadian Pacific. Rate from Chicago, $12.40 for the round trip. Dates of sale, August 30 to September 2, inclusive. Return limit, September 15, inclusive. Write for maps and time-cards. F. A. PALMER, A. G. P. A., 97 Adams Street, Chicago.

WANTED.

60 to 100 K. W. Dynamo, 110 or 220 volts. Also Engine to operate same. Prefer direct connected outfit. BOX 108, care Western Electrician, 510 Marquette Building, Chicago.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from.

THE SCIENTIFIC EXCHANGE,
Room 60, 6 Sherman St., Chicago.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

Electrical Machinery.

One 60 K. W. General Electric alternator, toothed armature, self oiling, $400; one 60 K. W. Westinghouse alternator, toothed armature, self-oiling, $400; one 30 K. W. Westinghouse, 60 cycle alternator, $390; two 50-light T. H. arc dynamos, ring armatures, self-oiling, $275; one extra ring armature for same, $100; one 75-light, 1,200 C. P. Wood arc dynamo, $325; one 60-light, 2,000 C. P. Wood arc dynamo, $275; two 60-light, 2,000 C. P. Standard arc dynamos, $275 each; one extra armature for 50-light Standard arc dynamo, $90; one 40-light, Wood arc dynamo, 2,000 C. P., $190; one 100 K. W. 500-volt Standard, $600; two 20 K. W. Edison, 125-volt machines, $225 each; one 40-light Western Electric, 2,000 C. P., with extra armature, $200; 141 Standard 2,000 C. P. arc lamps, $3.50 each.

National Stamping Works, Chicago, Ill.

FOR SALE.

In good operative condition, now being removed to make room for larger machinery.
4—72 inch x 16 feet tubular boilers.
2—9 and 16x12 inch tandem compound Ball engines.
1—8 and 13x12 inch tandem compound Ball engine.
1—500-H. P. Buffalo condenser.
1—500-H. P. Dean condenser.
69 T. H., Stanley & Wood transformers, 10 to 250 lights each, 1,000 volt primary, 100 and 50 volt secondary.
About 3,008 of 12 inch, and 100 feet of 18 inch double leather belting, in good condition.
All the above for immediate delivery.

Fond du Lac Street Railway and Light Co.,
FOND DU LAC, WIS.

READY AND GUARANTEED.

ENGINES. High Speed Automatic, Medium Speed Automatic, Corliss.
DYNAMOS. Direct Current Lighting and Railway. Alternating Current Lighting.
BOILERS, PUMPS, HEATERS, SMOKE STACKS, ETC.
Write for our new price list No. 49, just out.

ILLINOIS MAINTENANCE COMPANY,
E. H. CHENEY, Manager. No. 204 Dearborn St., CHICAGO.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	48x16 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	36x8 Horizontal Tubular.
5	60x16 Horizontal Tubular.	1	54x8 Vertical Tubular.
			Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

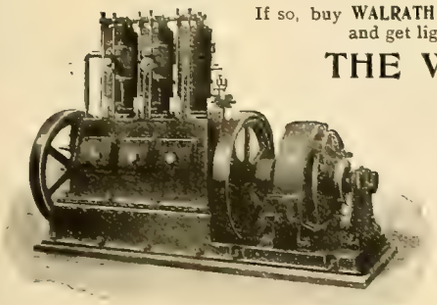
Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

HEAT AND LIGHT

PROCEED FROM ONE SOURCE.

In the great laboratory of nature, heat and light are the life of the world. If the sun gave out light and no heat, or vice versa, the world would be a dead planet.

The electric station that supplies power alone is only half fulfilling its mission. Heat is as staple an article as light and quite as indispensable, and heat bills are larger than bills for lighting in most buildings.

The electric station, lighting or railway, in its exhaust steam, which it is perhaps wasting in the air, possesses the means of increasing its net income by many thousands of dollars. Scores of these steam-heating plants constructed by us are in operation now.

Our underground system of steam mains is the most complete, the most durable, the most up-to-date that experience and ingenuity can devise. Our methods of insulation and devices for providing for expansion and contraction of the underground pipes are the most perfect yet invented.

Our Condensation Meter is a correct measure of the amount of steam used by each consumer, without which the Company is liable to serious loss without being able to locate it. A meter is one of the most essential features applicable to a heating system.

For particulars write for our pamphlet. Address—

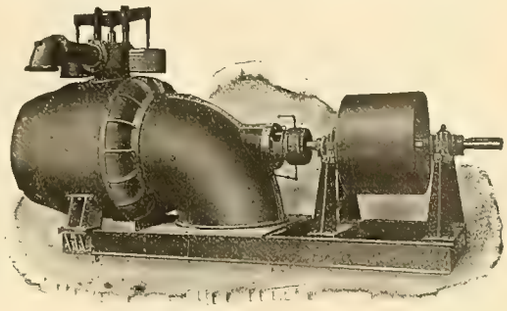
AMERICAN DISTRICT STEAM CO.

LOCKPORT, NEW YORK.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,

257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch St.
BOSTON, 73 Oliver St. CHICAGO, 311 Dearborn St.
NEW ORLEANS, 304 Hennen Bldg. LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance

Electrician Publishing Co.,

Suite 510 Marquette Bldg., - CHICAGO

PRATT INSTITUTE

BROOKLYN, N. Y.

TWO YEAR COURSES IN

APPLIED ELECTRICITY

AND IN

STEAM AND MACHINE DESIGN

Write for Catalogue and Particulars.

TEST INSTRUMENTS.

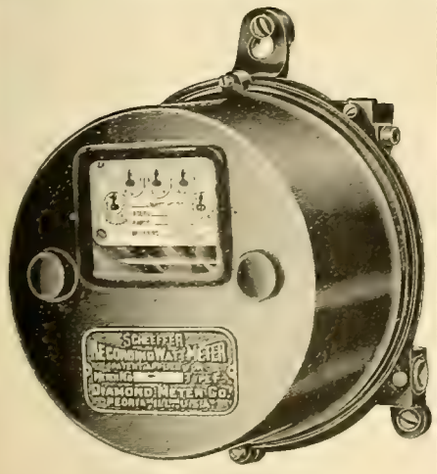
Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.

Send for Catalogue No. 507 10c in stamps.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

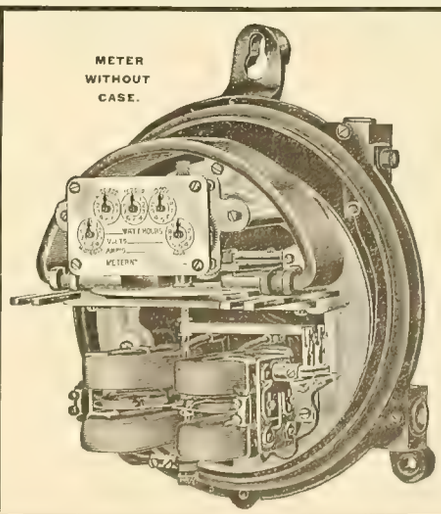
IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.



METER WITHOUT CASE.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

Before attachment.

PATENTED GALVANIZED STEEL CABLE HANGER.

Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

In place on cable.

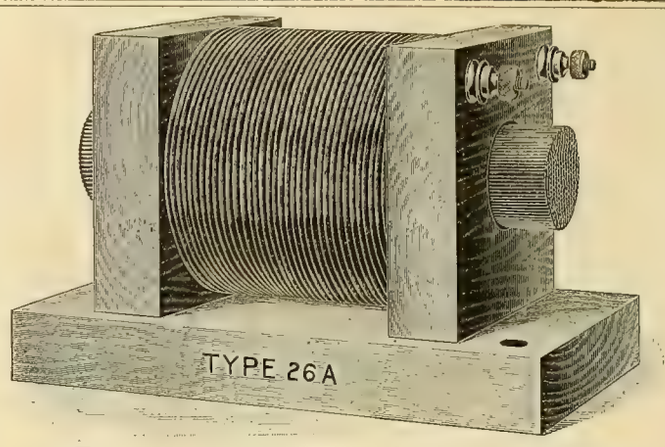
11½ -inch "Spread," points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.

20 inch "Spread," points up or down.

Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.



SPARK COILS

FOR EVERY PURPOSE.

VARLEY DUPLEX MAGNET CO., CHICAGO, ILL. PHILLIPSDALE, R. I.

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table, 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

THE TELEPHONE HAND-BOOK

BY

HERBERT LAWS WEBB.

Price $1.00.

The only complete and practical work of its kind on the market.

PUBLISHED BY

THE ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, Chicago

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

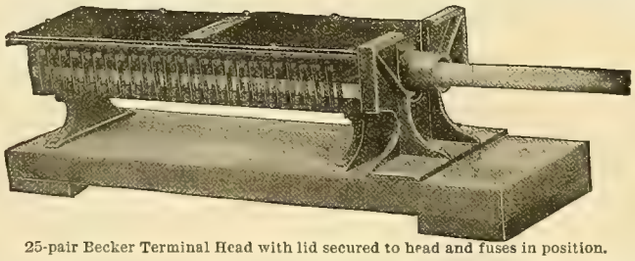
Chicago Pay Station Co.,

130 LA SALLE AVE.,

CHICAGO.

PROTECTION

THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

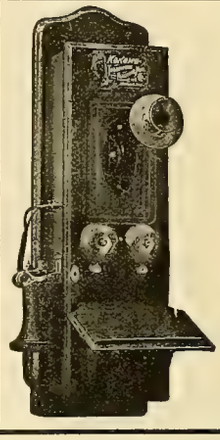
A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Illinois Electric Co., Chicago Agents.

Post-Glover Electric Co., Cincinnati Agents.

W. G. Nagel Electric Co., Toledo (O.) Agents.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American, Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

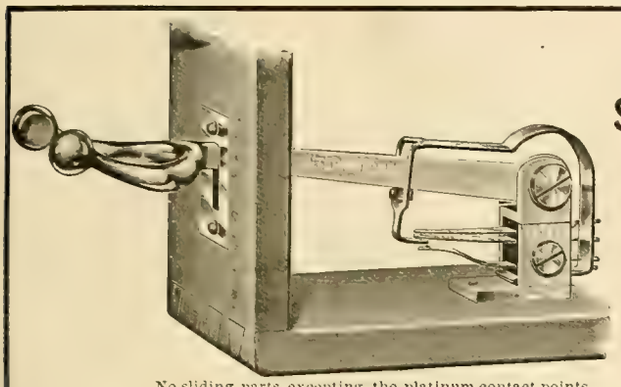
TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. INTERNATIONAL TELEPHONE MFG. Co.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

Telephone Troubles

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.

No. 34 Central Energy Telephone.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg,. Chicago.

82950

Lines installed

in multiple boards ALONE, up to July 29th

All modern systems demand multiple boards. Each operator has every subscriber's line within her reach in exchanges up to 18000 lines capacity when Kellogg three-tenths inch center multiple jacks are installed. No transfers; straight through connections. Investigation and comparison invited.

KELLOGG SWITCHBOARD & SUPPLY CO.
225 South Green Street, Chicago

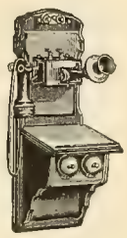
82950

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

Have You Investigated the EUREKA No. 20 RECEIVER? It's a crackerjack.

SWITCHBOARDS AND TELEPHONES of Every Description for Common Battery and Magneto Systems.

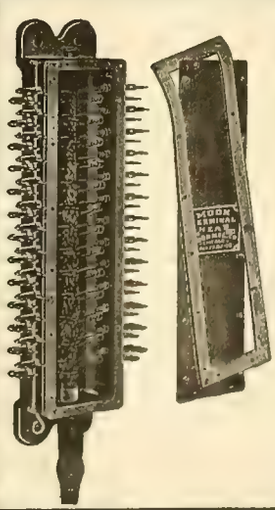
Samples cheerfully submitted. ...Prices Right.

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

Better protect your interests by obtaining our prices before placing your orders.

No. 20 Receiver Assembled. No. 20 Receiver Exposed.

EUREKA ELECTRIC CO., 143-149 SOUTH CLINTON ST., CHICAGO, U. S. A.



MOON TERMINALS

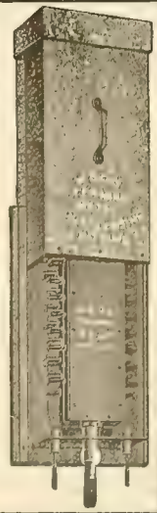
WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.



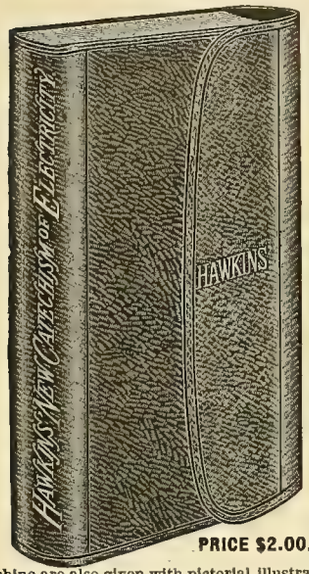
CEDAR POLES.
WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

HAWKINS' NEW CATECHISM OF ELECTRICITY.
Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.
The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.
It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.
It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.
The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.
The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.
Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.
The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.
The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.
The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.
In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.
ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

A NEW BOOK.
MUNICIPALITIES vs. PRIVATE CORPORATIONS.
Political and Business Management Compared.
By M. J. FRANCISCO.

Tables showing cost of lights furnished by Private Companies and Municipal Plants.
A list of Municipal Plants sold or abandoned.
Average cost by the two systems.
Experience of Municipalities who own plants.
Legal and official opinions from a large number of the most prominent men in the nation
Editorials opposing the system from nearly all the leading journals of the U. S.
All statistics to date.

Any Company doing street lighting will want the data contained in this book.
Sent postpaid on receipt of price, $1.00.
ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BLDG., CHICAGO.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

"Practical and to the Point"
IS ALL THAT NEED BE SAID OF
THE TELEPHONE HAND-BOOK
By HERBERT LAWS WEBB.
160 Pages, 133 Illustrations, Cloth, Price $1.00.
The book for those interested in telephony.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

The Inspector AND Trouble Man.
By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.
A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.
Mailed anywhere on receipt of price, **ONE DOLLAR.**
No technicalities. Substantially bound in cloth.
ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

GOOD BOOKS.
AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**
The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors.
By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**
The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D.
This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1.25.**
A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.
This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.
The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.
The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.
The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.
Sent Prepaid on Receipt of Price.
ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

FIVE GOOD BOOKS.
NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.
ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.
ONE DOLLAR EACH.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20 foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES.

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.
Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building. - CHICAGO

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES STREET RY. TIES PENRIZ TOMS DAGGETT MICH.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

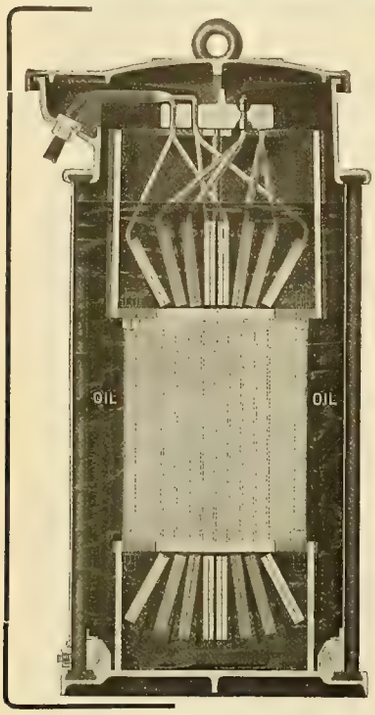
CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Preserve Your Copies
OF THE **WESTERN ELECTRICIAN.**
BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, ... CHICAGO.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

A Few More Facts About Transformers

Average Temperature



Every coil in the Westinghouse Transformer shares equally in the cooling—

(1) The exposed spread end of one coil presents the same surface in contact with cooling oil as any other. Each coil thus passes off its heat with equal facility, and no unequal expansions occur to injure the insulation.

(2) Heat generated within the interior travels, not through layers of insulation, but along highly conducting copper to the spread coil ends. This is why no "hot spots" develop, and this is why temperatures are uniform in O D and Type N Transformers.

There is practically no difference between the temperature measured by a thermometer placed between the coils and that measured in the copper by the resistance method. This is actual proof of the uniform temperature in O D and Type N Transformers.

FOR TRANSFORMER BOOKLETS ADDRESS NEAREST SALES OFFICE OF THE

WESTINGHOUSE ELECTRIC and Manufacturing Co.
PITTSBURG, PA.

New York, Atlanta, Dallas, Boston, Buffalo, Chicago, Cincinnati, Los Angeles, Cleveland, Detroit, Minneapolis, Philadelphia, Pittsburg, St. Louis, San Francisco, Syracuse, Seattle, Salt Lake City, Washington, Denver, Mountain Electric Co. Canada: Ahearn & Soper Limited, Ottawa.
Mexico: G. & O. Braniff, City of Mexico.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X; Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

A New Application of an Old Principle

An electrostatic ground detector employing the attractive force of oppositely charged points—not surfaces,—as of old.

Advantages—light moving parts, sensitiveness, no wear of jewels.

FORT WAYNE ELECTRIC WORKS.

MAIN OFFICE AND FACTORY: FORT WAYNE, IND.

LIST OF SALES OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 616 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 New St.

JUST OUT

NEW CATALOGUE OF ELECTRICAL BOOKS.

You Ought to Have One. Sent Free on Request.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

AMERICAN STORAGE CELLS

AMERICAN BATTERY CO.,
171 S. Clinton St., Chicago, Ill.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

GARDNER Die Stock

frame is the lightest and Strongest of any

CHARLES. H. BESLY & CO

FINE TOOLS & SUPPLIES FOR METAL WORKERS

108 & 112 N. CANAL ST. CHICAGO ILL. U.S.A.

SEND FOR 300 PAGE ILL CATALOGUE

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of Slates for Electrical Purposes

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

STURTEVANT EXHAUST HEADS

No Baffle Plates to rattle loose. Centrifugal action compels separation of water and steam.

B. F. STURTEVANT CO.

BOSTON, MASS.

NEW YORK - PHILADELPHIA - CHICAGO

LONDON

169

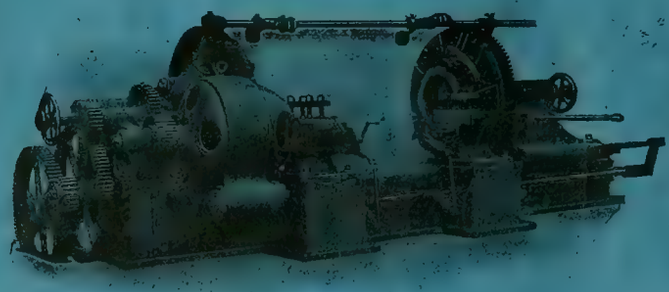
CROCKER-WHEELER

Direct-Current Machinery.

Accuracy in electrical design produces sparkless running.

Strength of insulation and mechanical features insure durability.

Graceful lines result in attractive equipments.



SALES OFFICES IN ALL LARGE CITIES.

Office and Works, - - - AMPERE, N. J.

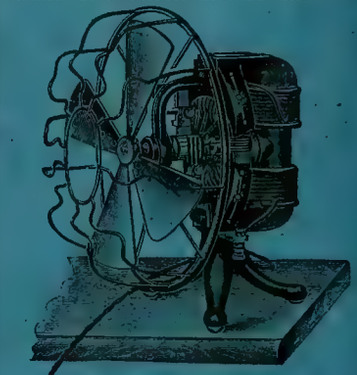
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

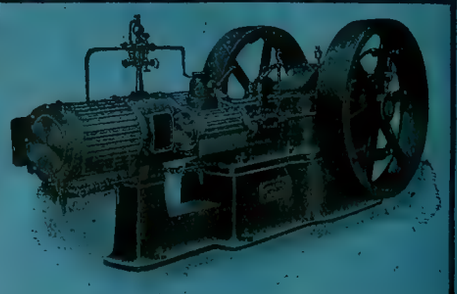
Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY

PHILADELPHIA, PA.

BUFFALO HIGH SPEED ENGINES FOR ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY

BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 6, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 10

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s

RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE

TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, M. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of Slates for Electrical Purposes

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

STANDARD

Standard Underground Cable Co.

822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.

Electric Cables, Conduits, Wires and Accessories.

Also High Grade Rubber Covered Wires and Cables.

McNAMARA BROS.

ELECTRIC SWITCHBOARDS, SLATE AND MARBLE.

Write for Catalogue B. Fair Haven, Vt.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ⅓ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

MARTIN MALEY,

MANUFACTURER OF ALL KINDS OF

VERMONT SLATE

FOR ELECTRICAL USE.

Switchboards A Specialty.

FAIR HAVEN, VERMONT.

THE PHOENIX GLASS CO.

MANUFACTURERS OF

GAS AND ELECTRIC GLOBES, SHADES, Etc.

SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.

Pittsburgh. New York. Chicago.

This No. 175 is handy for a desk 'phone or a wall 'phone—just suits your PARTICULAR subscriber.

STANDARD OF THE WORLD.

ERICSSON TELEPHONE CO. 296 B'WAY NEW YORK

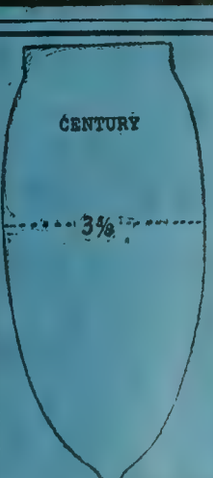
Full equipments for exchanges and private lines. Ask for Catalogue and information.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.



WE CAN PLEASE YOU

IN THE LINE OF

ELECTRICAL GLASSWARE

AND ARE PREPARED TO FURNISH YOU WITH GLOBES OR SHADES FOR ALL TYPES OF LAMPS.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Portable Galvanometer for Bridge Work.

Weston Standard Portable Direct Reading

Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters,

Ground Detectors and Circuit Testers,

Ohmmeters. Portable Galvanometers.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.

Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.

Mention the Western Electrician when writing for catalogues.

FOR HIGH GRADE

INSULATING VARNISHES

APPLIED

STANDARD VARNISH WORKS

CHICAGO NEW YORK

The Man Behind the Order

is the man you want to reach. You can reach him through the

WESTERN ELECTRICIAN'S ANNUAL FALL TRADE NUMBER

This number will be dated September 13, 1902, and its principal object will be to awaken interest in the Fall and Winter trade which, competent judges prophesy, will be exceptionally large.

You can obtain a share of this business by being largely represented in the advertising columns of this important issue. Place the merits of your product before the buyers of the world through an attractive announcement and you will secure much business which you would not obtain otherwise.

Give us an idea of what you wish to advertise and we will get up something striking for you.

Reserve your space early and obtain a choice location.

Western Electrician,

510 Marquette Building, Chicago.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.

The "Exide Accumulator" For Electric Vehicles.

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 260 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: Philadelphia, Allegheny Ave. & 19th St. New York, 100 Broadway. Boston, 60 State St. Chicago, Marquette Bld. Baltimore, Continental Trust Bld. St. Louis, Wainwright Bld. San Francisco, Nevada Block. Cleveland, New England Bldg. Detroit, Michigan Elec. Co. Havana, Cuba. F. G Greenwood, Mgr. 34 Empedrado Street.

R 52

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago.

Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

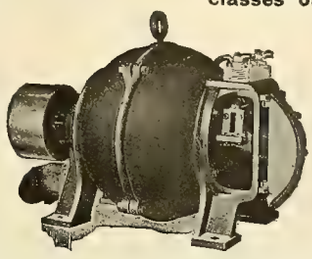
Federal Electric Co.
84 Market Street, CHICAGO, ILL.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
Allis-Chalmers Company....20
American Battery Co.....—
American District Steam Co.18
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
American School of Corresp. 9
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Badt & Co., F. B..... 10
Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Beidler & Co, Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 1
Bossert El. Construction Co.. 1
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co..—
Century Glass Co..... 1
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R.....16
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co.. 20
Chicago Insulated Wire Co..—
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Columbia Telephone Mfg.Co. 14
Continuous Rail Joint Company of America..... 5
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 7
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ...—
Dicke Tool Company.....16
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....18
Edwards & Company..... 5
Electrical Engineer Institute.11
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ericsson Telephone Company 1
Eureka Electric Company....—

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....16
Fulmer Lumber Co., D. M. ...17

General Electric Company... 4
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company..12

Hartford Steam Boiler Inspection & Insurance Co... 8
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....17
Holmes Fibre-Graph. Co..... 5
Hopkins & Co, A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....10
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....13
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company..... 15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 5

Machado & Roller..... 7
Maley, Martin..... 1
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..13
Marinette Iron Wks. Mfg. Co. 9
Matthews & Bros., W. N.....11
McLennan & Company, K....10
McNamara Brothers 1
Medora Milling Company....17
Metropolitan Tel. & El Co...14
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 5
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 5
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 5
Norton Tool Company, The..15

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed.....16
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John 11
Reisinger, Hugo..... 7
Reliance Electric Company.. 7
Replogle Governor Works.. .—
Reynolds Electric Company.—
Roebling's Sons Co., J. A.....13
Rose Electric Company 12

St. Louis Elec. Supply Co... 20
Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 12
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Signaloid Chemical Works...16
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 7
Smith Co., S. Morgan..... 8
Spies Electric Company..... 5
Sprague Electric Company... 3
Standard Electric Company..11
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 5
Stanley Instrument Co..... 5
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The....10
Sterrett Pump Company..... 9
Stilwell-Bierce & Smith-Valle Company..... 9
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co.....10

Union Pacific R. R..... 8
U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company....11
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
West Shore Route.....—
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst.. 7

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

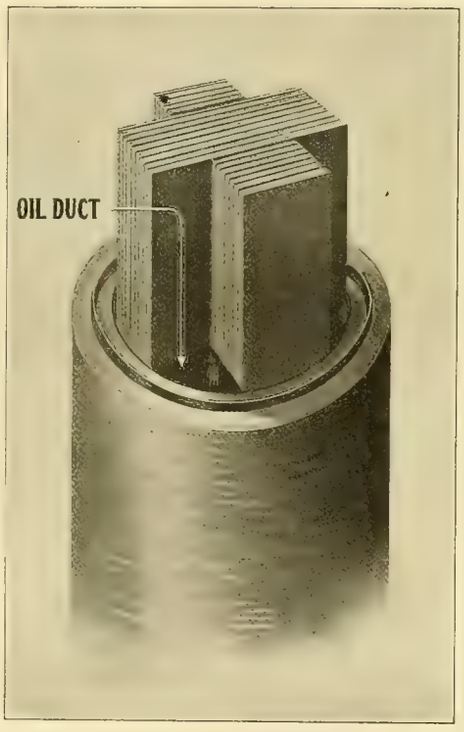
ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

GENERAL ELECTRIC COMPANY'S



Type "H" Transformers

OIL COOLED.

INITIAL AND ULTIMATE ECONOMY OF OPERATION—because of low core loss, non-aging of iron, and long life due to uniform temperature and expansions—MAKE TYPE "H" TRANSFORMERS A GOOD INVESTMENT.

GENERAL OFFICES: SCHENECTADY, N. Y.

CHICAGO OFFICE: Monadnock Block. Sales Offices, all large cities.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

Sales Office,
15 Cortlandt St., New York.

YONKERS, N. Y.

(10928)

TYPE K TRANSFORMERS.

PITTSBURGH TYPE K.

The saving effected by the use of efficient transformers is wiped out by the cost of rewinding and other repairs if these are subject to frequent burn-outs.

No transformer is truly efficient if it lacks durability

COLUMBIA LAMPS HAVE A LONG LIFE. TRY THEM.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

FIBRE-GRAPHITE COMMUTATOR BRUSH — SELF-LUBRICATING — WORKLESS

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

Kilfyre DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

GASOLINE MOTORS

—FOR—

BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

EDWARDS AND CO. New York, N.Y. U.S.A.

PUSHES.

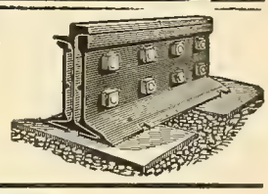
Fits in ¾ inch Hole. Fits in ½ inch hole
Fits in ⅝ inch hole.
No screws needed to fasten them as the spring clips hold them securely in place.

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING,

NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



GRIMSHAW WHITE CORE INSULATED WIRE

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Grimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

FLOTATION IN AIR

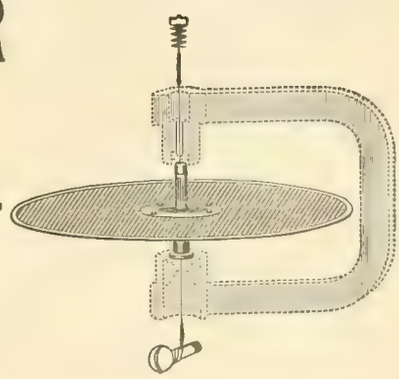
OF THE MOVING PARTS OF

STANLEY RECORDING WATTMETERS

FOR **ALTERNATING CURRENT**

IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION

"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

SALES OFFICE,
158 BROADWAY,
NEW YORK CITY N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. **B. S. BARNARD, Vice-President and Secretary.**

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring for Inc. Lamps.
Signaloid Chemical Works.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
Eureka Electric Company.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS.
FOR DIRECT CURRENT.
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY, NEW YORK.

There are no Carbons better than the "Electra" and none "just as good."

THE SAGE OHMMETER

is unquestionably the ***best*** resistance measuring device on the market. No other approaches it in accuracy, length of scale, finish or grade of material.

We satisfied ourselves fully of its vast superiority before taking over the exclusive manufacturing and selling rights.

We carry a large stock and are pleased to announce a

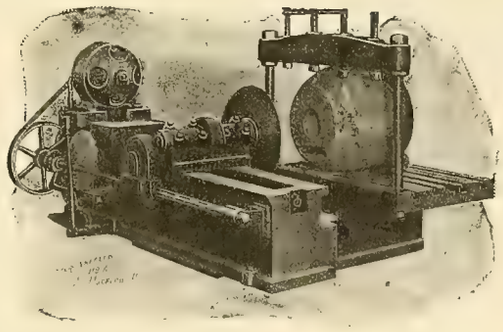
MARKED REDUCTION FROM FORMER PRICES.

List price of this four-scale range, $45.00

Send for discounts to **MACHADO & ROLLER,**
203 BROADWAY, NEW YORK CITY,
General selling agents for Whitney Electrical Instrument Co.
OR TO
Electric Appliance Co., Chicago. Electrical Engineering Co., Minneapolis
Western Elec'l Supply Co., St. Louis. Standard Electric Co., Cincinnati.

CROCKER-WHEELER COMPANY.

Motors of the highest grade of manufacture, well adapted to the operation of many forms of machine tools.



Sales Offices In All Large Cities.

Office and Works, - - AMPERE, N. J.

THE WORCESTER POLYTECHNIC INSTITUTE

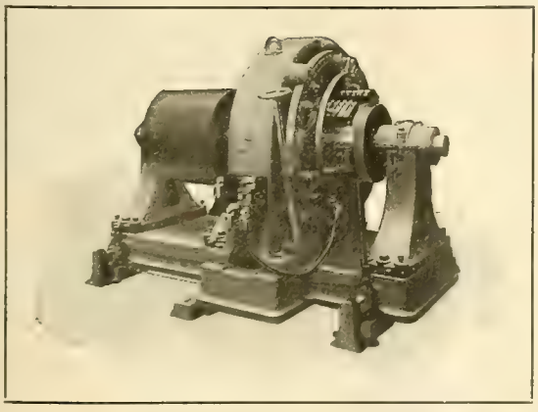
EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"RELIANCE"
GENERATORS AND MOTORS.
SEND FOR BULLETIN.
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.



POWER AND LIGHTING

BULLETINS No. 2003-2004

WILL SATISFY YOU AS TO THE

SUPERIORITY

OF OUR APPARATUS

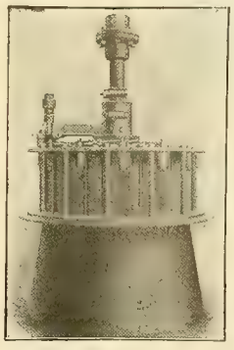
WESTERN ELECTRIC COMPANY

CHICAGO—SAINT LOUIS PHILADELPHIA—NEW YORK

ALL PARTS of the BOILER CAN BE KEPT CLEAN BY USING
DEARBORN BOILER COMPOUNDS
MADE TO SUIT THE WATER AS PER ANALYSIS : : :

NEW BOILER COMPOUND FEEDER, WILL FEED ANY KIND OF COMPOUND Write for Particulars

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



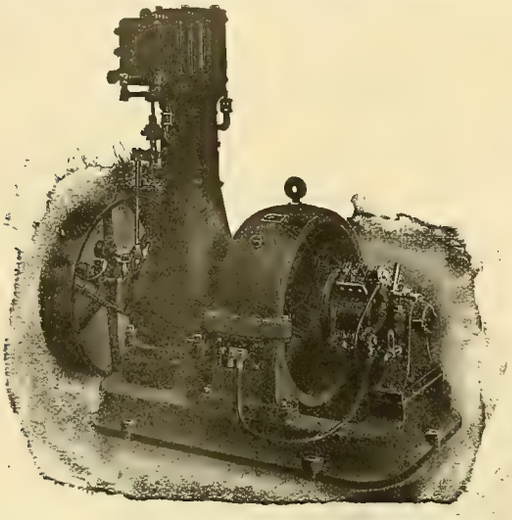
SAMSON TURBINE
UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



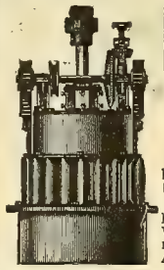
HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

TO THE GREAT NORTHWEST
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"
ELECTRIC LIGHTED
. . TO . .
California
VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, Etc.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL CHAINS
FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

GRAPHITE RESISTANCE.
Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS — "Phosphor Bronze" — DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. — HARTFORD, CONN.

THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.

The Pioneer Limited. Famous Train of the World.

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent,
Chicago, Ill.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN
CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP

IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

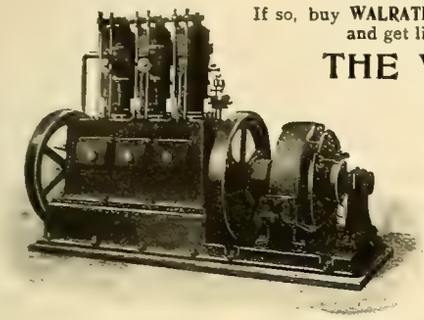
Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

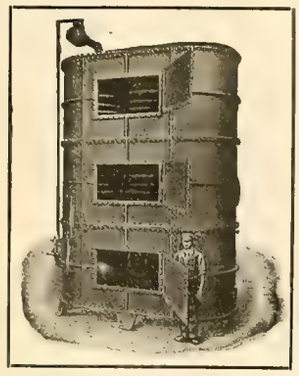
MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

When You Save Steam,



You Economize in Fuel, and

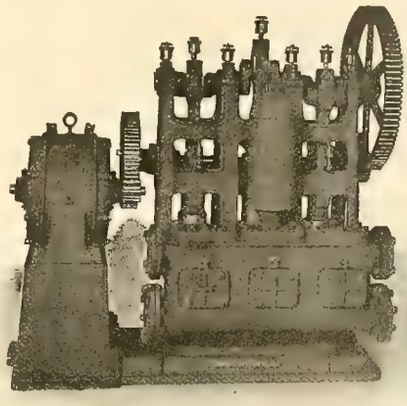
ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,



Jet and Surface CONDENSERS, AIR COMPRESSORS,

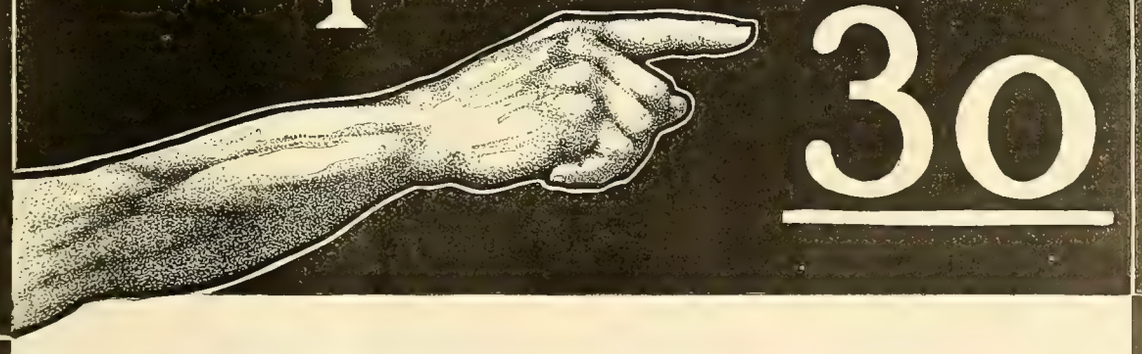
Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS

The Stilwell-Bierce & Smith-Vaile Co.,

P. O. Box 257, DAYTON, OHIO, U. S. A.

September 30



Grasp the opportunity now almost out of your reach, and get a good technical education. The

FREE SCHOLARSHIPS

which, through the generosity of the founders, we have been able to offer, are almost exhausted, and, on the thirtieth of September, the offer will positively be

WITHDRAWN.

Applications for the few remaining scholarships will be considered strictly in the order received, and none postmarked later than September 30th will be accepted. Students can be enrolled after that date only at our regular tuition ($50.00).

The opportunity of a lifetime for an ambitious young man to get a technical education. The courses are particularly adapted for practical **Electricians, Mechanics and Engineers,** who need the theory of their trades to prepare themselves for better positions,—such as **Chief Engineers, Superintendents of Motive Power, Managers of Electric Railroads, Master Mechanics, etc.**

Successful applicants will have no expense except for postage and text-books.

Courses given in **Mechanical, Electrical, Stationary, Locomotive, Marine and Textile Engineering, Mechanical Drawing, Heating, Ventilating and Plumbing.** Thorough instruction in **Mechanical Drawing** is included with each course.

Examination credits count toward Degree at Resident Technical School.

Handbook describing courses, methods and regular terms, sent upon request.

AMERICAN SCHOOL OF CORRESPONDENCE, BOSTON, MASS., U.S.A.

Ad Man's On His Vacation, So Here Goes For Letting the Other Fellow Talk.

No. 371.

"We have used the Packard lamp for the last two years and it has given general satisfaction. We are very much pleased with it and have had no complaints from the users whatever. As far as we know, this is the only lamp used in this city, which fact alone speaks highly in its favor. You are at liberty to use this testimony if it is of any value to you.
Yours truly,"

The above is one of hundreds of similar letters on file in our office.

ELECTRIC APPLIANCE COMPANY,
92 AND 94 WEST VAN BUREN STREET, CHICAGO.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

M. I. C. COMPOUND

HIGH INSULATOR FOR ARMATURES, FIELD COILS, SPOOLS, TRANSFORMERS, MOTOR FRAMES, CAR TRUCKS, ETC.

Four Grades to suit all Requirements. Non-Corrosive, no Carbon Bisulphide. Impervious to Moisture, Oil or Acid. Send for Price List and Samples.

MICA INSULATOR CO.,
NEW YORK. CHICAGO.

ARC LAMPS — A CHEMIST'S BALANCE — ARC LAMPS

39 CORTLANDT ST. — 19th & ALLEGHENY AVE.

Is not more delicately balanced than are the operating parts of a Toerring 200-hour Arc Lamp.

FRICTION, the bane of all machinery, is eliminated by the use of a knife edge bearing and perfect regulation—the kind that stays perfect—is the logical result.

——HIGHEST AWARDS PHILADELPHIA, PARIS, BUFFALO——

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. G. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,
1504 Monadnock Block,
TELEPHONE HARRISON 745. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.

For Sale by all Supply Houses, or

FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

BEARDSLEE CHANDELIER MFG CO.

256 AND 257 SO CANAL ST. CHICAGO

GAS & ELECTRIC FIXTURES FOR THE TRADE.

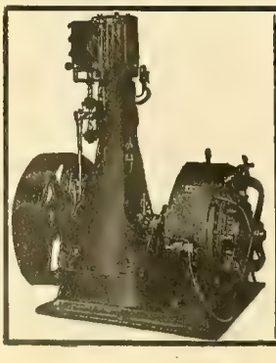
CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

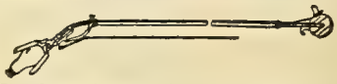
TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

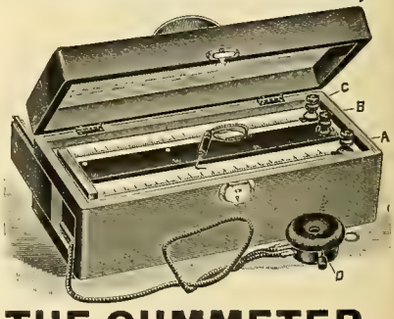
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c.p lamp at any height or angle.

Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

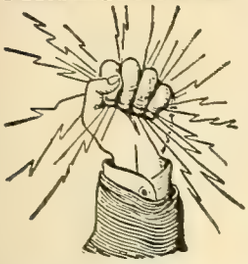
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENBEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book, "Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute,
Dept. K. 240-242 W. 23d St., New York.

THE BEST IS THE CHEAPEST

In the best there is more profit for Dealers and Contractors.

A Fine Push

MAKES ALL THE BELLS WORK NICE.

Write for Prices and Samples.

JOHN RAUSCHER, St. Paul, Minn.

PERFECTION!
SIMPLE AND EFFECTIVE
TROLLEY CONNECTOR.

WIRES CAN BE SPLICED IN THREE MINUTES.
MADE FOR USE ON HEAVY FEED WIRES.

THE STANDARD ELECTRIC CO.,
113 W. THIRD ST., CINCINNATI, O.

TRANSFORMERS.
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
Easy to install.
Cheaper than other guys.
One piece. No moving parts.
Necessary for well guyed poles.
Operated like a corkscrew.
Mechanically correct.
Indestructible by fire or frost.
Carefully made.
Anchors that pay dividends.
Labor savers.

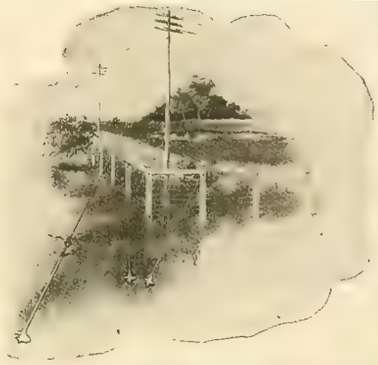
STOMBAUCH GUY ANCHOR

STOMBAUCH GUY ANCHORS

Write for prices, to

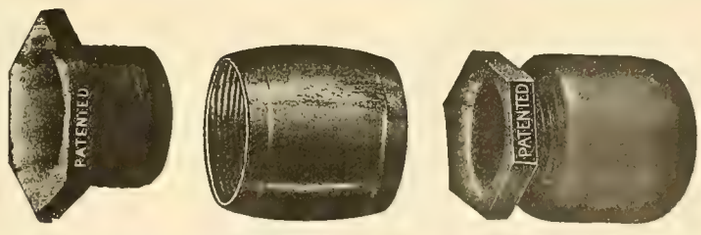
W. N. MATTHEWS & BRO.

603 Carleton Building,
ST. LOUIS.



Worm's-Eye View.

TO CONTRACTORS
USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. C. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1 00 an insertion; additional words 2c each.*

WANTED.

First-class solicitor for light and power business Salary and commission. City of 60,000. Address BOX 106, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Practical young electrician and mechanic as superintendent of prosperous manufacturing business; must invest $2,000 in stock of company; good salary, fine opportunity. Address BOX 111, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Armature winders, coil makers and other experienced electrical workers wanted. Steady employment with good living conditions near works. Apply BOX 153, Erie, Pa.

WANTED.

The manufacturer of a high-grade line of direct-current dynamos and motors, ranging in sizes from ¼ H.P. to 22 H. P., desires to secure a few more responsible selling agents. Address BOX 110, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

60 to 100 K. W. Dynamo, 110 or 220 volts. Also Engine to operate same Prefer direct connected outfit. BOX 108, care Western Electrician, 510 Marquette Building. Chicago.

POSITIONS OPEN.

	PER MONTH.
5 Draftsmen, Electrical	$ 00
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
1 Electrical Superintendent	$85
1 Electrical Superintendent	$50
2 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
No. 6 SHERMAN ST., CHICAGO, ILL.
SEE NEXT ISSUE.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

BUSINESS CHANCES.

We can sell or trade your electric-light plants every time. Consult us.
THE SCIENTIFIC EXCHANGE
Room 60, No. 6 Sherman St., CHICAGO, ILL.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
2— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Two 250 K. W. 10,000 volt, 60 cycle, three-phase, revolving field type, belted General Electric alternators, in service two years. PORTLAND LIGHTING & POWER COMPANY, Portland, Me.

FOR SALE.

Good second hand transformers, General Electric Type F, 125 cycle, primary 1,040V, secondary 52V and 104V. All sizes from 300 to 3,500 Watts. PEOPLE'S LIGHT COMPANY, Davenport, Iowa.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano. Ill.

Electrical Machinery.

One 60 K. W. General Electric alternator, toothed armature, self oiling, $400; one 60 K.W. Westinghouse alternator, toothed armature, self-oiling, $400; one 30 K.W. Westinghouse, 60 cycle alternator, $390; two 50-light T. H. arc dynamos, ring armatures, self-oiling, $275; one extra ring armature for same, $100; one 75-light, 1,200 C P. Wood arc dynamo, $325; one 60-light, 2,000 C. P. Wood arc dynamo, $275; two 60-light, 2,000 C. P. Standard arc dynamos, $275 each; one extra armature for 50-light Standard arc dynamo, $90; one 40-light, Wood arc dynamo, 2,000 C. P., $190; one 100 K. W. 500-volt Standard, $600; two 20 K. W. Edison, 125-volt machines, $225 each; one 40-light Western Electric, 2,000 C. P., with extra armature, $200; 141 Standard 2,000 C. P. arc lamps, $3.50 each.

National Stamping Works, Chicago, Ill.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H, Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw, Mich.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450
ROSE ELECTRIC CO., ST. LOUIS.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

Western Electrician WANT ADS Bring Results.

ALTERNATORS.

1—75 K. W. two phase 60 cycles Westinghouse.
1—60 K. W. 1,100 volts Westinghouse.
1—45 K. W. 1,100 volts Westinghouse.
1—125 K.W. 1,100 or 2,200 volts Westinghouse.
1—75 K. W. 1,100 volts Westinghouse.
3—37½ K. W. 1,100 volts Westinghouse.

GENERATORS.

1—240 K. W. Walker M. P. 4. 3 bearing 250 volts.
1—120 K. W. Eddy Compound, 125 volts.
1—17½ K. W. Ft. Wayne 125 volts. M. P. 4.
We carry a complete line of station equipments.

STEAM AND ELECTRICAL EQUIPMENT CO.
Wood and Water Sts., Pittsburg, Pa.

U. S. ENGINEER OFFICE, 735 N. Capitol St., Washington, D. C., August 27, 1902. Sealed proposals will be received here until noon, September 26, 1902, and then publicly opened, for furnishing Electrical Fixtures and Supplies for New Building for Government Printing Office. Information furnished on application. JOHN STEPHEN SEWELL, Capt. Engrs.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

When in search of a position advertise in the WESTERN ELECTRICIAN.

IT'S UP TO YOU.

We pay highest market prices for
SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.
WRITE US.
We Manufacture Copper Hard Babbitt
the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.
GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

A. C. SCHOONMAKER CO.

126A Liberty Street, New York City,

DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1	20x18½ Harrisburg Ideal Engine.
1	14x13 Armington & Sims Engine.
1	16x16 Erie Ball Engine.
1	15x15 Erie Ball Engine.
1	12x12 Erie Ball Engine.
2	120-kw G. E. single phase Alternators.
1	100-kw Card M. P. 500-volt Generator.
1	200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.	
2	60-kw G. E. Transformers.
497	Improved M. G. E. Arc Lamps.
2	15 hp M. P. 500-volt Motors.
2	10-hp M. P. 500-volt Motors.
2	8 hp M. P. 500-volt Motors.
2	5-hp M. P. 500-volt Motors.
3	3-hp M. P. 500 volt Motors.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
		1	48x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	36x8 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	54x8 Vertical Tubular.
5	60x16 Horizontal Tubular.		Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

AUTOMATIC ENGINES.

1 90 H. P, 9x12 New York Safety. 1 75 H. P. 12x18 Taylor, side crank.
1 50 H. P. 9x9 New York Safety.

110 VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.
2 500 light, 25 K. W. Jenny.
1 350 light, 20 K. W. Mather.
1 250 light, Sperry.
1 200 light, Western Electr c.
1 175 light, 15 K. W. Brush.
1 120 l ght, Mayo.
1 90 light, Westinghouse multi-polar.

133 CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H. 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.
ILLINOIS MAINTENANCE COMPANY, E. H CHENEY, Manager. 204 Dearborn St., CHICAGO.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

Sales Representatives Wanted.

A large, successfull and well established machinery manufacturing company, West of Ohio, doing a constantly increasing business and having an enviable reputation with its present product is prepared to place upon the market a line of

ELECTRICAL MACHINERY

including alternating-current generators up to 1,000 K. W. and direct-current generators and motors of corresponding size.

Only high-grade sales representatives are wanted to sell on commission or otherwise.

Correspondence is desired with established firms or others who are properly equipped and are experienced in the sale of electrical machinery.

All communications will be considered confidential.

Address BOX 109, care Western Electrician, 510 Marquette Building, Chicago.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

NOW

IS THE TIME TO

SUBSCRIBE

TO THE

Western Electrician

WRITE FOR PARTICULARS.

What the I. C. S. did for me

When I took up the training in electrical engineering of the International Correspondence Schools, of Scranton, Pa., I was an apprentice in an electrical instrument-making establishment. As I proceeded with my studies, I advanced in my work and soon raised myself to be instrument maker. Soon after, I accepted a better paying position as designer of arc lamps. Here I advanced very rapidly and was soon put in charge of the testing room. Later, I left this place to accept a position as electrician with the Long Island Railroad's trolley line at Rockaway Beach, and a month later was placed in charge. My salary is now seven times as much as when I enrolled in the I. C. S. The I. C. S. has also greatly benefited numerous other young men to whom I have recommended it, which goes to show that the I. C. S. system is thoroughly practical.

ROBERT W. BROADMANN,
22 Second Ave., College Point, N. Y.

Do You Want A Better Salary and Postion?

Such evidence as the above is proof conclusive of the value of our training. Actual results is the best argument. We have hundreds of endorsements like the above—just as strong, just as convincing. Isn't this one convincing enough to induce you to cut out, fill in, and send us the attached coupon with **X** marked before the position for which you wish to be trained?

DO IT ANYWAY

International Correspondence Schools
Box 1002, Scranton, Pa.

Please explain how I can qualify for the position marked **X** below

	Electrical Engineer		Fire Underwriters' Inspector
	Telephone Engineer		Interior Wireman
	Telegraph Engineer		Foreman Dynamo Room
	Erector of Electric Machinery		Foreman Electrical Repairs
	Manager Electric Railway		Dynamo Tender
	Manager Electric Light Plant		Electrical Lineman
	Supt. Electric Light and Power Plant		Motorman

Occupation _____ *Age.* _____

Name _____

Street and Number _____

City _____ *State* _____

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

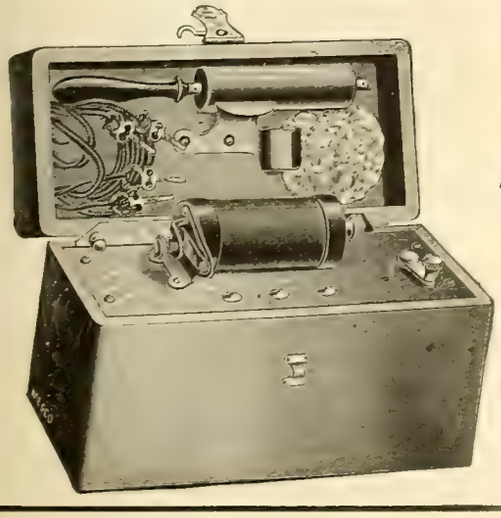
CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg,. Chicago.



ANTI-Doc

No. SIX

A First-Class Medical Apparatus.

RETAIL PRICE, $2.50. SOLD BY ALL DEALERS.

MADE BY

MANHATTAN ELECTRICAL SUPPLY CO.,

32 Cortlandt Street, NEW YORK.
188 Fifth Avenue, CHICAGO.

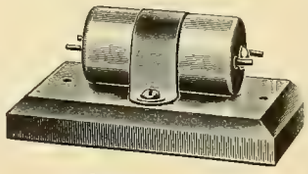
STERLING

CONDENSERS AND REPEATING COILS

Like all STERLING apparatus, are BEST and CHEAPEST.

TRY THEM!

1 Microfarad, 70c.
2 Microfarads, 80c.

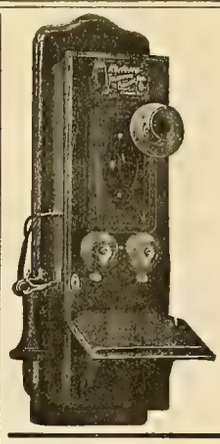


Highest Efficiency for All Classes of Service.

$2.00

STERLING ELECTRIC COMPANY,

LAFAYETTE, - - - - INDIANA.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

BUY

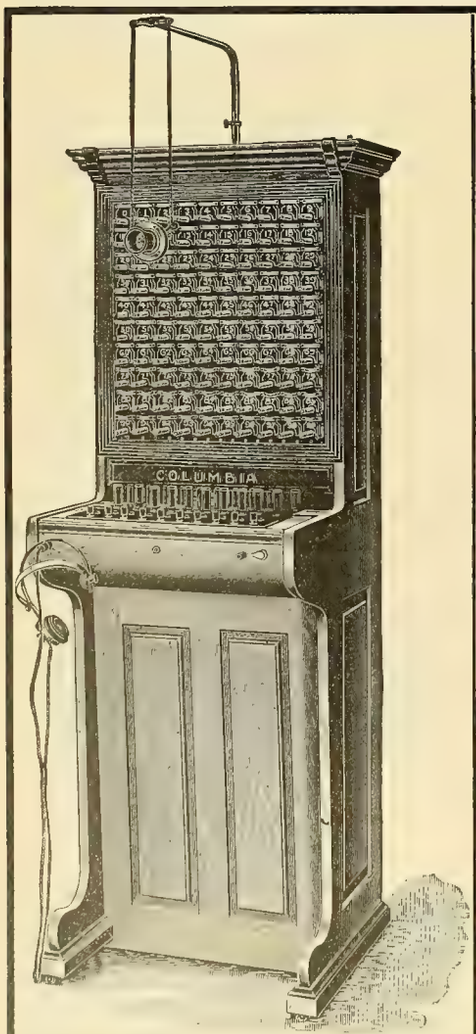
Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

THE TELEPHONE HAND-BOOK

BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.
Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1,200	lines	and	telephones
Ennis, Tex., . .	"	1,200	"		"
Norwalk, Ohio, .	"	2,400	"		"
Frankfort, Mich.,	"	250	"		"
Dundee, Mich., .	"	200	"		"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

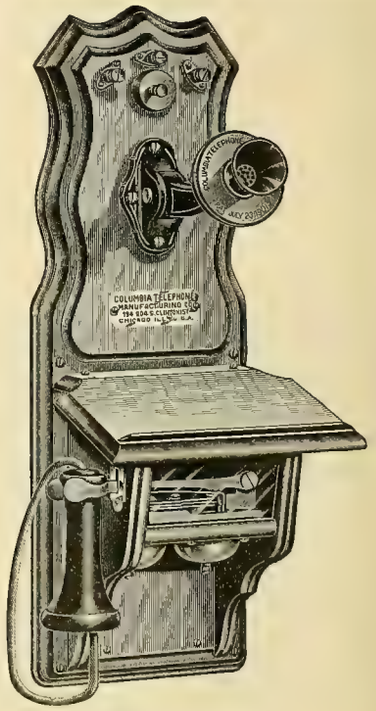
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

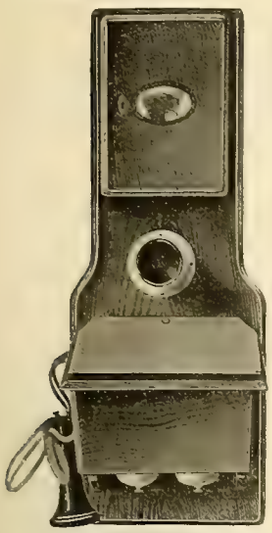
INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.



Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

SATISFACTION IN USING **KELLOGG TELEPHONES**

A Kellogg Telephone is Worth the Price of Your Guarantee

Write for 128-Page Catalog.

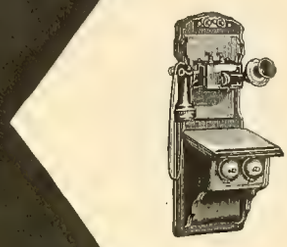
KELLOGG SWITCHBOARD AND SUPPLY CO. 229 S Green St. CHICAGO.

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

Telephone Troubles

ARE UNKNOWN WHEN OUR

CENTRAL ENERGY SYSTEM

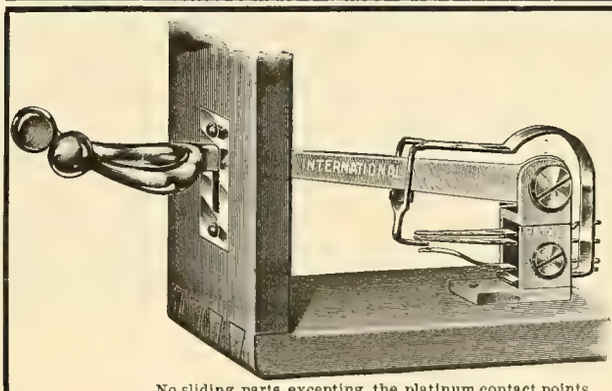
Is Installed in Your Exchange.

IT REPRESENTS THE HIGHEST TYPE OF MODERN TELEPHONE APPARATUS AND IS PERFECT IN EVERY DETAIL.

The Only Perfect Party Line Selective Ringing Telephones. Write for Descriptive Circular.

No. 34 Central Energy Telephone.

AMERICAN ELECTRIC TELEPHONE CO.,
36-58 W. Jackson Boulevard, CHICAGO, U. S. A.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. INTERNATIONAL TELEPHONE MFG. CO.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger
for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.
No. 1. Light, 1¾ x ⅜ in.
No. 2. Medium, 1¾ x ½ in.
No. 3. Heavy, 2 x ½ in.
Nos. 2 and 3 always in stock.

DEAD END HANGER.
Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.

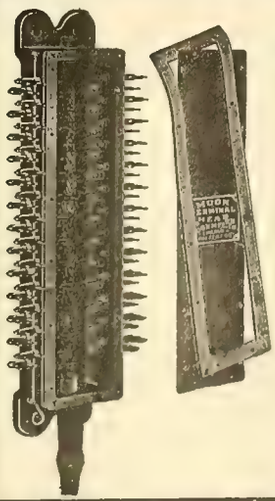
Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties and up-to-date. Tell us what you want.

Corner Brackets, Guy Shims, and Special Forgings made to order.

3-Bolt Guy Clamp.

Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.



MOON TERMINALS

WITH

METALLIC OUTER CASE . . .

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

M. KLEIN & SON

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

The Franklin Gas Engine

One-Half Horsepower.

Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'g'r and Tkt. Agt.
CHICAGO, ILL.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

A GLIMPSE AT OUR WESTERN STOCK.

1 700	pieces	40	feet, 7-inch	tops
1,700	"	40	" 8	"
1,750	"	45	" 7	"
1,250	"	45	" 8	"
1,750	"	50	" 7	"
750	"	50	" 8	"
3,000	"	55	" 7	"
750	"	55	" 8	"
750	"	60	" 7	"
300	"	60	" 8	"
250	"	65	" 8	"
200	"	70	" 8	"

Our Prices Will Interest You.

POLES

30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR TROLLEY LINE CONSTRUCTION ALWAYS IN STOCK.

YARDS:

MENOMINEE,	MICH.
ESCANABA,	MICH.
NADEAU,	MICH.
CLOQUET,	MINN.
HERON,	MONT.
CABINET,	IDAHO.

OUR ADDRESS:

FRANCIS BEIDLER & CO.

W. 22d and Loomis Sts, CHICAGO, ILL.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

SIGNALOID

THE MOST PERFECT AND RELIABLE

Coloring and Frosting Liquid

FOR

INCANDESCENT ELECTRIC LAMPS.

Will never peel, chip or crack, and the color will outlive the life of the lamp.

MANUFACTURED BY

SIGNALOID CHEMICAL WORKS

JERSEY CITY,
NEW JERSEY.

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

146 Pages. 129 Ills. Cloth.
PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BLDG., CHICAGO.

It's No Secret...

That the proper illustration in an **Ad.** pays for itself and the entire space of the ad.

WE MAKE THE PROPER KIND ...
TRY THEM AND SEE

Real order fetchers
Full of force...

Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

"RUSH" POLE ORDERS

That's what we are looking for and it don't matter how big they are either.
All sizes from 20-foot up, and the price is right.

MALTBY LUMBER CO., - BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES....
SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

THE HOLCOMB-LOBB COMPANY
CEDAR POLES & POSTS
745 MARQUETTE BLDG. CHICAGO ILL.

"Practical and to the Point"
IS ALL THAT NEED BE SAID OF
THE TELEPHONE HAND-BOOK
By HERBERT LAWS WEBB.
160 Pages, 133 Illustrations, Cloth, Price $1.00.
The book for those interested in telephony.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., CHICAGO.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1703-7 FISHER BLDG. CHICAGO.

MEDORA MILLING COMPANY
CHESTNUT POLES
20 ft. to 75 ft. LENGTHS.
LARGE STOCK CARRIED
MEDORA, IND.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES FERRIZOT-SOWS DAGGETT MICH.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

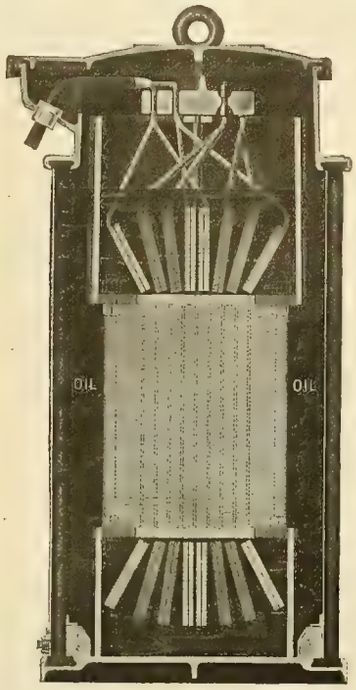
SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

CEDAR POLES
THE VALENTINE-CLARK CO.,
— 234 LA SALLE ST, CHICAGO.
YARDS: PINCONNING, Mich. — GREEN BAY, WIS. — NEW LONDON, WIS.

A Few Facts About Transformers

Average Temperature



Every coil in the Westinghouse Transformer shares equally in the cooling—

(1) The exposed spread end of one coil presents the same surface in contact with cooling oil as any other. Each coil thus passes off its heat with equal facility, and no unequal expansions occur to injure the insulation.

(2) Heat generated within the interior travels, not through layers of insulation, but along highly conducting copper to the spread coil ends. This is why no "hot spots" develop, and this is why temperatures are uniform in **O D and Type N Transformers.**

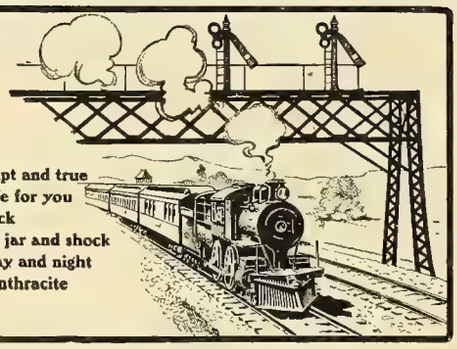
There is practically no difference between the temperature measured by a thermometer placed between the coils and that measured in the copper by the resistance method. This is actual proof of the uniform temperature in O D and Type N Transformers.

FOR TRANSFORMER BOOKLETS ADDRESS NEAREST SALES OFFICE OF THE

WESTINGHOUSE ELECTRIC and Manufacturing Co.
PITTSBURG, PA.

New York, Atlanta, Dallas, Boston, Buffalo, Chicago, Cincinnati, Los Angeles, Cleveland, Detroit, Minneapolis, Philadelphia, Pittsburg, St. Louis, San Francisco, Syracuse, Seattle, Salt Lake City, Baltimore, Denver, Mountain Electric Co. Canada: Ahearn & Soper Limited, Ottawa.
Mexico: G. & O. Braniff, City of Mexico.

Lackawanna Railroad
THIS IS THE ROAD OF ANTHRACITE.



These are the signals prompt and true
That make the journey safe for you
Over the bed of ballast rock
That keeps the trains from jar and shock
That smoothly run both day and night
On the dustless Road of Anthracite

ALL SIGNALS OPERATED EXCLUSIVELY BY
EDISON PRIMARY BATTERIES
Formerly Known as Edison-Lalande.
FULL DESCRIPTION IN BOOKLET NO. 4.
EDISON MANUFACTURING COMPANY
Factory, ORANGE, NEW JERSEY, U. S. A. New York Office, 83 CHAMBERS STREET
Chicago Office, 144 WABASH AVENUE

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

HEAT AND LIGHT
PROCEED FROM ONE SOURCE.

In the great laboratory of nature, heat and light are the life of the world. If the sun gave out light and no heat, or vice versa, the world would be a dead planet.

The electric station that supplies power alone is only half fulfilling its mission. Heat is as staple an article as light and quite as indispensable, and heat bills are larger than bills for lighting in most buildings.

The electric station, lighting or railway, in its exhaust steam, which it is perhaps wasting in the air, possesses the means of increasing its net income by many thousands of dollars. Scores of these steam-heating plants constructed by us are in operation now.

Our underground system of steam mains is the most complete, the most durable, the most up-to-date that experience and ingenuity can devise. Our methods of insulation and devices for providing for expansion and contraction of the underground pipes are the most perfect yet invented.

Our Condensation Meter is a correct measure of the amount of steam used by each consumer, without which the Company is liable to serious loss without being able to locate it. A meter is one of the most essential features applicable to a heating system.

For particulars write for our pamphlet. Address—

AMERICAN DISTRICT STEAM CO.
LOCKPORT, NEW YORK.

FORT WAYNE ELECTRIC WORKS

(INCORPORATED)

A is the pocket
B is the stud
C is the cam
that locks
them together

Type A Oil Transformers

Sizes .6 to 50 kw. Standard Voltages.

Lightning Proof

Easy to install with the new
Patented Suspension Hooks.

MAIN OFFICE AND FACTORY. - - FORT WAYNE, INDIANA.

SALES OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 625 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.

Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 616 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.

Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 New St.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid.

$1 A VOLUME.

Electrician Publishing Co.,

510 Marquette Building, Chicago.

A NEW PAPER-WEIGHT.

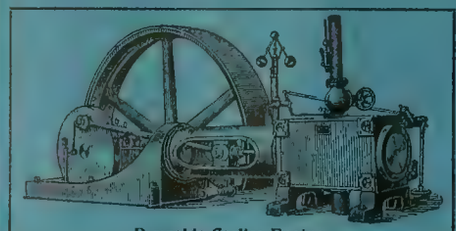
Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

CHARLES. H. BESLY & CO
FINE TOOLS & SUPPLIES FOR METAL WORKERS
10 & 12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE.

STURTEVANT SYSTEM OF HEATING & VENTILATION

Centralized plant.
No scattered steam piping.
Utilizes exhaust steam.
Send for Catalogue No. 84

B. F. STURTEVANT Co. BOSTON,
NEW YORK · PHILADELPHIA · CHICAGO · LONDON ·

HAZARD MANUFACTURING CO.
HIGH-GRADE RUBBER COVERED, WEATHERPROOF WIRES AND CABLES.
MAGNET, OFFICE, ANNUNCIATOR WIRE.
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg

VULCANIZED FIBRE.
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.
HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

LARGE STOCK
NO DELAYS IN SHIPPING.

I. X. L. Weatherproof, or Grimshaw Rubber Covered Wire. Any size or quantity.

Electro Galvanized Conduit—American Circular Loom. Peerless Transformers. Columbia Carbons. Edison Leland Battery.

The best direct current Arc Lamp on the market, the "ANDERSON."

TRY US ON AN ORDER.

ST. LOUIS ELECTRICAL SUPPLY CO.,
NO. 1118 PINE ST., ST. LOUIS, MO.

Black Diamond File Works
Est. 1863. Inc. 1895.

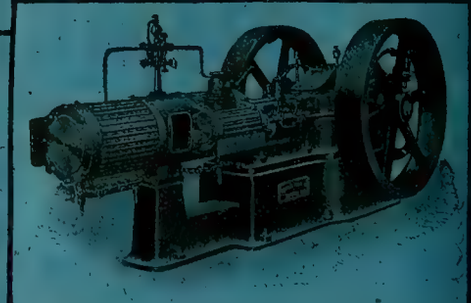
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO HIGH SPEED ENGINES FOR ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

ANNUAL FALL TRADE NUMBER.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 13, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 11.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT. H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

UNDERGROUND CONDUIT
ECONOMY FIRST AND LAST.
...WRITE...
THE FIBRE CONDUIT CO.,
ORANGEBURG, N. Y.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

The FRANKLIN Model Shop
The Franklin Model Shop
Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOCADORE, OHIO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.

IMITATED BY MANY
ONLY THE BEST GOODS ARE IMITATED.
LOOK AT THE LONG LIST OF OUR IMITATORS AND DECIDE FOR YOURSELF.

EQUALED BY NONE
OUR MOTTO. THE RECOLLECTION OF QUALITY REMAINS LONG AFTER THE PRICE IS FORGOTTEN.
ERICSSON TELEPHONE CO., 296 Broadway, New York.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters,
Millivoltmeters,
Voltammeters,
Ammeters,
Millammeters,
Ground Detectors and
Circuit Testers,
Ohmmeters,
Portable Galvanometers.
Our Portable Instruments are recognized as The Standard Laboratory Instruments. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed for extreme accuracy and low consumption of energy.
BERLIN: European Weston Electrical Instrument Co., Ritterstrasse 50-51.
LONDON: Finsbury Pavement House, 101 St. Martins Lane.
Mention the WESTERN ELECTRICIAN when writing for catalogues.
Weston Ground Detector and Circuit Tester.

ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR.
Practically dust and water proof. For Polishing, Drilling, Tapping, Reaming, Emery Grinding, etc. Write for catalogue and terms.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Stow Flexible Shaft Co., 86 Queen Victoria Street, London, England.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U.S.A.
Carbons of all kinds and for all purposes.

BETTER BUY BUCKEYE, BECAUSE,

We inspect the size and appearance of all the joints connecting the filament to the platinum and leading in wires. If the joints are too big, it is harder to exhaust the lamp and the chances are greater of imperfect exhaustion. If the joints are too small the connection may break and the lamp go out earlier in its life.

MAIN SALES OFFICE AND WORKS, CLEVELAND, OHIO.

1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa. 202 Real Estate Trust Bldg., Pittsburg, Pa.

These, our little "SHOW WINDOWS," coming out even as they do every week, can't give you an adequate idea of ALL the goods we manufacture—

BUT OUR CATALOGUE CAN.

SEND FOR IT.

EDWARDS & CO., New York.

WESTERN ELECTRIC CO., New York,
Eastern Selling Agents.

20 H.P., 60 Cycle, 208 Volt. Single Phase Motor Geared to Triplex Pump.

OUR **SINGLE PHASE MOTORS** ARE
Particularly Suited for Pump Operation.
THEY WILL **START UNDER FULL LOAD** BY
Simply Closing the Primary or Secondary Circuit at any point however distant from the motor.
ONLY ONE TRANSFORMER REQUIRED.
If interested we would be pleased to have you inform us of your requirements.

WAGNER ELECTRIC MFG. CO.

ST. LOUIS, MO., U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" *For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.*

The "Exide Accumulator" *For Electric Vehicles.*

EXIDE BATTERY DEPOTS { NEW YORK, 148 W. 18th St. PHILADELPHIA, 260 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

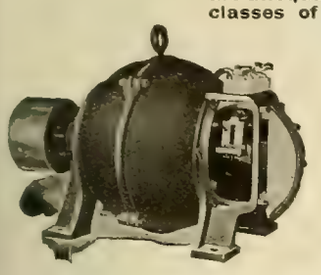
SALES OFFICES: PHILADELPHIA, Allegheny Ave & 19th St. R 52 — NEW YORK, 100 Broadway. — BOSTON, 60 State St. — CHICAGO, Marquette Bld. — BALTIMORE, Continental Trust Bld. — ST. LOUIS, Wainwright Bld. — SAN FRANCISCO, Nevada Block. — CLEVELAND, New England Bldg. — DETROIT, Michigan Elec. Co. — HAVANA, CUBA, F. G GREENWOOD, MGR. 34 Empedrado Street

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

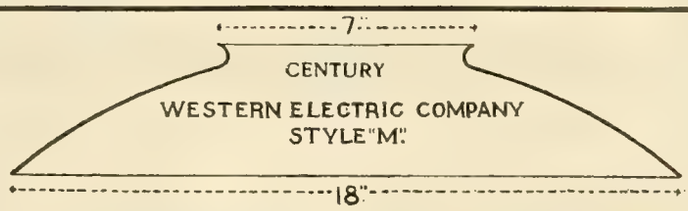
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



WE CAN PLEASE YOU IN THE LINE OF

ELECTRICAL GLASSWARE

and are Prepared to Furnish you with Globes or Shades for all Types of Lamps.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.

BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..15
Akron Smoking Pipe Co..... 1
Allen-Palmer Company 30
American Battery Co..... .17
American District Steam Co. –
Amer. Electrical Heater Co..20
Amer. El. Telephone Co 21
American Electrical Works .17
Amer. Rolled Gold & Lighting Co. 22
Amer. Steel & Wire Company 1
Anderson, H. 16
Anderson & Sons, W. H..... 20

Badt & Co., F. B 16
Bass Mfg. Co. 19
Baxter & Company..... 3
Bell Vacuum Co. ..... .16
Barnett Company, G. & H....20
Bartlett & Co., J. S.... 17
Bayley & Sons Co., W..... 24
Beardsley Chandelier Mfg. Co.—
Beardsley Gravity Batt. & Construction Co. ..... .19
Beecher & Co., Francis .....—
Berthoud & Jennings..... 27
Besly & Co., Charles H. 30
Bonnell, Edward 30
Bossert El. Construction Co 19
Bowers Hall Bell 27
Brown & Leasure 16
Buckeye Electric Co. .....
..... 2, 5, 12, 17, 19, 24, 28
Buffalo Forge Co.....30

Central Electric Co..... 5
Central Manufacturing Co. .27
Central Telephone & El. Co. 20
Century Glass Co..... 4
Chase-Shawmut Company...17
Chicago & Alton Railroad....24
C. & N. W. R. R.....24
Chicago Dry & Elec. Co..... 7
Chicago Edison Company.4, 18
Chicago Electro, Stereo. & Engraving Co.....23
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....24
Chicago Pay Station Co.....20
Columbia Telephone Mfg. Co.—
Consumers Carbon Co..... 1
Continuous Rail Joint Company of America..... 19
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 4
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co 24
Diamond Meter Company....12
Dicke Tool Company.....—
Diehl Mfg. Co..... 7
Dixon Crucible Co., Joseph..24

Edison Decorative & Miniature Lamp Department... 16
Edison Mfg. Company.....12
Edwards & Company..... 2
Electrical Engineer Institute.—
Electric Appliance Company.16
Electric Storage Battery Co.. 3
Electrician Pub. Company...28
Ericsson Telephone Company 1

Federal Electric Company...
Fibre Conduit Co..... 1
"For Sale" Advertisements..18
Ft. Wayne Elec. Works., Inc.29
Fowler, John H.....27
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...27
General Electric Company... 9
General Incandescent Arc Light Company.....13
General Incand. Lamp Co....—
Gordon Battery Co.....10
Great Western Smelting & Refining Company.... ....—
Gregory Electric Company ..18

Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....18
Holcomb-Lobb Co.....—
Holmes Fibre-Graph. Co.....—
Hopkins & Co., A. P.....27
Huebel Company, C. J.....27
Humphrey, Henry H.....16

Illinois Electric Specialty Co.16
Illinois Maintenance Co.....18
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..21

Jeffrey Manufacturing Co....24
Jewell Elec. Inst. Co.....12
Johnston, Thomas J.....17

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company..... ....20, 26
Klein & Son, Mathias.....26
Kohler Brothers.....16
Kokomo Tel. & El. M. Co....20

Leather Preserv. M. Corp....25
Leavitt, R. H.....26
Leffel & Co., James.....24
Lindsley Brothers Company..27
Lowell Model Co..... .....—

Machado & Roller.....—
Maley, Martin.....—
Maltby Lumber Company.. .27
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.25
Matthews & Bros., W. N.....17
Mayer, Geo. M..... 19
McLennan & Company, K....16
McNamara Brothers 30
Medora Milling Company....27
Metropolitan Tel. & El Co...21
Mica Insulator Company.....—
Minnesota Elec. Co.....20
Miscellaneous Advs..... ..18
Monarch Fire Appl. Co.....—
Monon Railroad.....26
Moon Mfg. Co., The.....21
Morse Cedar Company.....27
Mott & Company, J. E.....30
Munsell & Co., Eugene.....16

National India Rubber Co....—
Naugle Tie Co., E. E 26
New York Ins. Wire Co..... 5
Norton Tool Company, The..21

Okonite Company, The 1

Pacific Coast Pole Co ... 24
Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....27
Phillips, Eugene F.....17
Phillips Insulated Wire Co..17
Phœnix Glass Company.....11
Phosphor-Bronze S. Co.....25
Pignolet, L. M.....16
Pittsburg & L. S. Iron Co.....27
Porter Cedar Company.....27

Rauscher, John .....—
Reisinger, Hugo.....—
Reliance Electric Company..19
Replogle Governor Works.. .—
Reynolds Electric Company. 6
Roche, Wm 4
Roebling's Sons Co., J. A.....19
Rose Electric Company 18

St. Louis Elec. Supply Co... 30
Sargent & Lundy... .....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Schott, W. H. 16
Schureman & Hayden.....18
Scientific Exchange.....18
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 16
Smith Co., S. Morgan.....25
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Electric Company..22
Standard Pole & Tie Co.... .27
Standard Underg. Cable Co..—
Standard Varnish Works 19
Standard Vitrified Cond. Co. 12
Stanley Instrument Co..... 5
Steam & Elec. Equipment Co 18
Sterling & Son, W. C.....27
Sterling Electric Company...—
Sterling Varnish Co., The....18
Sterrett Pump Company.....23
Stilwell-Bierce & Smith-Vaile Company.....25
Stow Mfg. Company.....1, 8
Stromberg-Carlson Tel. Mfg. Company 21
Sturtevant Company, B. F...30

Toerring Company, C. J 16
Torrey Cedar Company..... .27
Triumph Electric Co.....19

Union Pacific R. R.....24
U. S. Electric Mfg. Co.....21

Valentine-Clark Co., The....—
Varley Duplex Magnet Co....20
Vindex Electric Company....—
Vreeland, B. F 26
Vulcanized Fiber Company..30

Wagner Electric Mfg. Co..... 2
Walsh's Sons & Company....18
West Shore Route.....25
Western Electric Company... 7
Western El. Supply Co.....14
Westinghouse Electric & Manufacturing Company ..28
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..18
Whitmore, A. E.....27
Wickes Bros.....18
Willyoung, Elmer G.....25
Wisconsin Central R. R.....24
Wittenberg Cedar Co.....27
Worcester Company, C. H....27
Worcester Polytechnic Inst..19
Wrigley, Thos 22

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

CROCKER-WHEELER COMPANY

MANUFACTURERS AND ELECTRICAL ENGINEERS.

Generators and Motors

FOR LIGHTING AND POWER INSTALLATIONS.

Belted and Direct Connected Dynamos that are Compact and Neat in Design, Strong in Construction, Non-Sparking and Cool in Operation.

OUR SYSTEM OF SHOP EQUIPMENTS HAS THE FOLLOWING STRONG POINTS IN ITS FAVOR.

Motors have variable speed, under instant control and over any range.
Every speed constant regardless of load.
Controllers simple, rugged and convenient.
Makes high cutting speeds easy by superior facilities for manipulation.
Permits the use of small motors.
Adapted to existing shops.
Employs standard motors.
Output of machine tools greatly increased over belt drives.

Main Office and Works: - - AMPERE, N. J.

SALES OFFICES IN ALL LARGE CITIES.

New Standard Specialties.

DRY CELL.

If kept out of the sun, in a cool dry place, this cell will not run down on the shelf in two years, and at the end of that time will be as good as other makes fresh from the factory. To maintain its superiority to all others, no expense is spared and only the best materials and chemicals are used in its manufacture.

This cell will save the consumer money, because a fewer number will perform a given amount of work four times as long as any other cell of equal size.

ELECTROMOTIVE FORCE 1.52 VOLTS.
CURRENT, - 14 TO 18 AMPERES.

..CATALOGUE FOR THE ASKING..

ELECTRIC FLASHLIGHT No. 1.
A RELIABLE LIGHT AT ALL TIMES.
Patents Applied for in U. S., France and England.

SEND FOR CIRCULAR AND PRICES.

WILLIAM ROCHE,

No. 40 VESEY STREET, NEW YORK CITY.

COLUMBIA LAMPS.

HIGHEST EFFICIENCY.

LONGEST LIFE.

UNIFORM CANDLEPOWER.

CORRECT PRICES.

ALL CANDLE POWERS AND ALL VOLTAGES.

NO NEED TO WAIT. LAMPS SHIPPED FROM CHICAGO STOCK.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL SALES AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

Crimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

BETTER BUY BUCKEYE, BECAUSE,

Operatives at the Buckeye factory test every lamp after it is capped or based, by twisting the base with A PAIR OF PLIERS to see if it will loosen. You cannot afford to do without this inspection.

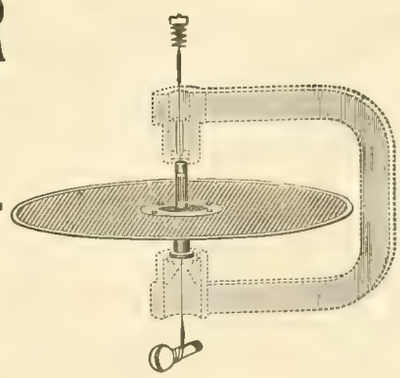
Main Sales Office and Works, CLEVELAND, OHIO.

1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg., Pittsburg, Pa.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. NO FRICTION. NO LOST REVENUE. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

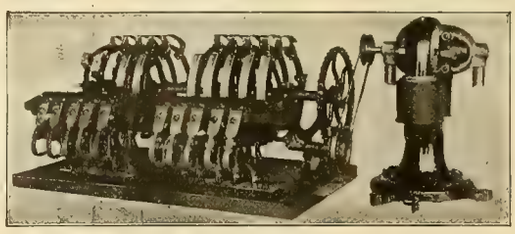
SALES OFFICE, 158 BROADWAY, NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS, JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

EVERY CENTRAL STATION MANAGER SHOULD BECOME ACQUAINTED WITH OUR

ELECTRIC SIGN FLASHERS

The most practical and simple device in the world for flashing electric signs, flags and all electrical displays. We can convince every Central Station Manager, Electrical Contractor and Dealer that it's the greatest seller they ever handled.



Will increase the output of current, put your plant on a larger paying basis and open a new field of profit. Your customers will pay their current bills more willingly when using our flashers.

WRITE NOW FOR DETAILS.

REYNOLDS ELECTRIC CO., (INC.) 221 FIFTH AVE., CHICAGO, ILL.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Gordon Battery Company.
Roche, William.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books. Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Badt & Co., F. B.
Central Electric Co.
Electric Appliance Co.
Fibre Conduit Company.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Leavitt, R. H.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Chic. Electro. Stereo. & Eng. Co.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Co.
Diehl Manufacturing Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Badt & Co., F. B.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Badt & Co., F. B.
Baird Manufacturing Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Diehl Manufacturing Co.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Die & Elec. Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.
Wrigley, Thos.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Minnesota Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Winders.
Anderson, H.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Pacific Coast Pole Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
Amer. Reflector & Lighting Co. 22

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

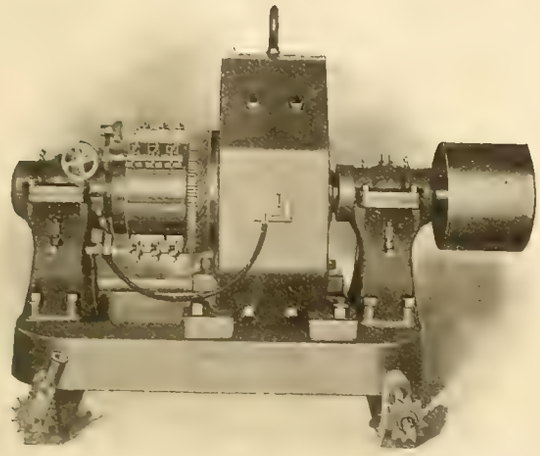
Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

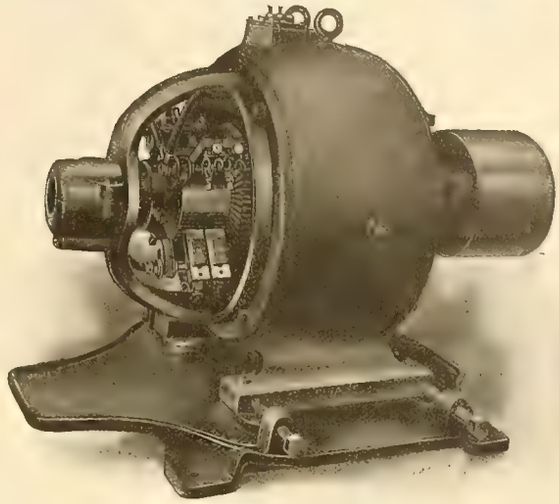
For Alphabetical Index of Advertisements See Page 3.

DIEHL MOTORS AND GENERATORS



TYPE S—4.
Built in sizes from 30 to 200 H. P.

ARE PERFECT IN CONSTRUCTION AND OPERATION.



TYPE C. (open)
Enclosed or Open. ¼ to 25 H. P.

Diehl Motors are furnished in 3 Types, 2, 4 or 6 pole in sizes from $\frac{1}{30}$ to 200 H. P.
Belted or Engine Type Generators from 1 to 200 K. W.

BRANCHES:
NEW YORK. BOSTON. PHILADELPHIA.

DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

MAXSTADT Patent Improved AMERICAN JOINTS

We manufacture our joints under the **patent** we advertise.

PATENTED AUGUST 14, 1900, IN THE UNITED STATES AND FOREIGN COUNTRIES

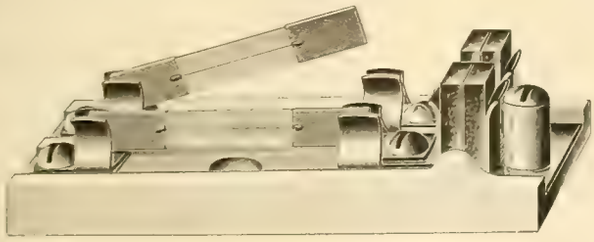
No. 882.

The illustration, No. 882, represents the Maxstadt Patent Improved American Joint, ready for use. Made in copper and tinned steel, for copper and galvanized iron wire. This joint is absolute. It costs less money than any joint on the market to day.
Prices and samples an application.

SOLE MANUFACTURERS OF THE

MAXSTADT PATENT IMPROVED FUSIBLE CUT-OUT CARBON LIGHTNING ARRESTERS.

No 416 represents a full size Maxstadt Patent Improved Double-Pole Porcelain Cut Out and Carbon Lightning Arrester. The object of this Arrester is to economize space. Its compactness and efficiency has made it the most practical combination cut out and lightning arrester on the market to-day, and it costs less money than any other arrester made.



Patented March 31, 1891. No. 416.

The above is one of the many different styles of Maxstadt Fuse Blocks we manufacture. We can also furnish fuses, paper sleeves, fuse wire and links.
Write for prices and samples.

Manufacturers of the Maxstadt Patent Improved American Joint:

CHICAGO DIE & ELECTRIC CO.,
87-91 W. LAKE STREET, CHICAGO, ILL.

ARC LAMPS

DIRECT CURRENT and SERIES ALTERNATING SYSTEM.

WRITE FOR BULLETINS

No. 7008-7010-7011.

Arcade in the Colonial Hotel of Cleveland, Ohio. This hotel has in use 150 Western Electric Company Type 270 Arc Lamps.

WESTERN ELECTRIC COMPANY.
CHICAGO—SAINT LOUIS. PHILADELPHIA—NEW YORK.

ESTABLISHED 1875.

OUR VARIOUS TYPES OF

MULTI-SPEED ELECTRIC MOTORS

ARE ILLUSTRATED BELOW.

We call them MULTI-SPEED, because an absolutely unbroken range is furnished between the highest and lowest points—in other words EVERY imaginable speed is given within these limits—a most desirable feature when fine adjustment or great variety is desired.

They will carry their full load at all speeds within their range without sparking, with an efficiency practically as high at one speed as another.

Efficiency in all cases is up to the standard of modern practice.

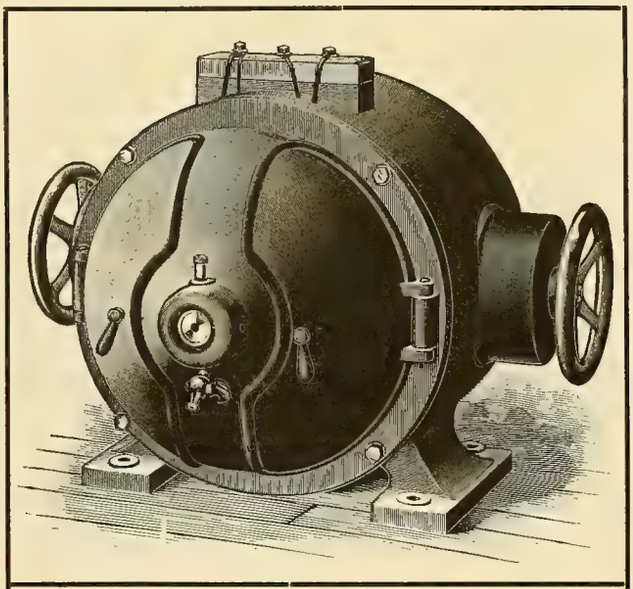
The above results are arrived at without use of rheostats or controllers.

A RADICAL DEPARTURE FROM OLD TIME METHODS OF MOTOR SPEED REGULATION!

PERMIT US TO FURNISH YOU FURTHER DETAILS.

STOW MFG. CO., BINGHAMTON, N. Y.

Gen'l European Agents: Selig, Sonnenthal & Co., 85 Queen Victoria St., London, Eng. New York Office: 136 Liberty St., New York.



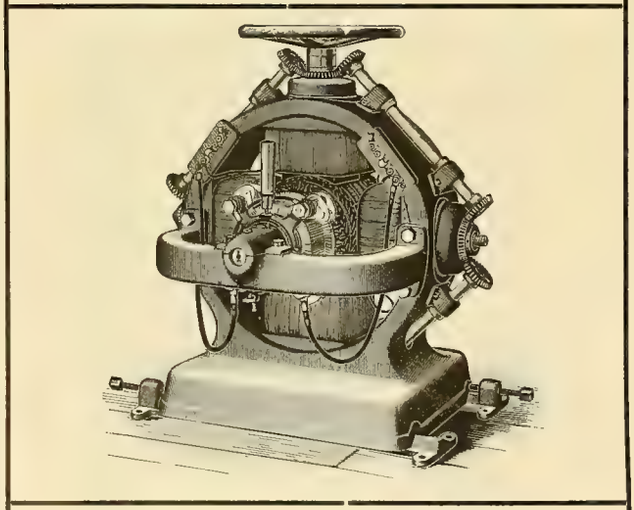
MULTI-SPEED MOTOR, TYPE S. B.

This motor has cast steel frame, and balanced field. We are prepared to furnish them from 1 H.-P. up to and including 10 H.-P.

The cut shows the fully enclosed type, but if the four doors are removed, giving full ventilation, the motor will carry about one-third more load. The speed is varied by use of one or both hand wheels, depending upon variation desired.

The 1 H.-P. has a speed range of 70%, the 10 H.-P. 150%, AND ALL INTERMEDIATE speeds.

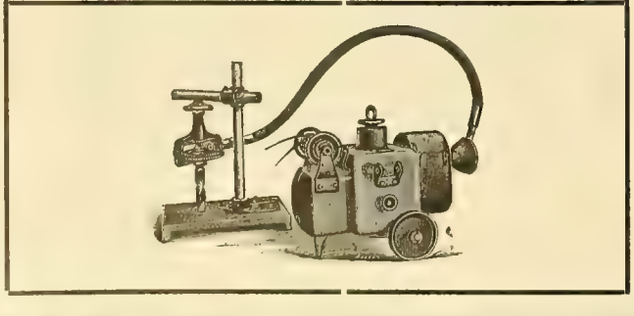
Its form specially fits it for driving Lathes and smaller tools.



MULTI-SPEED MULTI-POLAR TYPE.

This motor, as will be observed from cut, is of heavier construction than the type S. B. The four pole pieces are all alike, and each one provided with similar windings, and as the adjustment of the four plungers is made simultaneously by means of hand wheel and gearing, it will be seen that the armature rotates within a symmetrical magnetic structure—we make them in sizes from 5 H. P. up. The machine shown in cut is of 6 H.-P. capacity and has a minimum speed of 700 revolutions, with a maximum of 1,500. With motors of greater H.-P. a larger speed range is given.

The cut shows the open type, but the design is such that suitable inclosing heads can be attached when desired.



COMBINATION OF

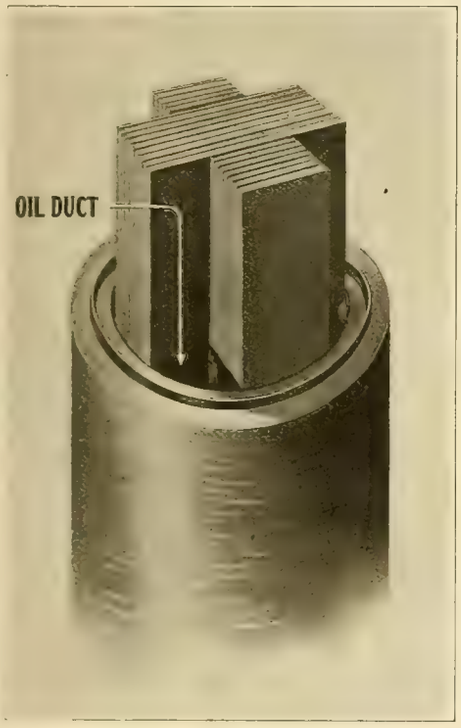
FLEXIBLE SHAFT AND MULTI-SPEED ELECTRIC MOTOR.

This is a modified type of our Multi-Speed Motor specially designed to meet the exacting requirements of a portable tool. It was a good machine when first placed on the market, four or five years ago—it's better now—the weak points have been eliminated as fast as practical use developed them, and the entire plant strengthened and improved in many ways. It is a practical machine shop in itself—Drilling, Tapping, Reaming, Emery Grinding, etc., with equal facility. No portable tool on the market excels it in efficiency. None equal it, we think, in economical consumption of power. Simply connect wire on reel with power current and the plant is ready for work. Its range is limited only by the length of wire on reel. Many hundreds in use, both in this country and Europe, giving excellent satisfaction.

GENERAL ELECTRIC COMPANY'S

TYPE "H" TRANSFORMERS

CORE TYPE.



In larger sizes of Type H Transformers, where it would not be economical to limit the thickness of coils to one and one-half inches, ducts for the circulation of cooling oil are provided between the windings and the iron core.

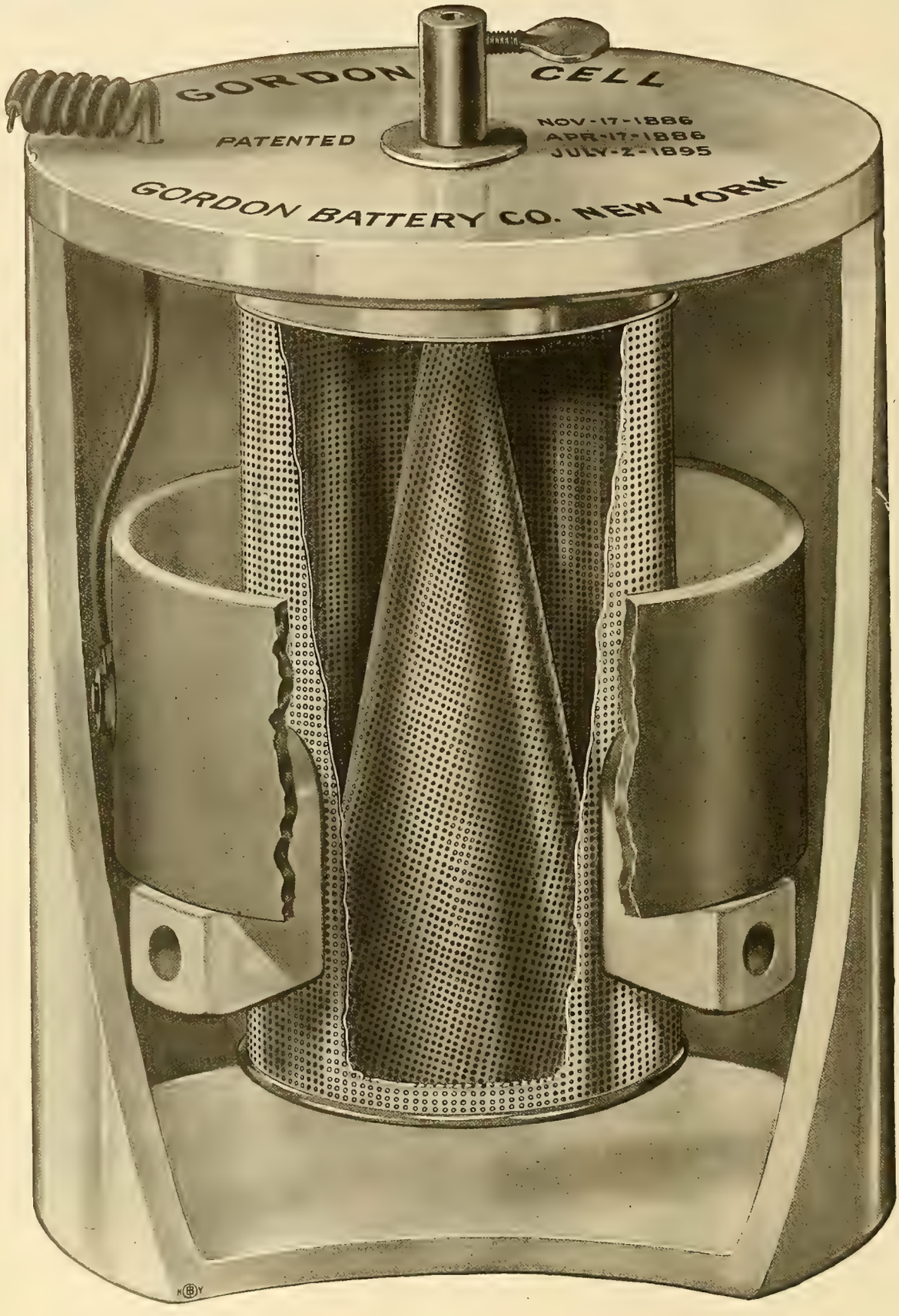
Unequal expansion of transformer windings, which always causes weakening of the mechanical and electrical strength of the insulation, can be avoided only when temperatures throughout the windings are maintained perfectly uniform.

It is evident that this uniform heating can exist only when all parts of the winding are at a uniformly short distance from the cooling oil.

Type H Transformers--even of the largest size--never have any part of the copper more than one and one-half inches from the cooling oil. Therefore TEMPERATURES AND EXPANSIONS ARE UNIFORM in all parts--a result even more desirable than low average temperature.

PRINCIPAL OFFICE, SCHENECTADY, N. Y.

New York Office, 44 Broad Street. Sales Offices in All Large Cities.


GORDON CELL
PATENTED
NOV-17-1886
APR-17-1886
JULY-2-1895
GORDON BATTERY CO. NEW YORK

If interested—

send for one of these.

Contract to Supply 300,000 Duct Feet of

VITRIFIED SALT GLAZED CONDUITS

Awarded to us July 15, 1902, for the

MUNICIPAL CONDUIT SYSTEM IN NEW CASTLE, PA.

STANDARD VITRIFIED CONDUIT CO.,

39-41 CORTLANDT ST., NEW YORK.

R. W. LYLE, President. **B. S. BARNARD, Vice-President and Secretary.**

BETTER BUY BUCKEYE, BECAUSE,

Every lamp is tested after exhaustion on a spark coil and all doubtful lamps are rejected. Every lamp MUST therefore be good vacuum.

MAIN SALES OFFICE AND WORKS,

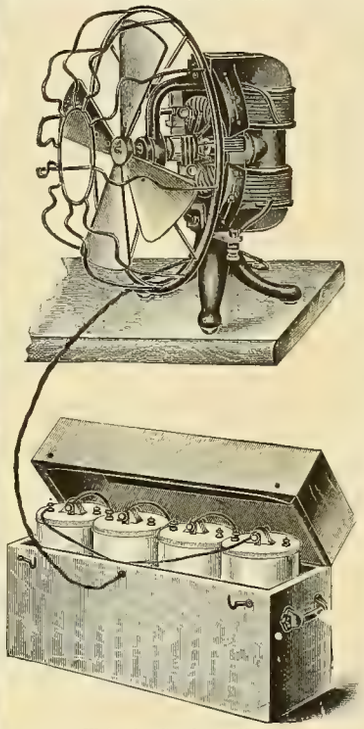
CLEVELAND, OHIO.

1537 Monadnock Bldg., Chicago, Ill.
1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg., Pittsburg, Pa.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

REMOVAL!

JEWELL ELECTRICAL INSTRUMENT CO.'S

FACTORY and OFFICE

TO

61 and 63 Union Park Court

NEAR CARROLL AVENUE.

CHICAGO.

To Reach Us Take Lake Street "L" to Sheldon Street, walk one block west, and three blocks north.

NEW LINE POCKET AMMETERS and VOLTMETERS.
Just Out—Fine for automobile service.
NEW LINE BABY SWITCHBOARD INSTRUMENTS—Just Out.
Send for New Bulletin.

REMOVAL!

METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

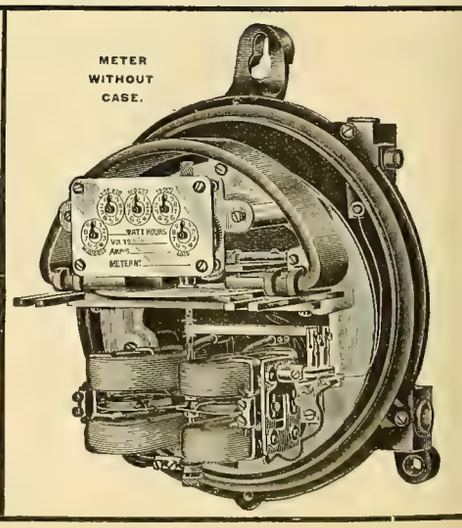
DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,
PEORIA, ILL., U. S. A.



METER WITHOUT CASE.

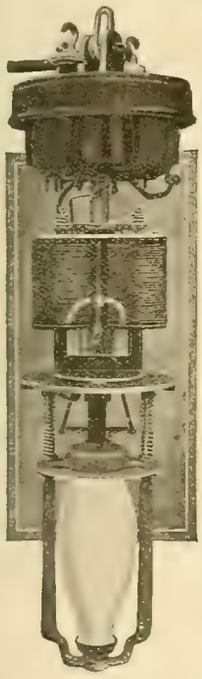
TRADE G. I. MARK TRADE G. I. MARK

EVERY INCH AN ARC LAMP

TRADE G. I. MARK TRADE G. I. MARK

DIRECT AND ALTERNATING CURRENT.

MECHANISM.

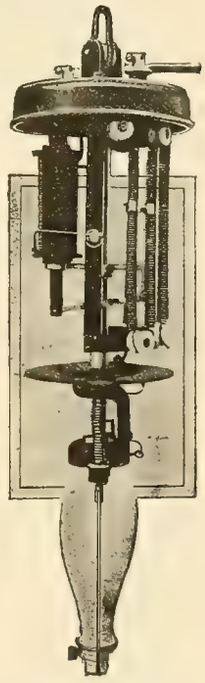


ALTERNATING CURRENT.

G. I. ARC LAMP SHELLS AND PARTS

INTERCHANGEABLE

MECHANISM.



DIRECT CURRENT.

INDEX OF BULLETINS

DESCRIBING OTHER ELECTRIC SUPPLIES MANUFACTURED BY THE G. I. COMPANY.

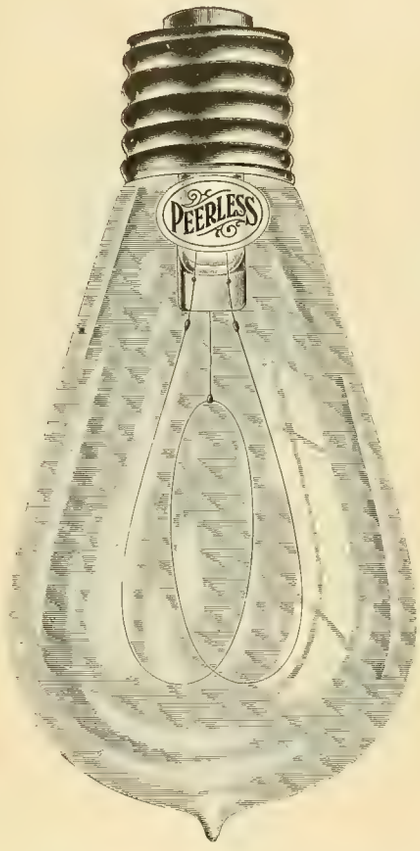
SWITCHES (Knife and Oil) AND CIRCUIT BREAKERS FROM 100 TO 30,000 VOLTS	No. 50, 53, 54, 152, 155
SWITCH AND PANEL BOARDS	No. 51
MOTORS, GENERATORS, CONVERTERS, FROM $\frac{1}{20}$th TO 50 H. P.	No. 161, 162, 164
RHEOSTATS OF EVERY DESCRIPTION	No. 240
CONDUIT BOXES, ETC., ETC.	No. 91, 94
INCANDESCENT LAMPS, ALL SHAPES, C. P. AND VOLTAGES	No. 190

BULLETINS, BLUEPRINTS, PHOTOGRAPHS, ESTIMATES, ETC., MAILED FREE ON APPLICATION.

GENERAL INCANDESCENT ARC LIGHT COMPANY,

NEW YORK, N. Y. and all large cities.

PEERLESS INCANDESCENT LAMPS.



They're not the best on earth, but they are strictly high grade lamps, backed by all sorts of responsible guarantees.

We can make all kinds of claims for them but we won't. What we will do is to guarantee to give you a lamp that will give the very best of service and satisfy you. If we don't, send them back at our expense. Write us to-day.

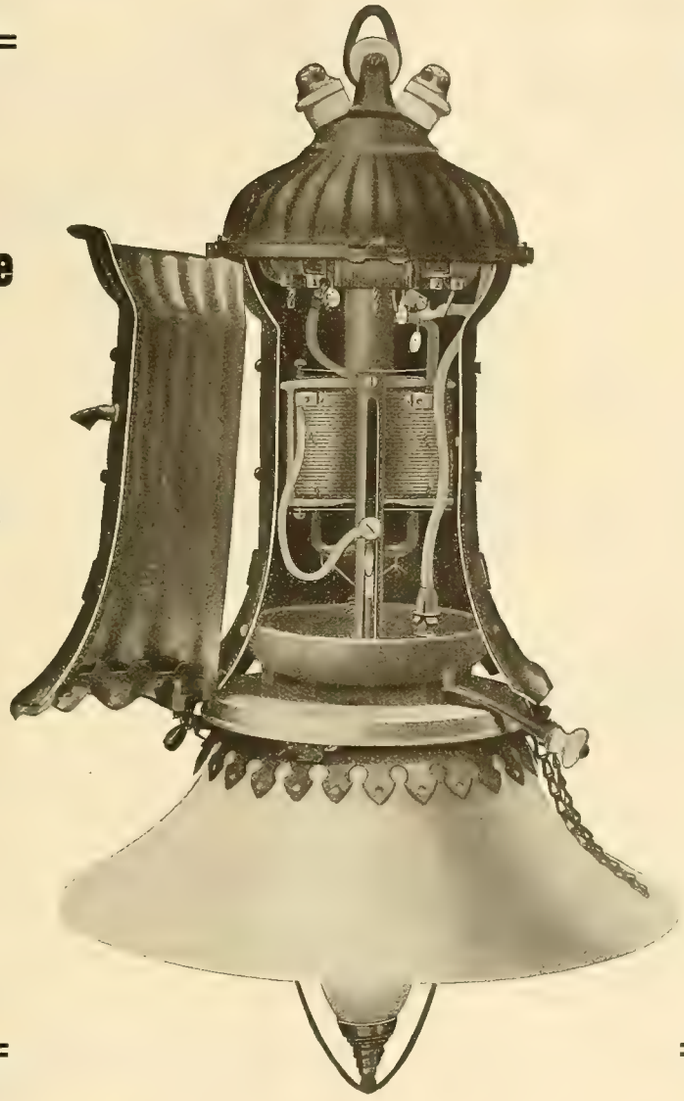
WESTERN ELECTRICAL SUPPLY CO., St. Louis, U. S. A.

Sample Lamps for Trial on Application.

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market.
It's good to look at and built to stand the most severe service.
Never has been beaten in a competitive test.



Their Efficiency and Regulation are Perfect.
Easiest lamp to trim made.
Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. C. POMEROY,
No. 309 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
C. A. THOMSON,
No. 136 Liberty Street.

NOXEM

A Double-Pole Receiver of new and improved design.

The most perfect in mechanical and electrical detail and the simplest receiver on the market.

Write for special circular on Noxem Receivers.

ELECTRIC APPLIANCE COMPANY, TELEPHONE MANUFACTURERS, ELECTRICAL SUPPLIES, 92 AND 94 W. VAN BUREN STREET, CHICAGO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

INDIA MICA

We import directly from India and handle the output of the best mines. A large stock constantly on hand enables us to make prompt shipments. ALL OTHER QUALITIES. Prices low.

EUGENE MUNSELL & COMPANY,
NEW YORK AND CHICAGO.

ARC LAMPS

ARC LAMPS

39 SORT. LANDT ST.

19th & ALLEGHENY AVE.

WHY THEN BUY IT?

Such a lamp is generally cheap—in first cost. After a few months, when it commences to get in its worry—which has been bought and paid for—things will begin to look a little different. You will then begin to think of the Toerring 200-hour arc lamp—guaranteed in construction, operation and life, and the next lot of lamps you will buy will be Toerring Lamps. Why not save the worry and buy them at once?
Correspondence invited.

Highest Awards Philadelphia, Paris and Buffalo.

NEW YORK CITY. C. J. TOERRING CO PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

F. B. BADT. C. M. WILLIS.

F. B. BADT & CO.

CONSULTING ENGINEERS AND EXPERTS,

1504 Monadnock Block,

TELEPHONE HARRISON 745. **CHICAGO.**

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. **CHICAGO.**

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building,

CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

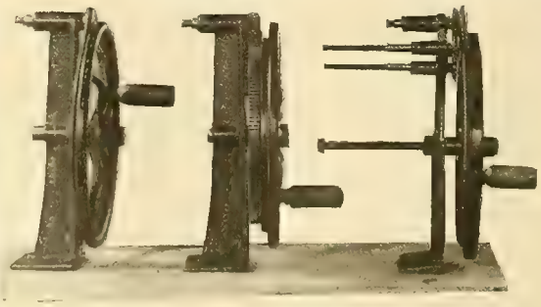
Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Manufacturers, **909, 100 Washington St., Chicago.**

ANDERSON MAGNET WINDERS.

MADE FOR HAND OR LATHE WINDING, OR RE-WINDING OF ALL SIZES OF WIRES.



Send for circular describing different styles, prices, etc.

ALL DEALERS SELL THEM.

Special winders and machinery made to order.

Also Manufacturer of Wire Reels and Measuring Machines for measuring wire while winding.

H. ANDERSON, Peekskill, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. **CHICAGO**

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"YOU PRESS THE BUTTON,

THE OHMMETER DOES THE REST."

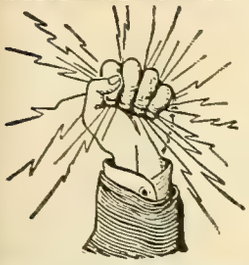
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. E. ROWLAND PHILLIPS, Vice-Pres.
G. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. O. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



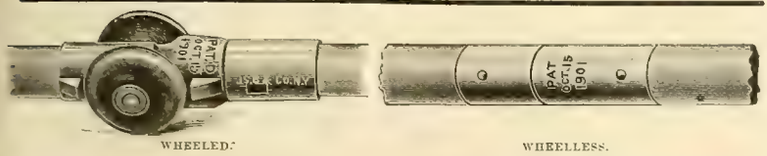
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing.
Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.



WHEELED. WHEELLESS.

Villard Automatic Wheeled and Wheelless Conduit Rods

Are Coupled and Uncoupled Instantly and with Ease.

Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed, and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa.
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
Easy to install.
Cheaper than other guys.
One piece. No moving parts.
Necessary for well guyed poles.
Operated like a corkscrew.
Mechanically correct.
Indestructible by fire or frost.
Carefully made.
Anchors that pay dividends.
Labor savers.

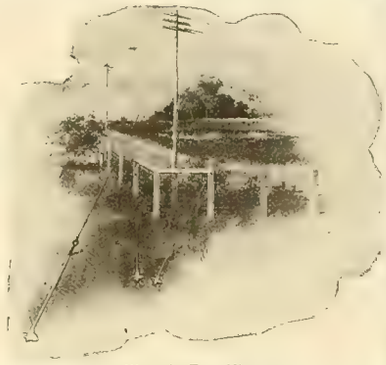
STOMBAUCH GUY ANCHOR

STOMBAUCH GUY ANCHORS

Write for prices, to

W. N. MATTHEWS & BRO.

603 Carleton Building,
ST. LOUIS.



Worm's-Eye View.

Better Buy Buckeye, Because,

After the lamps are all carefully photometered, another set of operators rephotometer. The operatives know they cannot slip bad work past this inspection. This insures your getting the full candlepower you pay for.

Main Sales Office and Works, CLEVELAND, OHIO.

1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg., Pittsburg, Pa.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

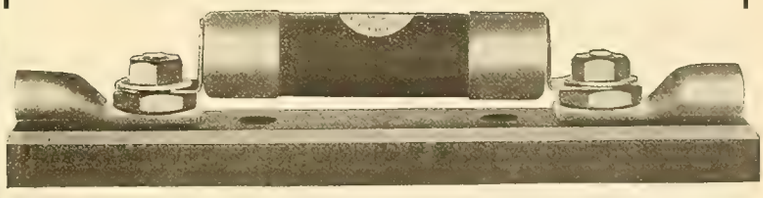
"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

"SHAWMUT" ENCLOSED FUSES



RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative:
WM. S. BROWN, 39 Cortlandt St., New York City.

Western Representative:
THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As engineer. Nine years' experience on all classes of engines, and 12 years on dynamos, motors, boosters, rotaries and storage batteries. Can take position first week of October. Reference given. Address HOWARD NEFF., care State Bank, Dillon, Mont.

WANTED.

Good town in which to build a telephone exchange—county seat preferred—or any good, growing town. Also desire partner in construction of plants, having $2,000. Address BOX 112, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Armature winders, coil makers and other experienced electrical workers wanted. Steady employment with good living conditions near works. Apply BOX 153, Erie, Pa.

WANTED.

The manufacturer of a high-grade line of direct-current dynamos and motors, ranging in sizes from ½ H.P. to 22 H. P., desires to secure a few more responsible selling agents. Address BOX 110, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Experienced telephone traveling salesmen; acquainted with Northwest trade preferred, but not essential.

THE VOUGHT-BERGER COMPANY,
Makers of Telephones and Switchboards,
La Crosse, Wis

POSITIONS OPEN.

PER MONTH.

5 Draftsmen, Electrical.....$100
2 Draftsmen, Structural Steel.....$125
2 Draftsmen, Bridge.....$75 up.
1 Electrical Superintendent.....$85
1 Electrical Superintendent.....$50
2 Armature Winders, must be gilt edge.....$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K.W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
2— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Two telephone exchanges, same county, $4,000.00 and $3,500.00, together or singly. Present yield 21 per cent net, all additional installations will yield 25 to 30 per cent. Excellent toll lines, and a good territory for future development. Owner is a clergyman called South. Write for further information. W. HOWARD MEARS, Kasson, Minn.

FOR SALE.

Good second hand transformers, General Electric Type F, 125 cycle, primary 1,040V, secondary 52V and 104V. All sizes from 300 to 3,500 Watts. PEOPLE'S LIGHT COMPANY, Davenport, Iowa.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

U. S. ENGINEER OFFICE, 735 N. Capitol St., Washington, D. C., August 27, 1902. Sealed proposals will be received here until noon, September 26, 1902, and then publicly opened, for furnishing Electrical Fixtures and Supplies for New Building for Government Printing Office. Information furnished on application. JOHN STEPHEN SEWELL, Capt. Engrs.

DEPARTMENT OF INTERIOR, Washington, D. C., August 30, 1902.—Sealed proposals, in duplicate, will be received at the Department until 2 o'clock P. M., on Wednesday, the first day of October, 1902, and then opened in the presence of such persons as may attend, for the construction of an Administration Building called Building "A;" for an addition to the Toner Building Kitchen; for the erection and completion of a Central Power and Heating Plant; Electric Power Plant; Power House, Chimney and Tunnels for the Government Hospital for the Insane at Washington, D. C., in accordance with the drawings and specifications, copies of which specifications and form of proposal may be had, and the drawings seen, on application at this Department. The right is reserved to reject any and all bids. THOS. RYAN, Acting Secretary.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., September 9, 1902.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 10th day of October, 1902, and then opened, for the installation of a conduit and electric wiring system for the United States postoffice and courthouse at Elmira, N. Y., in accordance with the drawings and specification, copies of which may be obtained at this office, or at the office of the superintendent of construction at Elmira, N. Y., at the discretion of the supervising architect. JAMES KNOX TAYLOR, Supervising Architect.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw, Mich.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance

Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

Sales Representatives Wanted.

A large, successfull and well established machinery manufacturing company, West of Ohio, doing a constantly increasing business and having an enviable reputation with its present product is prepared to place upon the market a line of

ELECTRICAL MACHINERY

including alternating-current generators up to 1,000 K. W. and direct-current generators and motors of corresponding size.

Only high-grade sales representatives are wanted to sell on commission or otherwise.

Correspondence is desired with established firms or others who are properly equipped and are experienced in the sale of electrical machinery.

All communications will be considered confidential.

Address BOX 109, care Western Electrician, 510 Marquette Building, Chicago.

ALTERNATORS.

Two 150 K. W. 3-phase, 60 cycles, Stanley. Almost new; bargain.
Two 75 K. W. Westinghouse, 60 cycles, direct connected to engine; 2-phase.
One 120 K. W., 133 cycles, 1,100 or 2,200 volts.
Three 37½ K. W., Westinghouse, 133 cycles.
One 90 K. W., Westinghouse, 133 cycles.
One 45 K. W., 60 cycles, 2-phase, Westinghouse.
All sizes of alternators.

GENERATORS.

One 240 K. W., Walker, 250 volts, M. P. 4, 300 R. P. M.
Two 50 K. W., G. E. direct to St. Line Engine, 110 volts.
One 45 K. W., G. E. 220 volt compound generator.
One 100 K. W., G. E. M. P. 4, 550 volts, 650 R. P. M.
Write for anything needed to equip a station. Goods fresh.

THE STEAM & ELECTRICAL EQUIPMENT CO.,
Wood and Water Sts., Pittsburg, Pa.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE. GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
		1	48x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	36x8 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	54x8 Vertical Tubular.
5	60x16 Horizontal Tubular.		Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110 VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.
2 500 light, 25 K. W. Jenny.
1 350 light, 20 K. W. Mather.
1 250 light, Sperry.
1 200 light, Western Electric.
1 175 light, 15 K. W. Brush.
1 120 light, Mayo.
1 90 light, Westinghouse multi-polar.

133 CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H. 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, E. H. CHENEY, Manager. 204 Dearborn St., CHICAGO.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

Above cut is full size. Weight, 4 oz.

THE BAIRD $1.50 BATTERY GAUGE

TRADE PRICE, $1.00 NET

CONVENIENT, SIMPLE, DURABLE,
RELIABLE, DOUBLE SCALE.

SATISFACTION GUARANTEED OR MONEY REFUNDED.

NOTE—This Gauge will detect either low Voltage or high Internal Resistance in a cell or battery, either of which renders the cell unfit for use.

Samples Sent On Approval.

BAIRD MANUFACTURING CO.,
187 ONTARIO STREET, CHICAGO.

Above cut is full size. Weight, 4 oz.

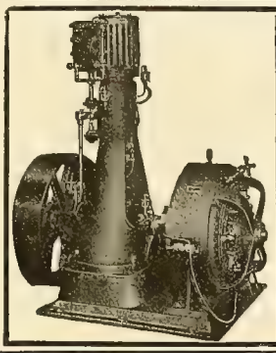
BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78 page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,
Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

THE WORCESTER POLYTECHNIC INSTITUTE

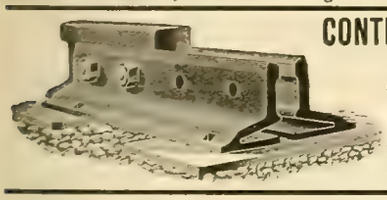
EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

When in search of a position advertise in the WESTERN ELECTRICIAN.

DESIGNS FOR PATENTS. WORKING DRAWINGS FOR SPECIAL AND AUTOMATIC MACHINERY.
DEVELOPING OF ELECTRICAL INVENTIONS A SPECIALTY.
GEO. M. MAYER, Mechanical Engineer, 1561 Monadnock Block, Chicago, Ill.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

BOOKS. BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

"RELIANCE"
GENERATORS AND MOTORS.
SEND FOR BULLETIN.
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

BETTER BUY BUCKEYE, BECAUSE,

We inspect every filament four times during its manufacture, insuring a well shaped filament, exact candlepower and voltage, and the right efficiency.

MAIN SALES OFFICE AND WORKS, CLEVELAND, OHIO.

1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg., Pittsburg, Pa.

WHEN IN DOUBT

STICK TO ARTICLES WHICH HAVE WELL EARNED REPUTATIONS.

KELLOGG TRANSMITTERS ABSOLUTELY UNIFORM.

In the past year over 72,380 Kellogg Transmitters have been put on the market, and out of that number only one purchaser has expressed his dissatisfaction and asked for his money back.

The above contains food for thought for intending

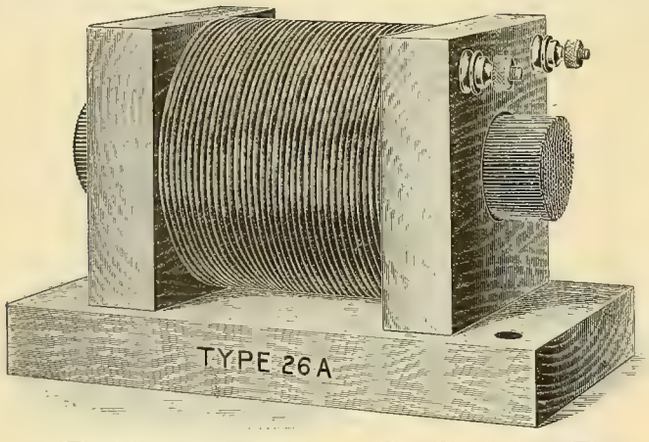
BUYERS OF TELEPHONE APPARATUS.

WRITE FOR GENERAL CATALOG.

BRANCH OFFICES:
Keystone Tel. Bldg., - - Philadelphia, Pa.
Electric Bldg., - - - Cleveland, O.
346 Broadway, - - - New York.

Kellogg Switchboard & Supply Co.

229 SO. GREEN STREET, CHICAGO.



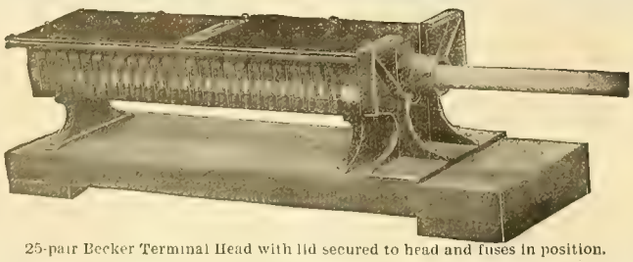
SPARK COILS
FOR EVERY PURPOSE.
VARLEY DUPLEX MAGNET CO., CHICAGO, ILL. PHILLIPSDALE, R. I.

CHICAGO TELEPHONE PAY STATIONS and METERS
Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.
Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

Bound Volumes
OF THE
WESTERN ELECTRICIAN
FOR SALE.
From Vol. 1 to Date.
ADDRESS
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO

EQUIP YOUR LINES THIS FALL
and be prepared for the storms of next Spring . . . . . .

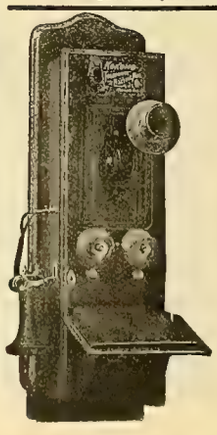
PROTECTION
THE BECKER TERMINAL HEAD.



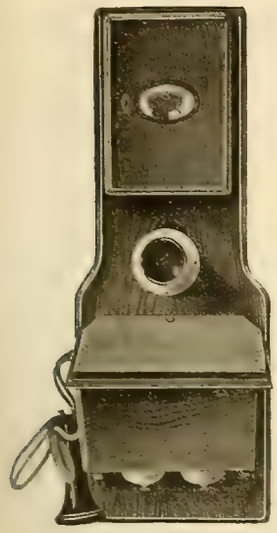
25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.
Illinois Electric Co., Chicago Agents. Post-Glover Electric Co., Cincinnati Agents. W. G. Nagel Electric Co., Toledo (O.) Agents.



KOKOMO TELEPHONES
Always Up-to-Date.
WE MANUFACTURE
SWITCHBOARDS, TELEPHONES
AND EVERYTHING FOR COMPLETE EXCHANGE.
Write for Catalog and Prices.
KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.



Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM
CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

OUR SUCCESS

WE HAVE BEEN IN BUSINESS less than ten years, time after time we have increased our facilities, only to find that other additions were necessary. When we moved into our present quarters 36-58 Jackson Blvd. three years ago we thought we had sufficient space for ten years growth but although every foot of space has been utilized, our building has become so crowded that we have found it necessary to rent lofts on both Jackson Blvd. and Van Buren St. This gives us a large amount of additional space for the manufacture of the only RIGHT KIND OF TELEPHONES AND SWITCHBOARDS and will enable us not only to fill our orders with promptness but to maintain our reputation of producing better telephones and switchboard apparatus than our competitors. If you want to keep at the head of the procession use AMERICAN TELEPHONES AND SWITCHBOARDS.

AMERICAN ELECTRIC TELEPHONE CO.
39 W. JACKSON BLVD., CHICAGO, ILL.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

PATENTED GALVANIZED STEEL CABLE HANGER.

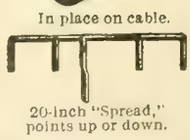
Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

Before attachment. In place on cable.

11½-inch "Spread," points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.



20-inch "Spread," points up or down.

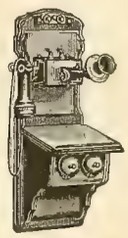
Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.

IMPROVED TELEPHONE APPARATUS.

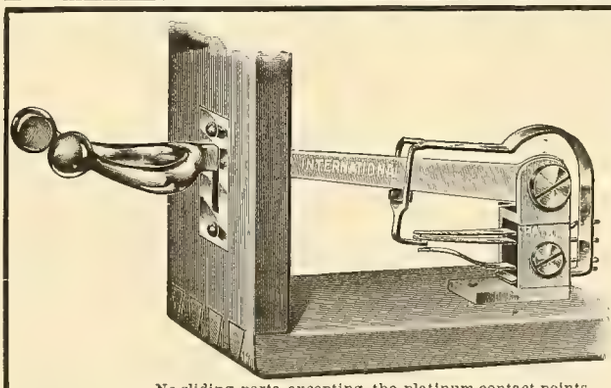
EVERYTHING UP-TO-DATE. SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"



MULTIPLE BOARDS

STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

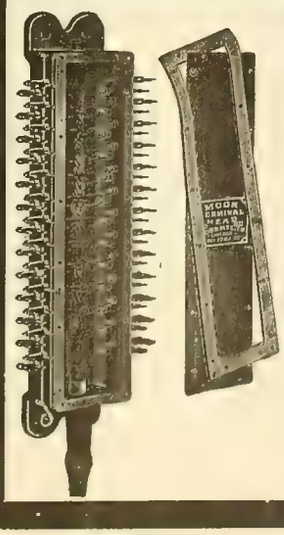


A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points. All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**



MOON TERMINALS

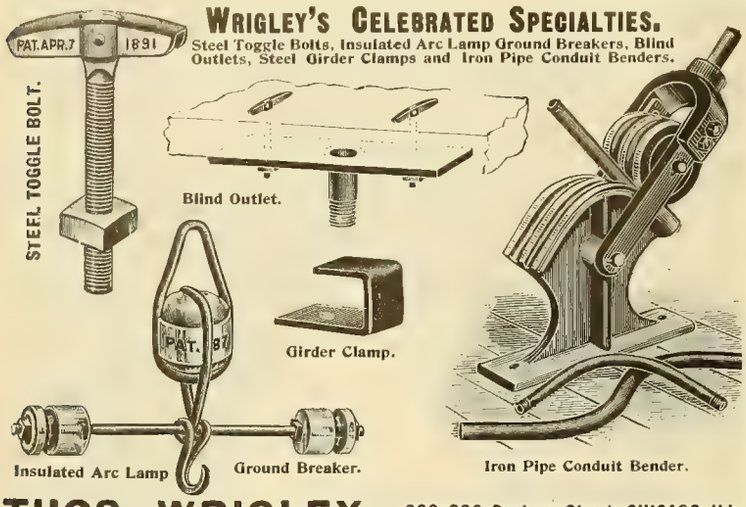
WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box. The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.



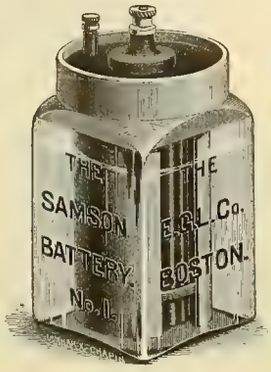
WRIGLEY'S CELEBRATED SPECIALTIES.

Steel Toggle Bolts, Insulated Arc Lamp Ground Breakers, Blind Outlets, Steel Girder Clamps and Iron Pipe Conduit Benders.

THOS. WRIGLEY, 300-306 Deaborn Street, CHICAGO, ILL.

WHEN YOU REQUIRE A BATTERY

BUY A GOOD ONE.



THE SAMSON

CAN'T BE BEAT.

IT IS THE STRONGEST SAL-AMMONIAC BATTERY MADE, AND THE ONLY SUCCESSFUL CELL FOR ELECTRIC GAS LIGHTING. ORDER NOW—A

SAMSON BATTERY.

THE STANDARD ELECTRIC COMPANY,

113 W. 3d STREET, CINCINNATI, OHIO.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,

$1 A VOLUME.

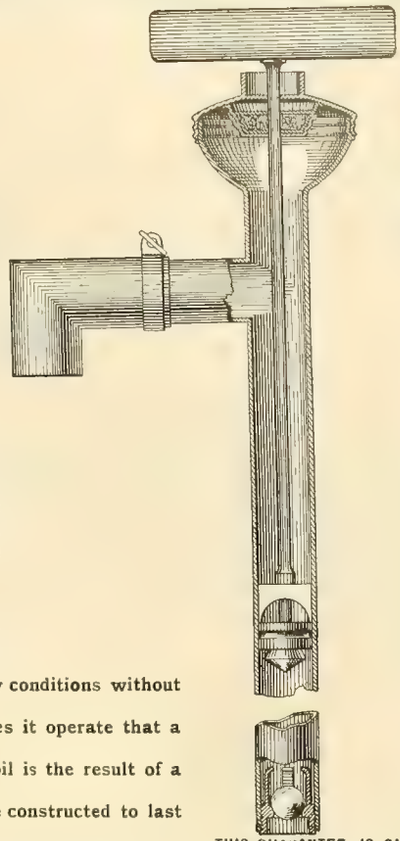
Electrician Publishing Co.,

510 Marquette Building, Chicago.

Cut showing pump in operation.
Notice the stream, then try and get it with any other pump.

DEMAND IS THE MOTHER OF THE PUMP.
THE PUMP FILLS PERFECTLY EVERY DEMAND.

THE STERRETT OIL PUMP



Is designed to handle heavy valve oils especially, and is guaranteed to pump any article that is in a liquid form. You have never had a pump that would do this work satisfactorily, because there has never been one made. The demand has always existed but never satisfied until "The Sterrett" was produced.

"THE STERRETT" possesses **FIVE** distinct points of superiority over any other oil pump on the market.

1ST—CLEANLINESS: Not a drop of oil escapes outside of the pump. It can be used at any time and under any conditions without soiling the hands or smearing oil over everything in the neighborhood.

2ND—EASE OF OPERATION: Its action is free and the slightest movement brings it into action. So easy does it operate that a child can handle it to its full capacity.

3RD—CAPACITY: No other pump on the market can compare with it in the volume of the flow. A full quart of oil is the result of a full stroke of the pump.

4TH—DURABILITY: The pump is made of seamless brass tubing; all parts are free from rust or breakage and are constructed to last a lifetime.

5TH—ADAPTABILITY: The general construction of the pump and the addition of the extension spout with its ability to pump anything from water to molasses, makes its adaptability greater than any other pump ever offered on the market.

You will never know the satisfaction of handling your oils easily until you try "THE STERRETT." **AFTER FIVE MINUTES' TRIAL YOU WOULD NOT PART WITH IT AT ANY PRICE.**

All jobbers handle it, or will be sent direct upon receipt of the retail price, **$3.50.** Manufactured by

THIS GUARANTEE IS ON EVERY PUMP:
If this pump does not prove satisfactory after 30 days' trial, return it and your money will be refunded without question. STERRETT PUMP CO., St. Paul, Minn.

STERRETT PUMP COMPANY, 69 East Sixth St., ST. PAUL, MINN.

ELECTROTYPING

ILLUSTRATING

ENGRAVING

141-155 PLYMOUTH PLACE.

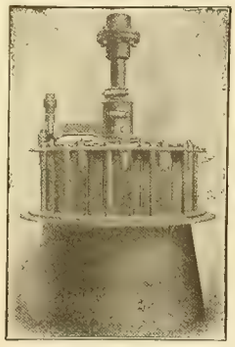
BOILERS SAVED LABOR SAVED

BY USING

DEARBORN BOILER COMPOUNDS. MADE TO SUIT THE WATER AS PER ANALYSIS : : :

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING

ELECTRIC LIGHTING AND POWER PLANTS,

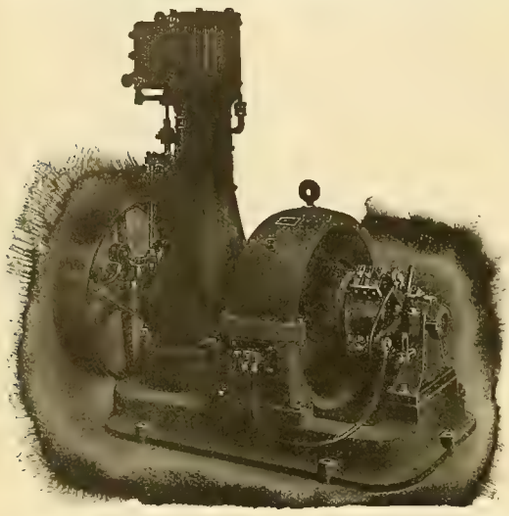
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,

SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,

MILWAUKEE, WIS., U. S. A.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago. Ill.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.
TEXAS. FLORIDA. UTAH.
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

UNION PACIFIC — THE OVERLAND ROUTE — WORLD'S PICTORIAL LINE.

"THE OVERLAND LIMITED"

ELECTRIC LIGHTED

. . TO . .

California

VIA THE UNION PACIFIC.

This train is really a FIRST-CLASS MODERN HOTEL, with

Handsome Parlors, Drawing Rooms, Bed Chambers, Boudoirs, Libraries, Smoking and Reading Rooms, Barber Shops, Bath Rooms (hot and cold water), Superbly Appointed Dining Rooms (Glittering with Mirrors, Cut Glass, Fragrant Flowers, Electric Candelabra, E. c.), Promenades, Observation Rooms, Electric Lights, Electric Fans, Telephones, Electric Reading Lamps, Perfect Heat, Etc. . . . . .

RUNS EVERY DAY IN THE YEAR.

E. L. Lomax, G. P. & T. A., Omaha, Neb.

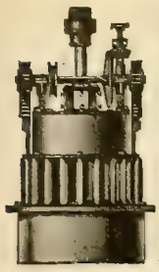
BETTER BUY BUCKEYE, BECAUSE,

Lamps after exhaustion are burned for half an hour 4% above rated voltage and then re-inspected for appearance of filament, bad vacuum and all possible defects. This is the severest kind of a test, but you need it for your business.

MAIN SALES OFFICE AND WORKS,

CLEVELAND, - - - - OHIO.

1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg, Pittsburg, Pa.



M'CORMICK TURBINE.

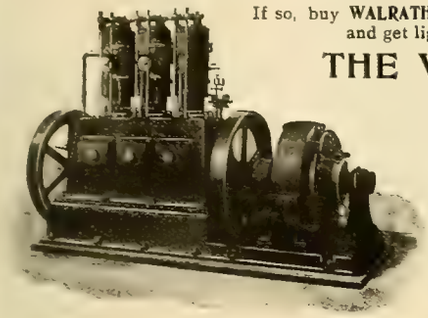
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

TEST INSTRUMENTS.

Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

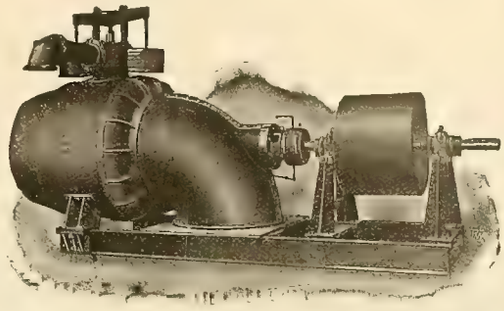
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,
257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch St.
BOSTON, 73 Oliver St. CHICAGO, 311 Dearborn St.
NEW ORLEANS, 304 Hennen Bldg. LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

REG. TRADE MARKS
"Phosphor Bronze"
DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

THE TELEPHONE HAND-BOOK

BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

Chicago TO New York AND Boston

VIA THE POPULAR

West Shore Route

Through sleeping and dining car service via Nickel Plate or Wabash from Chicago.

Passengers via this favorite route arrive in New York at uptown station, Forty-second street, the center of the hotel and shopping district, or downtown at Franklin street station, in close proximity to all ocean steamship docks and Jersey City and Brooklyn. For tickets, sleeping car space and further information call on or address

JOHN W. COOK,
G. W. P. A.,
205 S. Clark Street, CHICAGO, ILL.

Subscription Blank—Foreign.

WESTERN ELECTRICIAN
....EVERY SATURDAY....
CHICAGO { SUITE 510 MARQUETTE BLDG.
NEW YORK { 193 TIMES BLDG.

.....1901.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago, U. S. A.

Gentlemen:

Inclosed find $\$5.00$ / $\$2.50$, for which please send THE WESTERN ELECTRICIAN weekly to the following address for 12 / 6 months; this order to go into effect with current number.

Name.....

Address.....

$5.00 a Year (52 Numbers)
$2.50 6 Months (26 ")

WE HANDLE THE IDAHO

CEDAR POLES

NONE ARE BETTER.

Especially Adapted for City Construction.

PACIFIC COAST POLE CO.,

220 Mohawk Block, Spokane, Wash.

BETTER GET PRICES.

229 SOUTH GREEN STREET.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

IT WILL PAY YOU.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

MANUFACTURER OF

PINS, BRACKETS AND CROSS-ARMS

FOR LIGHTING, POWER AND TELEPHONE LINES.

Standard Electric Light Cross-Arms 3½ cents per lineal foot.
1¼ inch Oak Pins $6.00 per M.

R. H. LEAVITT,

Lock Box 8. CAPRON, ILL.

WESTERN CEDAR POLES—Low Prices.

Yards: Idaho. Office: Denver, Colo. B. F. VREELAND.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

YOUR BOOK ORDERS

Will receive PROMPT and CAREFUL attention if sent to

Electrician Publishing Company,

510 Marquette Bldg., Chicago.

Subscription Blank—Domestic.

WESTERN ELECTRICIAN ....EVERY SATURDAY.... CHICAGO { SUITE 510 MARQUETTE BLDG. NEW YORK { 193 TIMES BLDG.

.....1901.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

Gentlemen:

Inclosed find $\$3.00$ / $\$1.50$, for which please send THE WESTERN ELECTRICIAN weekly to the following address for $\frac{12}{6}$ months; this order to go into effect with current number.

Name.....

Address.....

.....

$3.00 a Year (52 Numbers)
$1.50 6 Months (26 ")

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

OUR STOCK OF

TROLLEY POLES AND TROLLEY TIES

is the biggest ever. Our shipping facilities among the best and prices—but wait till you write us.

"When we haven't the stock we don't quote," but when we do quote we get the order if it is get-able. . . . . .

MALTBY LUMBER CO.,

BAY CITY, MICH.

Write Us

If you want CEDAR POLES POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

POLES.

WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

POLES

W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years.

TIES.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH. Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES

LONG DISTANCE 'PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.

Mfrs. and Dealers in Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.

LARGE STOCKS ON HAND.

Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

WHITE CEDAR POLES.

HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

CEDAR POLES STREET RY. TIES FERRIZ & SONS DAGGETT MICH.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand.

CROSS ARMS

THE STANDARD POLE & TIE CO.

44 BROAD ST., NEW YORK

CROSS ARMS

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

MEDORA MILLING COMPANY

CHESTNUT POLES

20 ft. to 75 ft. LENGTHS.

LARGE STOCK CARRIED

MEDORA, IND.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .

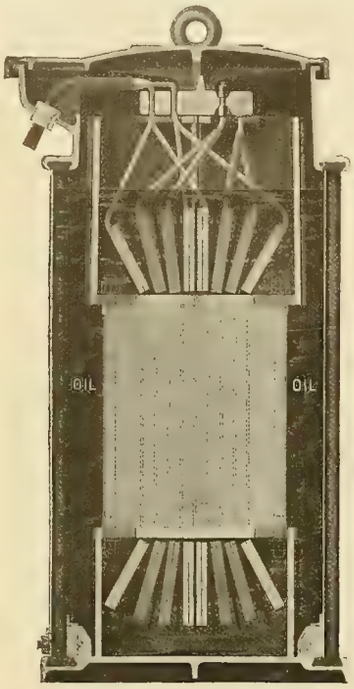
SPECIAL PRICES UPON APPLICATION.

PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn

A Few Facts About Transformers

Average Temperature



Every coil in the Westinghouse Transformer shares equally in the cooling—

(1) The exposed spread end of one coil presents the same surface in contact with cooling oil as any other. Each coil thus passes off its heat with equal facility, and no unequal expansions occur to injure the insulation.

(2) Heat generated within the interior travels, not through layers of insulation, but along highly conducting copper to the spread coil ends. This is why no "hot spots" develop, and this is why temperatures are uniform in O D and Type N Transformers.

There is practically no difference between the temperature measured by a thermometer placed between the coils and that measured in the copper by the resistance method. This is actual proof of the uniform temperature in O D and Type N Transformers.

FOR TRANSFORMER BOOKLETS ADDRESS NEAREST SALES OFFICE OF THE

WESTINGHOUSE ELECTRIC and Manufacturing Co.
PITTSBURG, PA.

New York, Atlanta, Dallas, Boston, Buffalo, Chicago, Cincinnati, Los Angeles, Cleveland, Detroit, Minneapolis, Philadelphia, Pittsburg, St. Louis, San Francisco, Syracuse, Seattle, Salt Lake City, Baltimore, Denver, Mountain Electric Co. Canada: Ahearn & Soper Limited, Ottawa.
Mexico: G. & O. Braniff, City of Mexico.

BETTER BUY BUCKEYE, BECAUSE,

All the inspections and tests we have mentioned before are only a small part of the entire number of inspections that a Buckeye lamp has to pass before it reaches the market.

Main Sales Office and Works, CLEVELAND, OHIO.
1537 Monadnock Bldg., Chicago, Ill. 1419 Real Estate Trust Bldg., Philadelphia, Pa.
202 Real Estate Trust Bldg., Pittsburg, Pa.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

"The Recognized Authority on Wiring and Construction."

The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING
For Electric Light and Power.
By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED
By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE
It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover (pocket size), $1.00.
Sent post paid upon receipt of price, by
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, - - CHICAGO, ILL.

NOW READY!!

WESTERN ELECTRICIAN'S MOONLIGHT SCHEDULE

FOR 1902.

ARRANGED IN BOOK FORM, POCKET SIZE.

10 Cents per Copy. Send for It.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

A Page from Bulletin No. 1031.

TYPE A OIL TRANSFORMERS.

EASE OF INSTALLATION—An examination of the illustrations and diagrams in this bulletin will reveal the refinement of design and construction of the details of these tranformers which indicate their general superiority over other transformers. Special attention has been paid to the matter of ease of installation. Sizes from .6 Kw. to 2.5 Kw. capacity are equipped with a single hanger iron illustrated in Fig. 7. Capacities from 3 to 25 Kw. are equipped with double hanger irons as illustrated in Fig. 8, while sizes above 25 Kw. are considered too large for installation on hanger irons and are furnished with lugs or feet on the base of the case, as in the majority of cases they will be used for sub-station work.

SUSPENSION HOOKS.—The suspension hook furnished with Type A transformers is a distinct novelty and possesses valuable features which will be appreciated by the practical engineer. Instead of attaching the hanger irons to the transformer case by bolts and nuts as is common practice, the hooks are provided with studs which properly fit into the lugs cast on the transformer case. In addition to the studs on the hooks a pivoted locking cam is mounted on the hook at a proper distance from the stud to force the stud up into the pocket. These suspension hooks may be readily attached to the transformer before it is elevated to its position on the pole, or the hooks can be set in place on the pole and the transformer raised in the ordinary manner until the pockets (AA) on the back of the case engage with the rivets or studs (BB) on the hanger irons. If the hooks are attached to the transformer before it is elevated, the eccentric cams (CC) should be driven home with a hammer with just sufficient force to drive the rivets well up into the pockets. The same procedure is followed after raising the transformer to the hooks previously mounted on the pole. These hooks are intended to overcome the inconvenience caused by the loss of bolts or nuts when installing and the difficulty sometimes found in removing old transformers when the bolts become rusted. These new hooks do not necessitate using a wrench or any other tool in mounting. Their other good qualities are very evident.

SUSPENSION HOOKS FOR "WOOD" TYPE A TRANSFORMERS

A *Complete* Bulletin on Wood Type A Oil Transformers will be sent to any address — A postal will bring it—from the nearest office.

FORT WAYNE ELECTRIC WORKS.

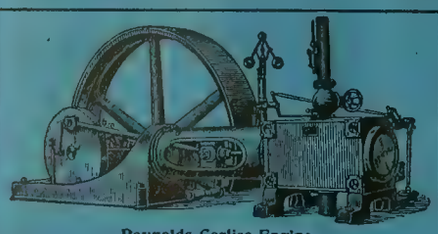
MAIN OFFICE AND FACTORY: FORT WAYNE, IND.

BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
Yokohama, Japan, Bagnall & Hilles.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 901 Fifth Ave.
Cleveland, O., 49 New Bldg.
Atlanta, Ga., 8 South Broad St.
New York, N. Y., 40 Nassau St.

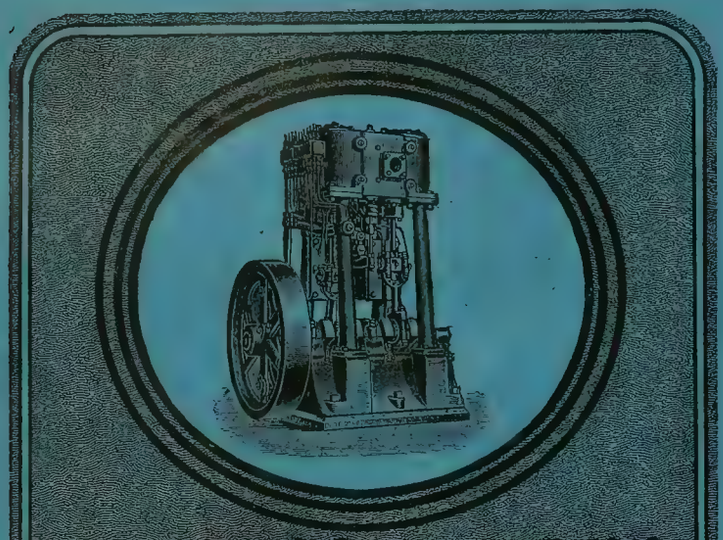
McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.
Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.

Reynolds Corliss Engine.
Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes
SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

VULCANIZED FIBRE.
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

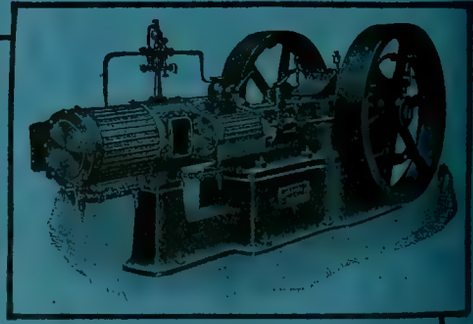
THE BEST VERMONT SLATE FOR Electrical Purposes.
It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.


STURTEVANT ENGINES
BLOWERS FORGES
ELECTRIC MOTORS
GENERATING SETS
ELECTRIC FANS
STEAM HEATING
VENTILATING AND
DRYING APPARATUS
MECHANICAL DRAFT
B. F. STURTEVANT CO.
BOSTON, MASS.
NEW YORK · PHILADELPHIA · CHICAGO · LONDON
243

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances.
Write for catalogue. 195-197 River St. DETROIT MICH

LARGE STOCK
NO DELAYS IN SHIPPING.
I. X. L. Weatherproof, or Grimshaw Rubber Covered Wire. Any size or quantity.
Electro Galvanized Conduit—American Circular Loom. Peerless Transformers. Columbia Carbons. Edison Leland Battery.
The best direct current Arc Lamp on the market, the "ANDERSON."
TRY US ON AN ORDER.
ST. LOUIS ELECTRICAL SUPPLY CO.,
NO. 1118 PINE ST., ST. LOUIS, MO.

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions
TRADE MARK.
Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO HIGH SPEED ENGINES FOR ELECTRIC LIGHT AND POWER SERVICE.

TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.
SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.
BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 20, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 12.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1127 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office. 253 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. 101 Milk St., Boston.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book, "Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute.
Dept. K, 240 242 W. 23d St., New York.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

GASOLINE MOTORS
—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.

A TELEPHONE THAT TALKS.
ERICSSON TELEPHONE CO.,
296 Broadway, NEW YORK.
It will pay you to be put on our bi-monthly free mailing list. Shall we? Thank you, send your address.

Kilfyre DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

THE PURCHASE OF GOOD GOODS WILL ESTABLISH A HIGH STANDARD IN YOUR PLANT. TO DO THIS, BUY ALL YOUR ELECTRIC SUPPLIES FROM THE OLD RELIABLE COMPANY
113 W. THIRD ST. CINCINNATI, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Standard Portable Alternating and Direct Current Wattmeter for Lamp Testing.

BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., No. 101 St. Martins Lane.
The Weston Standard Portable Direct Reading
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name. Write for circular and price lists 8 and 9.
Mention the WESTERN ELECTRICIAN when writing for catalogues.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

DO YOU WANT STREET-RAILWAY BUSINESS?

IF you wish to increase your business with the street-railway interests of the world, you should be represented in the WESTERN ELECTRICIAN of October 4th and 11th. These two issues will cover the annual meeting of the American Street-Railway Association to be held in Detroit, October 8th, 9th and 10th. The attendance promises to be unusually large. Many concerns wishing to exhibit at this convention were unable to obtain space.

The WESTERN ELECTRICIAN of October 4th will be distributed at the convention, and the issue of October 11th will contain the report of the meeting.

A large attractive announcement would enable you to place the merits of your products before almost every possible buyer.

Give us an idea of what you wish to advertise, and we will be pleased to get up an attractive announcement for your approval.

RESERVE YOUR SPACE NOW, AND
OBTAIN A CHOICE LOCATION : :

WESTERN ELECTRICIAN,

510 Marquette Building,
CHICAGO.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

The "Chloride Accumulator" For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, Etc., Etc.

The "Exide Accumulator" For Electric Vehicles.

EXIDE BATTERY DEPOTS: NEW YORK, 148 W. 18th St. PHILADELPHIA, 250 N. Broad St. BUFFALO, 200 Pearl St. CHICAGO, 264 Michigan Boulevard. ST. LOUIS, 3937 Olive St. DETROIT, MICH., 101 Woodward Ave.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES: PHILADELPHIA, Allegheny Ave. & 19th St. NEW YORK, 100 Broadway. BOSTON, 60 State St. CHICAGO, Marquette Bld. BALTIMORE, Continental Trust Bld. ST. LOUIS, Wainwright Bld. SAN FRANCISCO, Nevada Block. CLEVELAND, New England Bldg. DETROIT, Michigan Elec. Co. HAVANA, CUBA. F. G GREENWOOD, MGR. 34 Empedrado Street.

R 52

A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago. Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

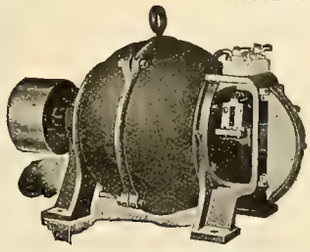
Federal Electric Co.
84 Market Street, CHICAGO, ILL.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co.....—
Allis-Chalmers Company....20
American Battery Co.....—
American District Steam Co.—
Amer. Electrical Heater Co...—
Amer. El. Telephone Co.....15
American Electrical Works..11
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg.Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Beidler & Co, Francis 16
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 11
Bossert El. Construction Co.. 1
Brooks, Hall L..... 17
Brown & Leasure..... 19
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co...—
Century Glass Co.....11
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R..... 4
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago Insulated Wire Co...—
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Columbia Telephone Mfg.Co.14
Connor Company, R.....16
Consumers Carbon Co..... 4
Continuous Rail Joint Company of America.....11
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 7
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ....—
Dicke Tool Company.....16
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 7
Edwards & Company..... 7
Electrical Engineer Institute. 1
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...18
Ely & Co., Allen P.....12
Ericsson Telephone Company 1

Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....17

General Electric Company... 5
General Incandescent Arc Light Company..... 9
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company ...12

Hartford Steam Boiler Inspection & Insurance Co... 8
Hazard Manufacturing Co....20
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holcomb-Lobb Co.....17
Holmes Fibre-Graph. Co..... 9
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....10
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... 1

Machado & Roller..... 4
Maley, Martin.....11
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co. 9
Matthews & Bros., W. N.....11
Mayer, Geo. M..... 4
McLennan & Company, K....10
McNamara Brothers 11
Medora Milling Company....17
Metropolitan Tel. & El Co...14
Mica Insulator Company.....10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 7
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 4
Norton Tool Company, The..15

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 4
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo..... 7
Reliance Electric Company.. 9
Replogle Governor Works.. . 9
Reynolds Electric Company.—
Roebling's Sons Co., J. A....13
Rose Electric Company 12

St. Louis Elec. Supply Co....20
Sargent & Lundy.....—
Sawyer-Man Elec. Company.18
Schoonmaker Co., A. G.....12
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 8
Spies Electric Company.....11
Sprague Electric Company... 3
Standard Electric Company.. 1
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 5
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electric Company...14
Sterling Varnish Co., The....10
Sterrett Pump Company..... 9
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F....20

Toerring Company, C. J 10
Torrey Cedar Company.....17
Triumph Electric Co.....10

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....17
Varley Duplex Magnet Co....—
Vindex Electric Company.... 4
Vreeland, B. F. 16
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Company, W. W..12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst.. 4

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

AN INSTRUMENT FOR ISOLATED PLANT WORK.

Diameter of Base Flange, 7½ Inches.

LIST PRICE $16.50.

This popular type of WHITNEY instrument has a polished all brass case and a permanent magnet movement giving equally divided scales and dead beat indications. The ammeters of large capacity are supplied with separate shunts.

Send for complete price list and our attractive discounts to

ELECTRIC APPLIANCE CO., Chicago, Ill.
WESTERN ELEC'L SUPPLY CO., St. Louis, Mo.
ELECTRICAL ENGINEERING CO., Minneapolis.
STANDARD ELECTRIC CO., Cincinnati, O.
OR
MACHADO & ROLLER, New York, N.Y.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

DESIGNS FOR PATENTS. WORKING DRAWINGS FOR SPECIAL AND AUTOMATIC MACHINERY.

DEVELOPING OF ELECTRICAL INVENTIONS A SPECIALTY.

GEO. M. MAYER, Mechanical Engineer, 1561 Monadnock Block, Chicago, Ill.

The Franklin Dynamo

50 Watts. 10 Volts, 5 Amperes.

3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50, $6, $8.50. Complete $12.50. Write for circular 16.

PARSELL & WEED, 129-131 W. 31st Street, New York.

THE WORCESTER POLYTECHNIC INSTITUTE

EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office, 15 Cortlandt St., New York.

(10928)

OKONITE WIRES are the best

OKONITE
TRADE MARK.

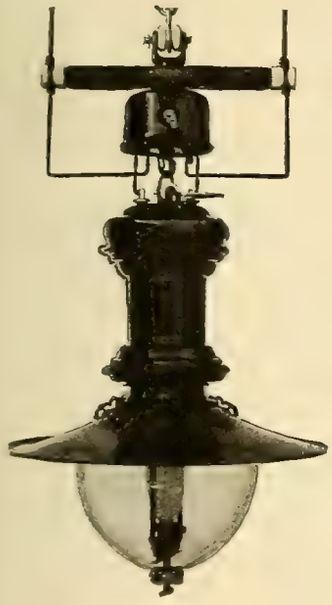
For TELEPHONE, TELEGRAPH, LIGHTING and POWER CIRCUITS, or anywhere that a rubber insulated wire is required.

We Ship "COLUMBIA" LAMPS from stock.

Central Electric Company,
GENERAL WESTERN AGENTS.

264-266-268-270 FIFTH AVENUE,
CHICAGO.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.

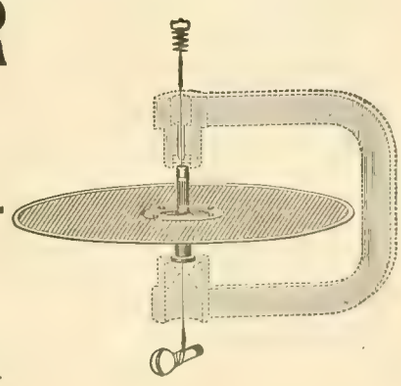
ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.
SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."
STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

SALES OFFICE,
138 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., { SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt.West.Sm.and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Connor Company, R.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt.West.Sm.and Refining Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Ely & Co., Allen P.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Company, W. W.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steam Heating Mains.
American District Steam Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel.M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company,
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 8.

The "Electra" Carbons are the recognized standard all the world over.

ELECTRA

HIGHEST GRADE NUERNBERG CARBONS

THE SUN'S GREATEST RIVAL

HUGO REISINGER, 11 Broadway, New York.

There are no Carbons better than the "Electra" and none "just as good."

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

EDWARDS AND CO.

ELECTRO-MECHANICAL GONG.

Is entirely encased in iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

NEW YORK N.Y.

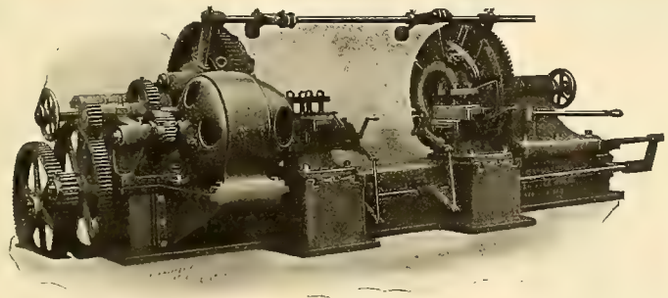
CROCKER-WHEELER

Direct-Current Machinery.

Accuracy in electrical design produces sparkless running.

Strength of insulation and mechanical features insure durability.

Graceful lines result in attractive equipments.



SALES OFFICES IN ALL LARGE CITIES.

Office and Works, - - - AMPERE, N. J.

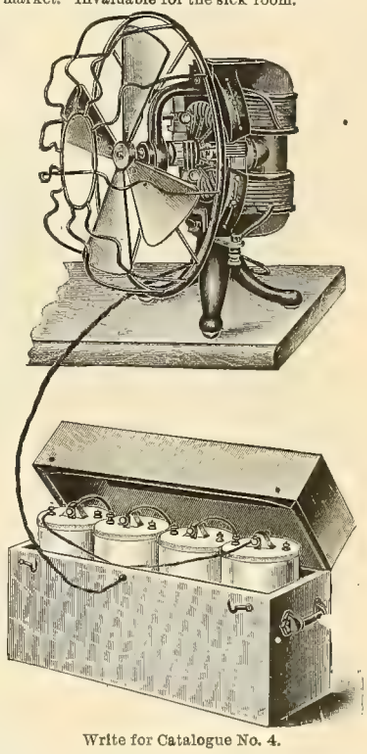
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



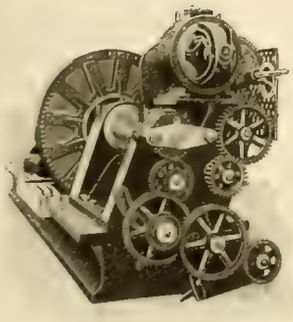
Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.



Write for Power Motor Catalogue.

MOTOR APPLICATIONS.

A Western Electric Company semi-encased motor, geared to a 72-inch Pond Machine Lathe. The gearing of this lathe is so arranged that a variable speed may be obtained.

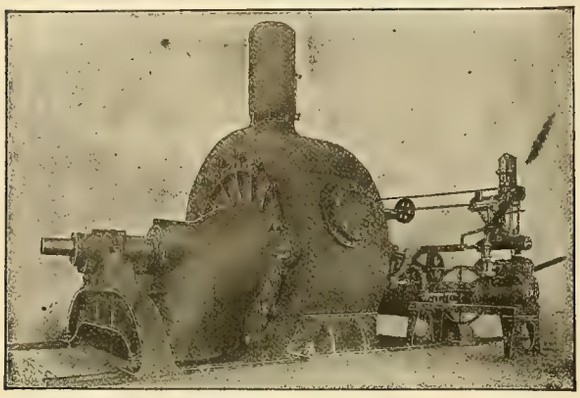
WESTERN ELECTRIC COMPANY,

CHICAGO, SAINT LOUIS —— PHILADELPHIA, NEW YORK.

CORROSION PREVENTED BY USING
DEARBORN BOILER COMPOUNDS
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H. EDGAR, President Telephone: Harrison 3930 and 3931.

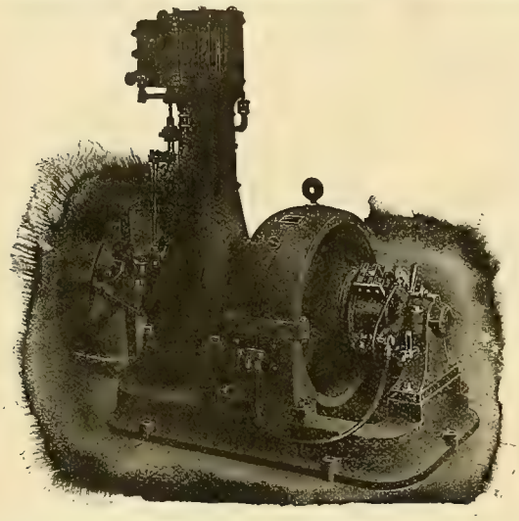


SAMSON TURBINE
UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.
Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

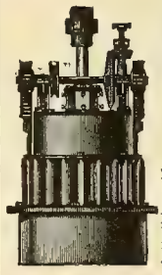
THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

The
Pioneer
Limited.

Famous
Train
of the
World.

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent,
Chicago, Ill.

Only 10 Cents Each
Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ½ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
510 Marquette Building,
CHICAGO.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

GRAPHITE RESISTANCE.
Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE
BETWEEN
CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS,
CHICAGO AND PEORIA,
ST. LOUIS AND KANSAS CITY.
THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND
HOT SPRINGS, Ark., DENVER, Colo.,
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

REG. TRADE MARKS. "Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

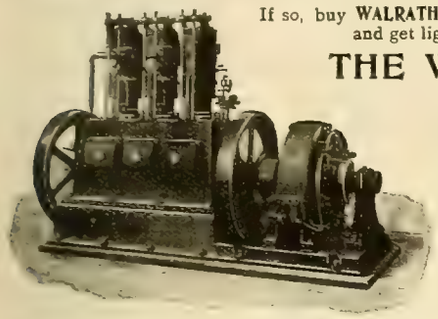
Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

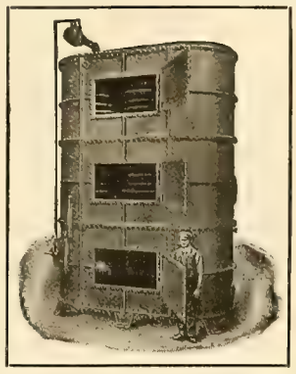
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

When You Save Steam,



You Economize in Fuel, and

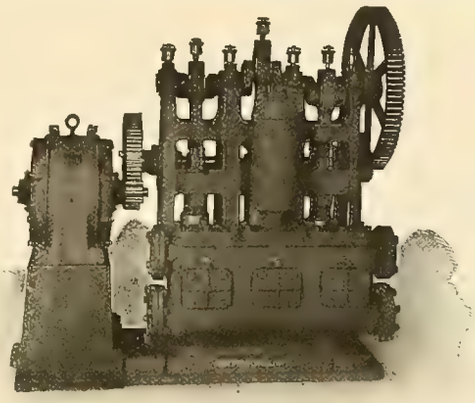
ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,



Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS

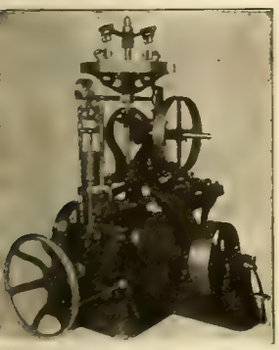
The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

FIBRE-GRAPHITE COMMUTATOR BRUSH — NOISELESS — SELF-LUBRICATING

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.



Water Wheel **Governors**

For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.

We are now prepared to

GUARANTEE ABSOLUTE SATISFACTION

Write for References in your Locality.

The Replogle Governor Works,

HIGH & CHESTNUT STS., AKRON, OHIO.

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - - WIS.
AGENTS WANTED EVERYWHERE.

G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I.

TRADE **G. I.** MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

WHY SAVE A DOLLAR?

You may save a dollar by buying other meters than the Gutmann. In the end you will save many times that by installing Gutmann Alternating Current Wattmeters.

Our new Wattmeter Catalog shows the new type. Send for one; or better still, for both.

ELECTRIC APPLIANCE COMPANY, ELECTRICAL SUPPLIES,
92 AND 94 W. VAN BUREN STREET, CHICAGO.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles, Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
Genera Electric Company, Harrison, N. J.

MICANITE CLOTH

HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.

MICA INSULATOR CO.
"ORIGINATORS."
CHICAGO. NEW YORK.

ARC LAMPS

ARC LAMPS

39 Cortlandt St.

19th & Allegheny Ave.

The Reputation

of making the best, the most economical, the least troublesome and the most efficient Arc Lamp is our constant effort.

That we are succeeding is proven by the fact that we more than doubled our business during the past year. We invite correspondence.

NEW YORK CITY **C. J. TOERRING CO.** PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

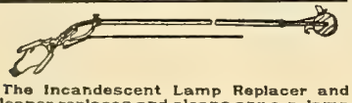
VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.

1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building,

CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

Gale's Commutator Compound.

The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

50c. per stick. $5.00 per dozen Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street. - CHICAGO.

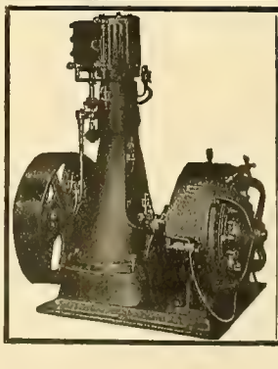
BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 S. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. CHICAGO

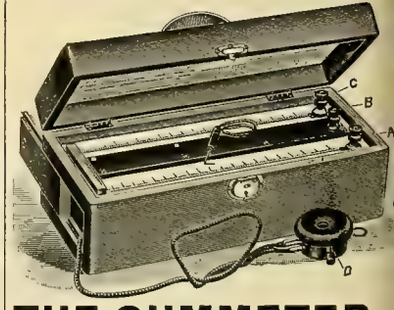
Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

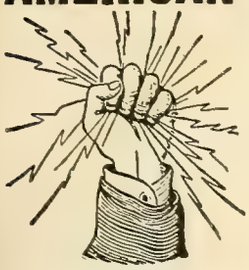
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

57k Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

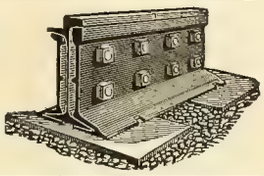
THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

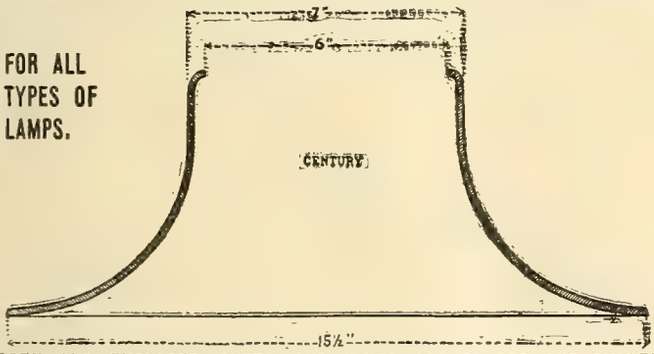
Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

CONTINUOUS RAIL JOINT CO. OF AM.
General Offices: Century Building,
NEWARK, N. J.
Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



COMPLETE STOCK ALWAYS ON HAND.

FOR ALL TYPES OF LAMPS.



OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES AND SHADES.
WRITE US.
THE CENTURY GLASS CO., BELLAIRE, OHIO.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
Easy to install.
Cheaper than other guys.
One piece. No moving parts.
Necessary for well guyed poles.
Operated like a corkscrew.
Mechanically correct.
Indestructible by fire or frost.
Carefully made.
Anchors that pay dividends.
Labor savers.

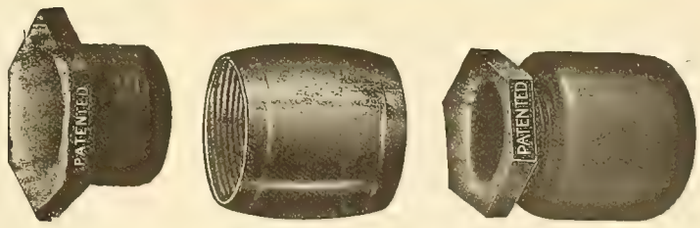
STOMBAUCH GUY ANCHOR

STOMBAUCH GUY ANCHORS

Write for prices, to
W. N. MATTHEWS & BRO.
603 Carleton Building,
ST. LOUIS.

Worm's-Eye View.

TO CONTRACTORS
USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1 00 an insertion; additional words 2c each.*

POSITION WANTED.

As engineer. Nine years' experience on all classes of engines, and 12 years on dynamos, motors, boosters, rotaries and storage batteries. Can take position first week of October. Reference given. Address HOWARD NEFF., care State Bank, Dillon, Mont.

WANTED.

Experienced telephone traveling salesmen; acquainted with Northwest trade preferred, but not essential.
THE VOUGHT-BERGER COMPANY,
Makers of Telephones and Switchboards,
La Crosse, Wis.

WANTED.

A thoroughly competent man to superintend an electric light and power plant in a city of 10,000 inhabitants; must be a business getter and thoroughly up-to-date on power and lighting contracts. Excellent opportunity for a hustler. Applications must be accompanied by a photograph of the applicant and testimonials from previous employers. These will be returned in any event; also state salary expected. Address BOX 115, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A partner to take half interest in electric light plant here. Plant run night and day. Prefer practical man with $3,000 to $6 000 Write me if you want a good business and have the money. R. B. F., BOX 90, Burlington, Kansas.

WANTED.

Salesman to travel Michigan selling general electrical supplies. State age, experience and salary expected. Address BOX 117, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Solicitor, familiar with motor, sign work and electric heating business. Apply BOX 116, care Western Electrician, 510 Marquette Building, Chicago.

POSITIONS OPEN.

	PER MONTH.
5 Draftsmen, Electrical	$ 00
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
1 Electrical Superintendent	$85
1 Electrical Superintendent	$50
2 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.
SEE NEXT ISSUE.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450
ROSE ELECTRIC CO., ST. LOUIS.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.
Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Telephone exchange in one of the best towns in Northern Indiana. Address BOX 114, care Western Electrician, 510 Marquette, Bldg., Chicago.

FOR SALE.

57 shares of Diamond Meter Co. stock; par value $100 per share. Paid 10 per cent on last dividend. Company in good shape. Plenty of business. Please make an offer. Address BOX 113 care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

Good second hand transformers, General Electric Type F, 125 cycle, primary 1,040V, secondary 52V and 104V. All sizes from 300 to 3,500 Watts. PEOPLE'S LIGHT COMPANY, Davenport, Iowa.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano. Ill.

U. S. ENGINEER OFFICE, 735 N. Capitol St., Washington, D. C., August 27, 1902. Sealed proposals will be received here until noon, September 26, 1902, and then publicly opened, for furnishing Electrical Fixtures and Supplies for New Building for Government Printing Office. Information furnished on application. JOHN STEPHEN SEWELL Capt. Engrs.

DEPARTMENT OF INTERIOR, Washington, D. C., August 30, 1902.—Sealed proposals, in duplicate, will be received at the Department until 2 o'clock P. M., on Wednesday, the first day of October, 1902, and then opened in the presence of such persons as may attend, for the construction of an Administration Building called Building "A;" for an addition to the Toner Building Kitchen; for the erection and completion of a Central Power and Heating Plant; Electric Power Plant; Power House, Chimney and Tunnels for the Government Hospital for the Insane at Washington, D. C., in accordance with the drawings and specifications, copies of which specifications and form of proposal may be had, and the drawings seen, on application at this Department. The right is reserved to reject any and all bids. THOS. RYAN, Acting Secretary.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., September 9, 1902.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 10th day of October, 1902, and then opened, for the installation of a conduit and electric wiring system for the United States postoffice and courthouse at Elmira, N. Y., in accordance with the drawings and specification, copies of which may be obtained at this office, or at the office of the superintendent of construction at Elmira, N. Y., at the discretion of the supervising architect. JAMES KNOX TAYLOR, Supervising Architect.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw,
95-97 Liberty St., New York City. Mich.
1214 Marquette Bldg., Chicago, Ill.

BOOK ORDERS

GIVEN PROMPT ATTENTION.
Electrician Publishing Co.,
Suite 510 Marquette Bldg., CHICAGO.

2—150 K. W. Stanley, 3-phase, 60 cycle alternators.
2—150 K. W. Stanley, 2-phase, 2200 volts, 60 cycle alternators.
2—G. E. A. 120 K. W., 125 cycles, 1040 volts.
1—150 K. W. Ft. Wayne Rotary, 250 volts, D. C. 2200 volts, 60 cycle, 2-phase or 5500 volts, 3-phase.
2—125 K. W. Westinghouse, 133 cycles, 1100 volts.
3—37½ K. W. Westinghouse alternators, 133 cycles.
1—50 K. W. Westinghouse, 133 cycles.
2—250 K. W. 3-phase, G. E. 60 cycle generators.
1—18x48 Brown Corliss Engine.
1—14x36 Corliss.
1—125-hp. Frick Corliss.
1—18x24 Automatic, Noye Mfg. Co.
1—G. E. 220-volt, 100 K. W. Generator direct to engine.

We have everything necessary for fitting up a station.

THE STEAM & ELECTRICAL EQUIPMENT CO.,
Wood and Water Sts., Pittsburg, Pa.

SECOND-HAND STEAM ENGINES.

1—70-hp. Westinghouse	$250
2—60-hp. Westinghouse	200
1—65-hp. Sioux City Corliss, 12x24	700
1—12x16 self-contained Chandler & Taylor	200
25—Engines of standard makes with slide valves, of from 8 to 20 hp., each. Write for description.	100
1—Smith-Valle Duplex Steam Pump, 2x8-x12	200
1—Fairbanks Duplex Steam Pump, 12x7-x12	150

DYNAMOS.

1—40 Arc Light Standard	$200
1—26 Arc Light T. H.	125
1—600 Light T. H. Generator and Exciter	300
20—Arc Lights, each	1
20—Street Shades, each	1

For sale by
ALLEN P. ELY & CO.
1110 Douglas St. OMAHA, NEB.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

IT'S UP TO YOU.

We pay highest market prices for
SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.
WRITE US.
We Manufacture Copper Hard Babbitt
the best on earth for electrical work. Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.
GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

A. C. SCHOONMAKER CO.

126A Liberty Street, New York City,
DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1 20x18½ Harrisburg Ideal Engine.
1 14x13 Armington & Sims Engine.
1 16x16 Erie Ball Engine.
1 15x15 Erie Ball Engine.
1 12x12 Erie Ball Engine.
2 120-kw G. E. single phase Alternators.
1 100-kw Card M. P. 500-volt Generator.
1 200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.
2 60-kw G. E Transformers.
497 Improved M. G. E. Arc Lamps.
2 15 hp M. P. 500-volt Motors.
2 10-hp M. P. 500-volt Motors.
2 8 hp M. P. 5 0-volt Motors.
2 5-hp M. P. 500-volt Motors.
3 3-hp M. P. 500 volt Motors.

When in search of a position advertise in the WESTERN ELECTRICIAN.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

5 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

ENGINES REBUILT AND READY.

34x60	Geo. H. Corliss.	16x32	Buckeye Automatic.
20x48	Harris Corliss.	13x21	Buckeye Automatic.
20x48	Wheelock Corliss.	13x20	Russell Automatic.
12x36	Harris Corliss.	8½x9	Armington & Sims Automatic.
18x24	Atlas Automatic.	9x12	Atlas Automatic.

BOILERS.

1	250 H. P. Babcock & Wilcox Water Tube.	1	56x16 Horizontal Tubular.
1	66x16 Horizontal Tubular.	1	48x16 Horizontal Tubular.
2	60x18 Horizontal Tubular.	1	36x8 Horizontal Tubular.
5	60x16 Horizontal Tubular.	1	54x8 Vertical Tubular.
			Heaters and Pumps of all sizes.

W. W. WHITEHEAD COMPANY,

DAVENPORT, IOWA.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety. 1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110 VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.
2 500 light, 25 K. W. Jenny.
1 350 light, 20 K. W. Mather.
1 250 light, Sperry.
1 200 light, Western Electric.
1 175 light, 15 K. W. Brush.
1 120 light, Mayo.
1 90 light, Westinghouse multi-polar.

133 CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H. 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.
ILLINOIS MAINTENANCE COMPANY, E. H CHENEY, Manager. 204 Dearborn St., CHICAGO

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

Sales Representatives Wanted.

A large, successfull and well established machinery manufacturing company, West of Ohio, doing a constantly increasing business and having an enviable reputation with its present product is prepared to place upon the market a line of

ELECTRICAL MACHINERY

including alternating-current generators up to 1,000 K. W. and direct-current generators and motors of corresponding size.

Only high-grade sales representatives are wanted to sell on commission or otherwise.

Correspondence is desired with established firms or others who are properly equipped and are experienced in the sale of electrical machinery.

All communications will be considered confidential.

Address BOX 109, care Western Electrician, 510 Marquette Building, Chicago.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

JUST OUT

NEW CATALOGUE OF

ELECTRICAL BOOKS.

You Ought to Have One. Sent Free on Request.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.

This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00

This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E Dobbs. 106 pp. Price $1.00.

A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 265 illustrations. Price $1.00.

Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp 288 illustrations. Price $1.50.

In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs 134 pp. Price 75 cents.

A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.

This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

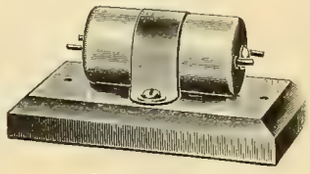
STERLING

CONDENSERS AND REPEATING COILS

Like all STERLING apparatus, are BEST and CHEAPEST.

TRY THEM!

1 Microfarad, 70c.
2 Microfarads, 80c.



Highest Efficiency for All Classes of Service.

$2.00

STERLING ELECTRIC COMPANY,

LAFAYETTE, - - - - INDIANA.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

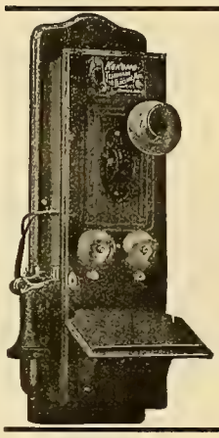
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

THE TELEPHONE HAND-BOOK

BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.
Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

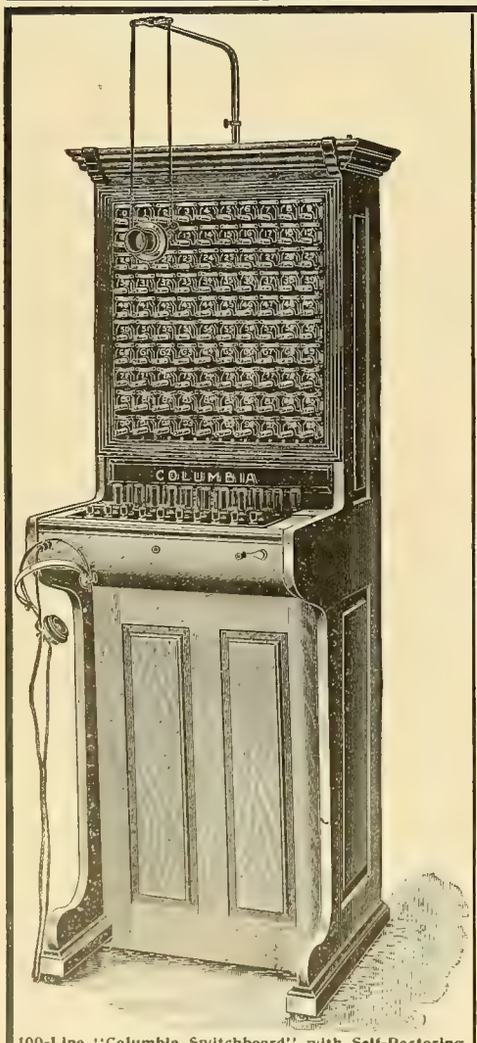
SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.
Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

BUY

Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1 200	lines and telephones
Ennis, Tex, . .	"	1,200	" "
Norwalk, Ohio, .	"	2,400	" "
Frankfort, Mich.,	"	250	" "
Dundee, Mich., .	"	200	" "

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

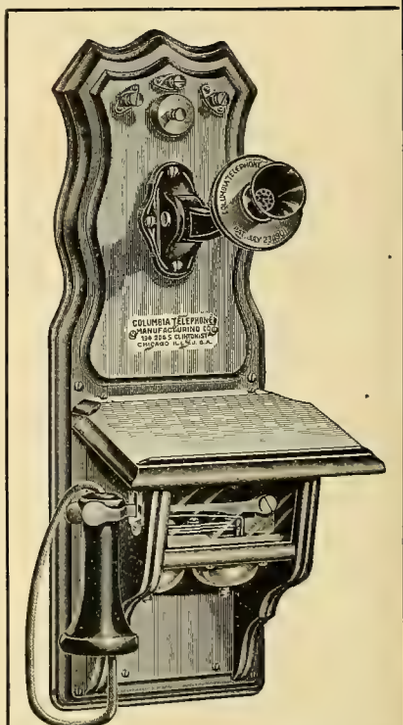
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

APPRECIATION

"ONE THING IN PARTICULAR ABOUT

KELLOGG APPARATUS

THAT HAS ALWAYS PLEASED ME IS THIS,—YOUR APPARATUS AND ITS PARTS ARE ALWAYS UNIFORM AND ALIKE."

KELLOGG METHODS OF MANUFACTURE

PRODUCE FINISHED PRODUCTS WHOSE QUALITY COUNTS.

WRITE FOR CATALOG.

KELLOGG SWITCHBOARD & SUPPLY CO., 229 So. Green St., CHICAGO, ILL.

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

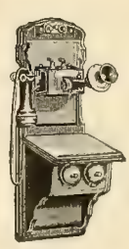
The U. S. Electric Mfg. Co.,
BUTLER, PA.

IMPROVED TELEPHONE APPARATUS.

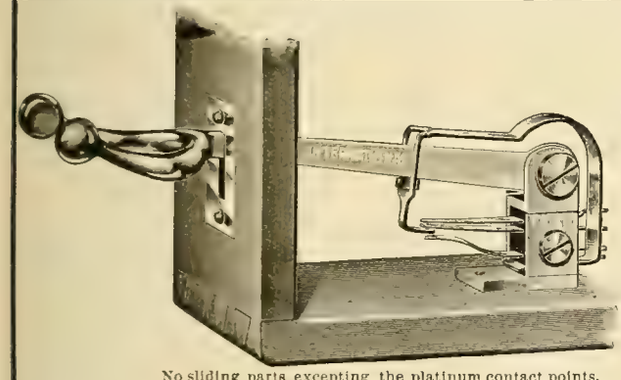
EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

OUR SUCCESS

WE HAVE BEEN IN BUSINESS less than ten years, time after time we have increased our facilities, only to find that other additions were necessary. When we moved into our present quarters 36-58 Jackson Blvd. three years ago we thought we had sufficient space for ten years growth but although every foot of space has been utilized, our building has become so crowded that we have found it necessary to rent lofts on both Jackson Blvd. and Van Buren St. This gives us a large amount of additional space for the manufacture of the only RIGHT KIND OF TELEPHONES AND SWITCHBOARDS and will enable us not only to fill our orders with promptness but to maintain our reputation of producing better telephones and switchboard apparatus than our competitors. If you want to keep at the head of the procession use AMERICAN TELEPHONES AND SWITCHBOARDS.

AMERICAN ELECTRIC TELEPHONE CO.
39 W. JACKSON BLVD., CHICAGO, ILL.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger
for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.

No. 1. Light, 1¾x⅜ in.
No. 2. Medium, 1¾x¼ in.
No. 3. Heavy, 2x⅛ in.

Nos. 2 and 3 always in stock.

DEAD END HANGER. Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.

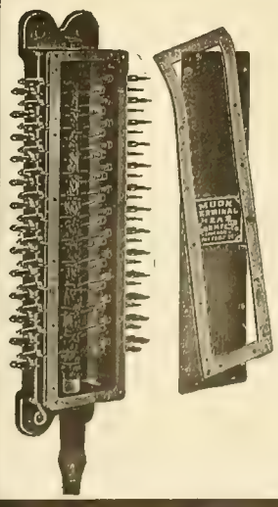
Note beautiful mechanical simplicity. Send for sample. Correspond with us, we have good specialties, and up-to-date. Tell us what you want.

Corner Brackets, Guy Shims, and Special Forgings made to order.

3-Bolt Guy Clamp.

Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

CEDAR POLES AT OUR LAONA YARD.

APPROXIMATE LIST.

325	4 inch x 20 feet	360	4 inch x 25 feet	614	6 inch x 30 feet	9	6 inch x 45 feet
82	5 " x 20 "	885	5 " x 25 "	43	6 " x 40 "	30	7 " x 45 "
138	6 " x 20 "	795	6 " x 25 "	96	7 " x 40 "	9	7 " x 50 "
24	7 " x 20 "	132	7 " x 25 "	6	8 " x 40 "	1	7 " x 55 "
						1	8 " x 55 "

POSTS.

800.....4 inch x 10 feet 900.....5 inch x 10 feet 750.....6 inch x 10 feet 125.....7 inch x 10 feet

WE WILL MAKE CLOSE PRICE ON THE ABOVE, AS WE WISH TO MOVE THEM ON ACCOUNT OF CHANGING THE LOCATION OF OUR CEDAR YARD AT LAONA.

R. CONNOR COMPANY,

Wholesale Manufacturers HARDWOOD, PINE AND HEMLOCK LUMBER AND CEDAR PRODUCTS.

General Office: MARSHFIELD, WIS.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

AWARDED HIGHEST MEDAL ON TOOLS AT PARIS EXPOSITION OF 1900.

ASK FOR THIS

AWARDED HIGHEST MEDAL ON TOOLS AT PAN-AMERICAN EXPOSITION

THE DICKE TOOL COMPANY,

FACTORY: DOWNER'S GROVE, ILL.
Eastern Office: J. E. Way, Manager, 39 Cortlandt Street, New York.
Thos. G. Grier, Electrical Building, Chicago.
St. Louis Office: W. N. Matthews & Bros., 320 N. 6th Street.

A GLIMPSE AT OUR WESTERN STOCK.

1,700	pieces	40 feet,	7-inch tops	
1,700	"	40 "	8	"
1,750	"	45 "	7	"
1,250	"	45 "	8	"
1,750	"	50 "	7	"
750	"	50 "	8	"
3,000	"	55 "	7	"
750	"	55 "	8	"
750	"	60 "	7	"
300	"	60 "	8	"
250	"	65 "	8	"
200	"	70 "	8	"

Our Prices Will Interest You.

POLES

30 ft., 35 ft. and 40 ft., 6 in. and 7 in. Tops, FOR TROLLEY LINE CONSTRUCTION ALWAYS IN STOCK.

YARDS:

MENOMINEE,	MICH.
ESCANABA,	MICH.
NADEAU,	MICH.
CLOQUET,	MINN.
HERON,	MONT.
CABINET,	IDAHO.

OUR ADDRESS:

FRANCIS BEIDLER & CO.

W. 22d and Loomis Sts, CHICAGO, ILL.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

AS SIMPLE AS ITS NAME.

A B C —OF— THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,

510 Marquette Building, Chicago, Ill.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

WESTERN CEDAR POLES—Low Prices.

Yards: Idaho. Office: Denver, Colo. B. F. VREELAND.

C. J. HUEBEL CO.

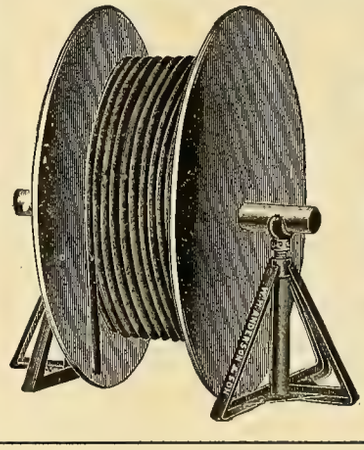
Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CABLE REEL JACK.



Made in Two Styles.

No. 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No. 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,

Tool Manufacturers.
Established 1871.

St. Aubin Ave., DETROIT, MICH.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

OUR STOCK OF **TROLLEY POLES AND TROLLEY TIES**

is the biggest ever. Our shipping facilities among the best and prices—but wait till you write us.

"When we haven't the stock we don't quote," but when we do quote we get the order if it is get-able.

MALTBY LUMBER CO. :: :: Bay City, Mich.

Write Us

If you want **CEDAR POLES** POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand.

POLES.

WHITE CEDAR.

IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS.

LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

THE HOLCOMB-LOBB COMPANY

CEDAR POLES & POSTS

745 MARQUETTE BLDG. CHICAGO ILL.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., CHICAGO.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

MEDORA MILLING COMPANY

CHESTNUT POLES

20 ft. to 75 ft. LENGTHS.

LARGE STOCK CARRIED

MEDORA, IND.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

CEDAR POLES

LONG DISTANCE 'PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO STAKES DAGGETT MICH.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years. **TIES.**

YELLOW PINE CROSSARMS!

THE VERY BEST ARMS THAT MONEY AND CAREFUL AND SKILLED WORKMANSHIP CAN PRODUCE. WE WANT YOUR ORDERS.

THE STANDARD POLE & TIE COMPANY, 44 BROAD ST., N. Y.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

CEDAR POLES

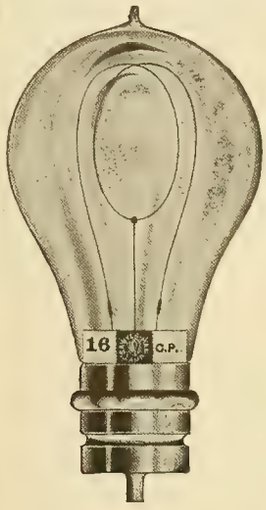
THE VALENTINE-CLARK CO.,

234 LA SALLE ST., CHICAGO

YARDS: PINCONNING, Mich. — GREEN BAY, WIS. — NEW LONDON, WIS.

The

Sawyer=Man LAMP



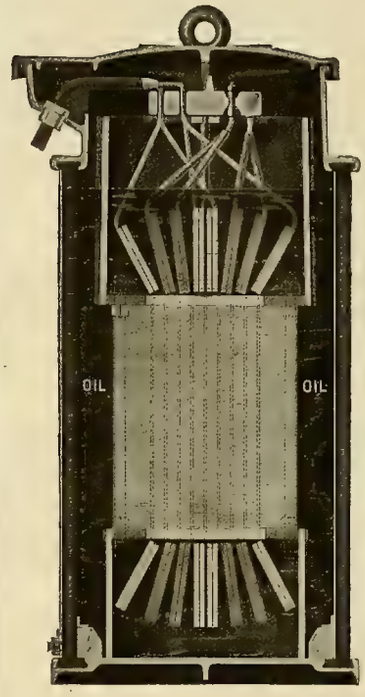
Maintains rated candle-power longer than any other make.

Sawyer=Man Electric Co.

New York

Chicago, Boston, San Francisco, Philadelphia, Pittsburg, Buffalo, St. Louis, Syracuse, Cincinnati, Detroit, Washington, Seattle, Atlanta, Dallas.

Westinghouse Transformers



O D Transformer

¼ to 50 K. W.; 4,800-16,000 and 3,000-3,600.

Type N Transformer

½ to 50 K. W.; 6,000 16,000 Alternations.

In the Westinghouse Transformer each coil passes off its heat with equal facility and no unequal expansions occur to injure the insulation. : :

For Transformer Booklets, Address Nearest Sales Office of the

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

85G2

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"Wood" Type A Transformers have

Lower core loss—higher efficiency.
Lower temperature rise—longer life.
Better insulation—greater durability.

And give more satisfactory service
than any other transformer made.
Sizes—0.6 to 50 kw.—Standard voltages.

Fort Wayne Electric Works, Fort Wayne, Ind.

BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
New York, N. Y., 40 New St.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
Yokohama, Japan, Bagnall & Hilles.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book

Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,

$1 A VOLUME.

Electrician Publishing Co.,

510 Marquette Building, Chicago.

A New Paper-Weight.

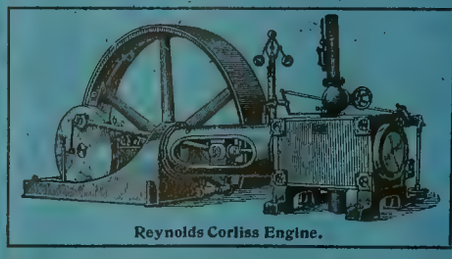
Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

863 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of

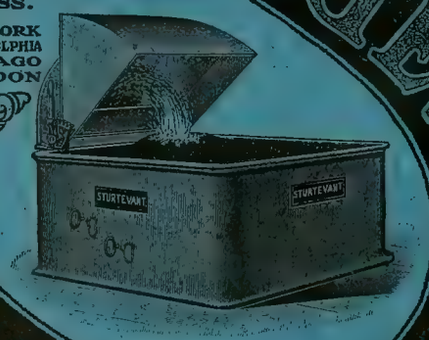
REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

THE STURTEVANT FORGES

B. F. STURTEVANT COMPANY
BOSTON, MASS.
NEW YORK
PHILADELPHIA
CHICAGO
LONDON



253

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF **WIRES AND CABLES.**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. | NEW YORK OFFICE, 50 Dey St. | CHICAGO OFFICE, 1201-2 Marquette Bldg

LARGE STOCK
NO DELAYS IN SHIPPING.

I. X. L. Weatherproof, or Grimshaw Rubber Covered Wire. Any size or quantity.

Electro Galvanized Conduit—American Circular Loom. Peerless Transformers. Columbia Carbons. Edison Leland Battery.

The best direct current Arc Lamp on the market, the "ANDERSON."

TRY US ON AN ORDER.

ST. LOUIS ELECTRICAL SUPPLY CO.,
NO. 1118 PINE ST., ST. LOUIS, MO.

Black Diamond File Works

Est. 1863. Inc. 1895.

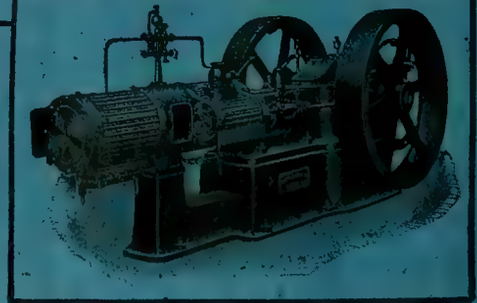
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO
HIGH SPEED **ENGINES**
FOR **ELECTRIC LIGHT** AND **POWER SERVICE.**



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

Western Electrician

Vol. XXXI $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 27, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 13.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT. H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

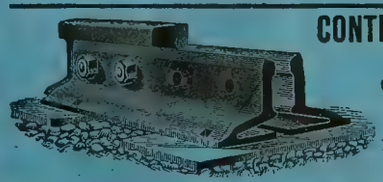
TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

The Franklin Gas Engine
One-Half Horsepower.
Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 15.
The FRANKLIN Model Shop
PARSELL & WEED, 129-131 W. 31st Street, New York.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.

The Ericsson phone will not buzz, and wheeze, and click, and rattle, and bang, and grunt, and roar, and groan, and whisper, and growl, and screech, and whistle, and yawp, and bellow, and crow, and creak, and snarl, and croak, and yawn, and whine, and then say: "What's the matter with you? Are you deaf?"
FULL PARTICULARS FROM
ERICSSON TELEPHONE CO. 296 Broadway, NEW YORK CITY.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading Wattmeter.

BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., No. 101 St. Martins Lane.

The Weston Standard Portable Direct Reading
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name. Write for circular and price lists 8 and 9.

Mention the WESTERN ELECTRICIAN when writing for catalogues.

ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selly, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

DO YOU WANT STREET-RAILWAY BUSINESS?

IF you wish to increase your business with the street-railway interests of the world, you should be represented in the WESTERN ELECTRICIAN of October 4th and 11th. These two issues will cover the annual meeting of the American Street-Railway Association to be held in Detroit, October 8th, 9th and 10th. The attendance promises to be unusually large. Many concerns wishing to exhibit at this convention were unable to obtain space.

The WESTERN ELECTRICIAN of October 4th will be distributed at the convention, and the issue of October 11th will contain the report of the meeting.

A large attractive announcement would enable you to place the merits of your products before almost every possible buyer.

Give us an idea of what you wish to advertise, and we will be pleased to get up an attractive announcement for your approval.

RESERVE YOUR SPACE NOW, AND
OBTAIN A CHOICE LOCATION : :

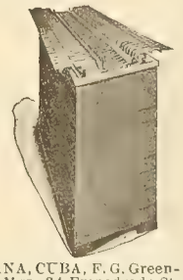
WESTERN ELECTRICIAN,

510 Marquette Building,
CHICAGO.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"



For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

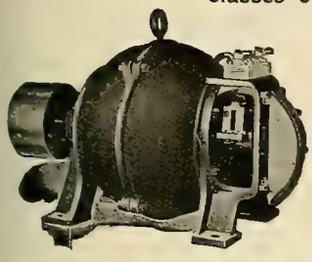
PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

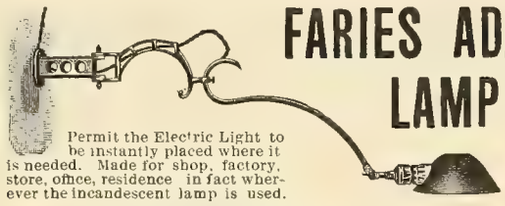
Write for Descriptive Bulletin No. 206.



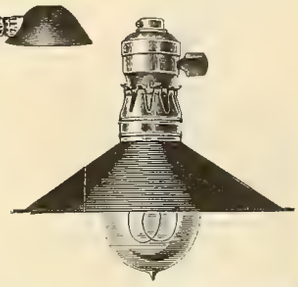
GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

FARIES ADJUSTABLE LAMP HOLDERS



Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence in fact wherever the incandescent lamp is used.



WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers.

Send for Catalogue No. 10, just issued.

FARIES MFG. CO., DECATUR, ILL.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co..... 1
Allis-Chalmers Company....20
American Battery Co..... 4
Amer. Electrical Heater Co..20
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refl. & Lighting Co. 7
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....16

Baker & Company..... 3
Bario Vacuum Co..... 10
Barnett Company, G. & H....20
Barron & Co., J. S.....11
Bayley & Sons Co., W..... 8
Beardslee Chandelier Mfg. Co.—
Beardsley Gravity Dam & Construction Co..... 7
Beidler & Co, Francis .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 7
Bossert El. Construction Co..20
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co .17
Central Telephone & El. Co..14
Century Glass Co.....10
Chase-Shawmut Company...11
Chicago & Alton Railroad.... 8
C. & N. W. R. R.....16
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....16
Chicago Pay Station Co.....14
Columbia Telephone Mfg. Co.—
Consumers Carbon Co..... 1
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 7
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ... 4
Dicke Tool Company.....—
Dixon Crucible Co., Joseph.. 8

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 7
Edwards & Company..... 8
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...19
Ely & Co., Allen P.....12
Ericsson Telephone Company 1

Faries Manufacturing Co.... 3
Federal Electric Company...—
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...16

General Electric Company... 5
General Incandescent Arc Light Company..... 4
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... ....—
Gregory Electric Company ..12

Hamblin & Russell Mfg. Co.. 7
Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....14
Holcomb-Lobb Co.....—
Holmes Fibre-Graph. Co.....—
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electric Specialty Co.10
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co.... 8
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....16
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp.... 4
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller.....—
Maley, Martin.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co. 9
Matthews & Bros., W. N.....11
Mayer, Geo. M.....11
McLennan & Company, K....10
McNamara Brothers 11
Medora Milling Company....16
Metropolitan Tel. & El Co...15
Mica Insulator Company.....—
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad.....16
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....20
Munsell & Co., Eugene.....10

National India Rubber Co....—
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 9
Norton Tool Company, The..14

Okonite Company, The 1

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo.....—
Reliance Electric Company..16
Replogle Governor Works....—
Reynolds Electric Company.—
Roebling's Sons Co., J. A.... 4
Rose Electric Company 12

St. Louis Elec. Supply Co... 20
Sargent & Lundy.....10
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan..... 8
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Electric Company..16
Standard Pole & Tie Co..... .17
Standard Underg. Cable Co..—
Standard Varnish Works 11
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 9
Station Equipment Co..... .12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Sterrett Pump Company..... 9
Stilwell-Bierce & Smith-Valle Company..... 9
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co..... 4

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....—
Vindex Electric Company....—
Vought-Berger Company..... 8
Vreeland, B. F. 16
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co..... 5
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co.....13
Westinghouse Electric & Manufacturing Company..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....11
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17
Worcester Polytechnic Inst. 20

For Classified Index of Advertisements See Page 6.

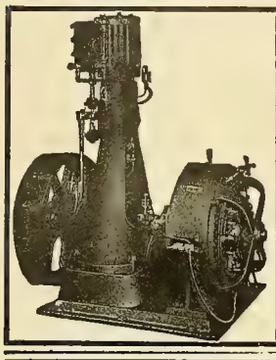
Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E"

CINCINNATI, O.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.

Absolutely Non-Infringing. Protection Guaranteed.

AMERICAN BATTERY CO.,

EST'D 1889. 171 S. Clinton St., Chicago, Ill.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

ROEBLING

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

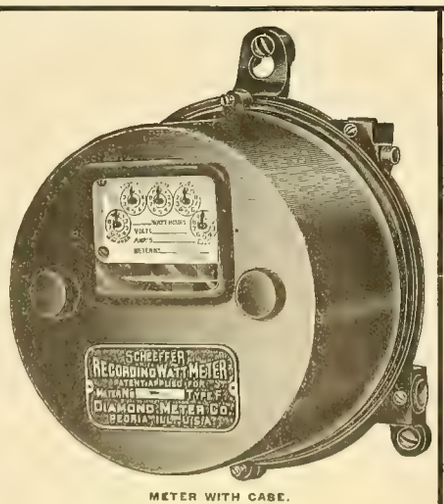
NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

G.I.

TRADE G. I. MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGH O.
NEW YORK, N. Y., AND ALL LARGE CITIES.



METER WITH CASE.

SCHEEFFER
INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

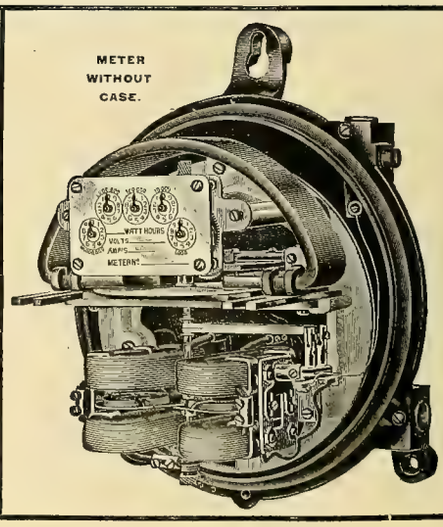
Unaffected by Alternations or Lag in Alternating Currents.

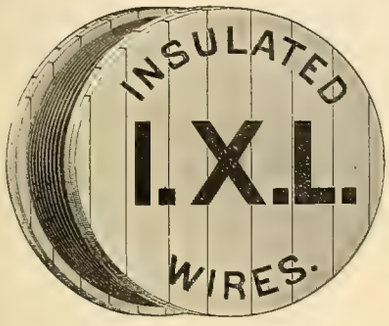
A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.

METER WITHOUT CASE.





YOU WANT THIS WIRE

AND

WE WANT YOUR ORDERS,

THEY WILL BE FILLED FROM CHICAGO STOCK.

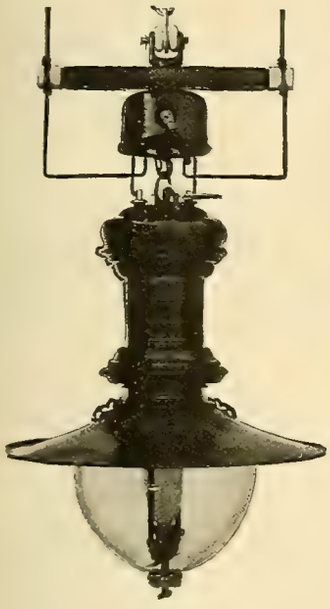
Don't Buy Lamps Before Trying the Columbia.

Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE :: :: CHICAGO.

THE GENERAL ELECTRIC COMPANY'S

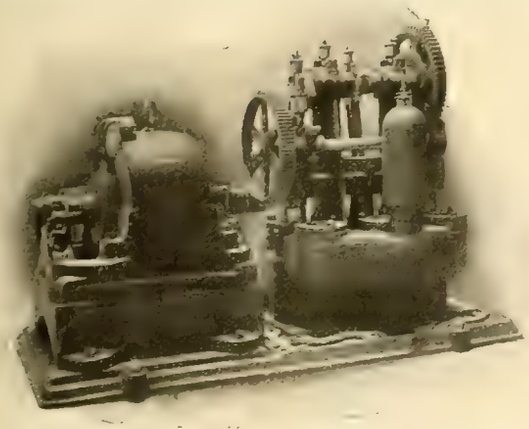


Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.



30 H. P., 60 Cycle, 208 Volt. Single Phase Motor Geared to Triplex Pump.

OUR **SINGLE PHASE MOTORS** ARE

Particularly Suited for Pump Operation.

THEY WILL **START UNDER FULL LOAD** BY

Simply Closing the Primary or Secondary Circuit at any point however distant from the motor.

ONLY ONE TRANSFORMER REQUIRED.

If interested we would be pleased to have you inform us of your requirements.

WAGNER ELECTRIC MFG. CO.

ST. LOUIS, MO., U. S. A.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
St. Louis Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Institutes.
Worcester Polytechnic Inst.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Beidler & Co., Francis.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Ely & Co., Allen P.
Gregory Electric Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
St. Louis Elec. Supply Co.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 8.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

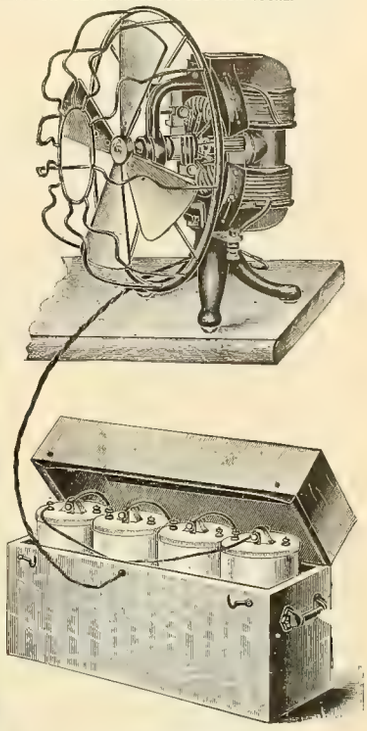
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

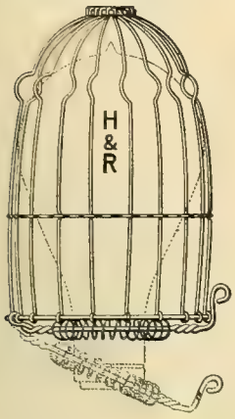
NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

"NEVER BREAK"

ELECTRIC LIGHT GUARD.

SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue

HAMBLIN & RUSSELL MFG. CO.,

WORCESTER, MASS.

THE BEST

VERMONT SLATE

FOR

Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

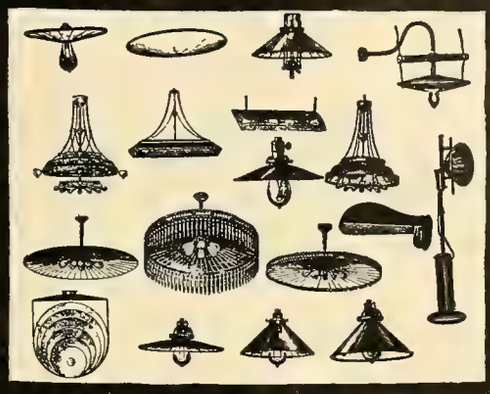
P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of **Slates for Electrical Purposes**

All Sizes of Slate Switchboards.

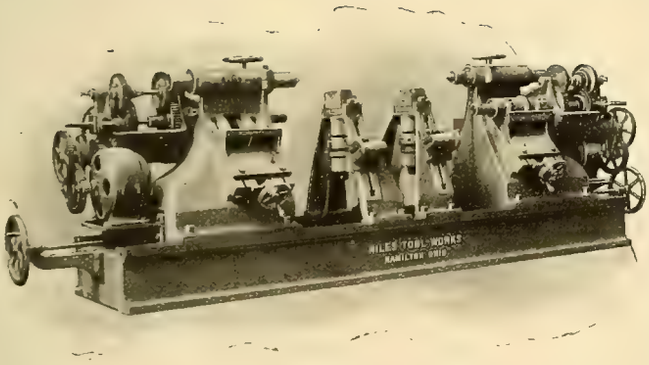
Best Black Enameled and Marbleized Finishes in Vermont.

WRITE FOR ILLUSTRATED CATALOGUE



AMERICAN REFLECTOR & LIGHTING CO.

CHICAGO.



SHOP OUTPUT

Increased and Improved by the use of electric drive.

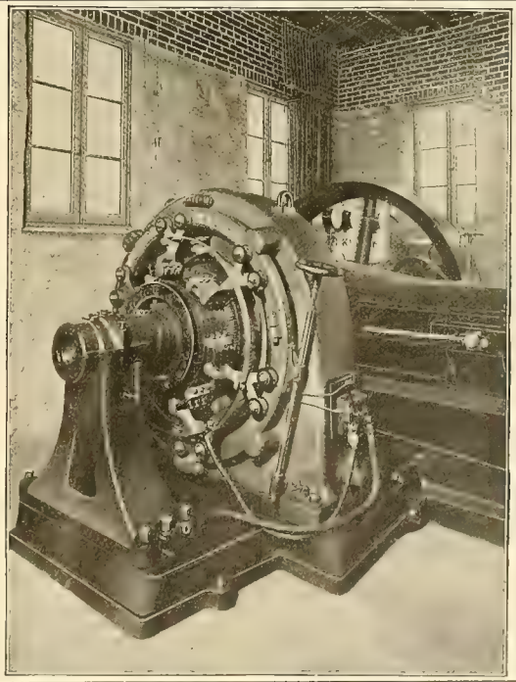
OUR MOTORS ARE ADMIRABLE FOR SUCH ATTACHMENTS.

Crocker-Wheeler Company,

AMPERE, N. J.

POWER AND LIGHTING APPARATUS

GENERATORS AND MOTORS.



ARC LAMPS AND SWITCHBOARDS.

WRITE FOR BULLETINS.

WESTERN ELECTRIC COMPANY.

CHICAGO. SAINT LOUIS.

NEW YORK. PHILADELPHIA.

DEARBORN VEGETABLE BOILER COMPOUNDS

WILL CLEAN ALL PARTS OF YOUR BOILERS AND KEEP THEM CLEAN.

WRITE US REGARDING AN ANALYSIS OF YOUR FEED WATER.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING

ELECTRIC LIGHTING AND POWER PLANTS,

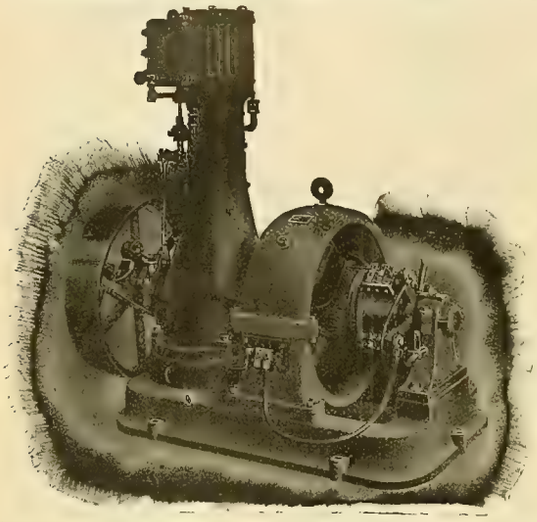
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,

SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,

MILWAUKEE, WIS., U. S. A.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

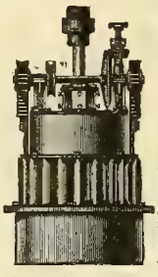
CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS,
CHICAGO AND PEORIA,
ST. LOUIS AND KANSAS CITY

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, DENVER,
TEXAS, FLORIDA, UTAH
CALIFORNIA AND OREGON

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL CHAINS FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS.

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

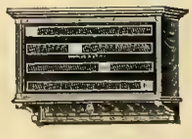
IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

EDWARDS AND CO.

Lock Gravity Drop Annunciator.



Extra heavy, well finished case of ornamental design.

The drops being fastened to the back-board, the case may be removed without disconnecting wires.

NEW YORK N.Y

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

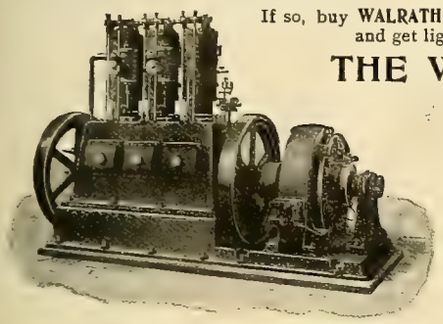
Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

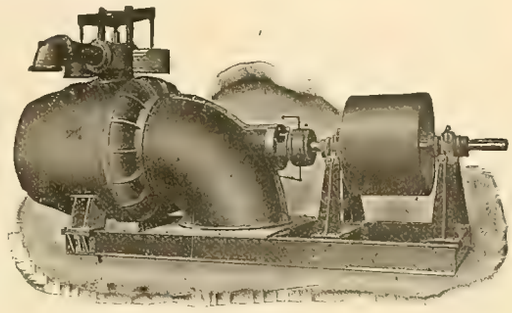
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



We make a specialty also of

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

If interested address

THE STILWELL-BIERCE & SMITH-VAILE CO.,

257 Lehman St., DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch St.
BOSTON, 73 Oliver St. CHICAGO, 311 Dearborn St.
NEW ORLEANS, 304 Hennen Bldg. LONDON, E. C., 97 Queen Victoria St.
BALTIMORE, 315 Equitable Bldg.
LAUFKETTER & BENDIT M. E. CO., Sales Agents, 810 Olive St., ST. LOUIS, MO.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Grimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FLOTATION IN AIR

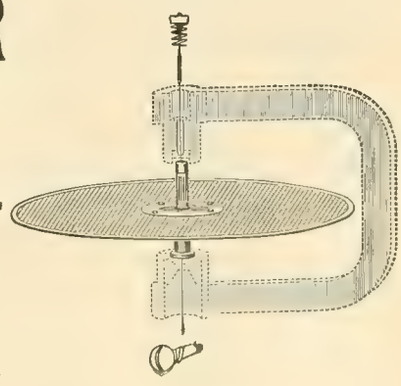
OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.



SALES OFFICE,
158 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., { SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

Say "ZU-ZU" To Your Grocer And "A.B." To Your Supply Man.

IT'S A SNAP.

Those who have used various makes of lamps will tell you to buy Adams-Bagnalls.

It's risky and expensive to experiment with arc lamps.

Install the lamps that are KNOWN to be the best. It's the only way.

ELECTRIC APPLIANCE COMPANY,
ELECTRICAL SUPPLIES.
92-94 WEST VAN BUREN ST., ... CHICAGO.

EDISON MINIATURE LAMPS

Dry Battery Lamps

For use in portable lighting devices--electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

All types supplied—
Accurately rated—
Carefully selected.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
Chicago Office: Monadnock Block. Sales Office all large cities.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS ARC LAMPS

39 Cortlandt St.

MEN GROW RICH

Not by what they make, but BY WHAT THEY SAVE.

We can save you one-half the expense of maintaining your arc lamps. Our Lamps, in connection with other up-to-date machinery, cannot fail to land you a winner.

19th & Allegheny Ave.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

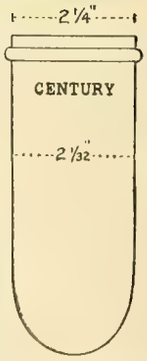
Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

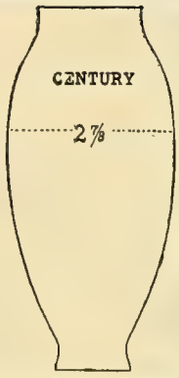
THE ONLY HOUSE
IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.



WE CARRY GLOBES AND SHADES FOR ALL KINDS AND TYPES OF LAMPS.

OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES.

SEND FOR OUR ILLUSTRATED CATALOGUE.



THE CENTURY GLASS COMPANY, : : : BELLAIRE, OHIO.

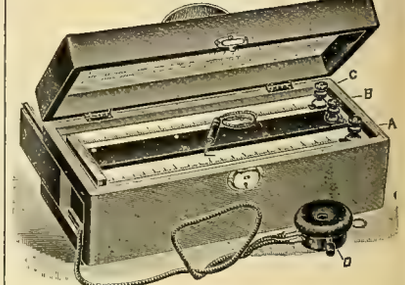
SARGENT & LUNDY,

Engineers,
1000, 46 E. VAN BUREN ST., CHICAGO.
FREDERICK SARGENT. A. D. LUNDY

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"YOU PRESS THE BUTTON,



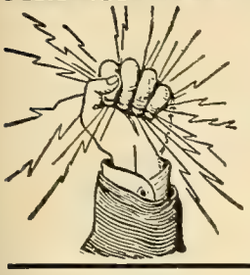
THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to
ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

FRANK N. PHILLIPS, President. C. H. WAGENBEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. O. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

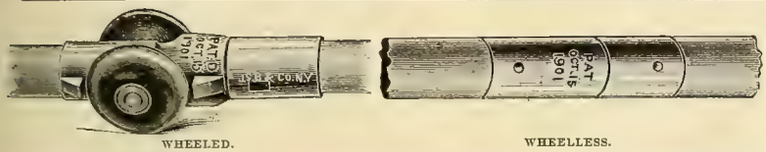
New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - - NEW YORK CITY.
Patent Causes. Patent Soliciting.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

DESIGNS FOR PATENTS. WORKING DRAWINGS FOR SPECIAL AND AUTOMATIC MACHINERY.
DEVELOPING OF ELECTRICAL INVENTIONS A SPECIALTY.
GEO. M. MAYER, Mechanical Engineer, 1561 Monadnock Block, Chicago, Ill.



WHEELED. WHEELLESS.

Villard Automatic Wheeled and Wheelless Conduit Rods
Are Coupled and Uncoupled Instantly and with Ease.

Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed, and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa.
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.

TEST INSTRUMENTS.
Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
Easy to install.
Cheaper than other guys.
One piece. No moving parts.
Necessary for well guyed poles.
Operated like a corkscrew.
Mechanically correct.
Indestructible by fire or frost.
Carefully made.
Anchors that pay dividends.
Labor savers.

STOMBAUCH GUY ANCHOR

STOMBAUCH GUY ANCHORS

Write for prices, to

W. N. MATTHEWS & BRO.
603 Carleton Building,
ST. LOUIS.

Worm's-Eye View.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As manager or electrician of Telephone Exchange. Have experience in both inside and outside work. Also understand both common and local battery. Can furnish best of references as to ability. Address BOX 119, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

Mechanical and electrical engineer, thirty years old, technically educated and familiar with central station operation, desires to correspond with a company who are in need of a reliable superintendent or chief electrician. BOX 118, care of Western Electrician, 518 Marquette Building, Chicago.

WANTED.

Inside wiremen. State experience.
THE SANBORN-MARSH ELECTRIC CO.
8 W. Market Street,
Indianapolis, Ind.

WANTED.

Solicitor, familiar with motor, sign work and electric heating business. Apply BOX 116, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Experienced telephone traveling salesmen; acquainted with Northwest trade preferred, but not essential.
THE VOUGHT-BERGER COMPANY,
Makers of Telephones and Switchboards,
La Crosse, Wis.

WANTED.

A partner to take half interest in electric light plant here. Plant run night and day. Prefer practical man with $3,000 to $6.000. Write me if you want a good business and have the money. R. B. F., BOX 90, Burlington, Kansas.

WANTED.

Salesman to travel Michigan selling general electrical supplies. State age, experience and salary expected. Address BOX 117, care Western Electrician, 510 Marquette Building, Chicago.

WANTED TO BUY.

A good 100 or 120 K. W. 1100-Volt, 1600 alt. Generator, complete with exciter and rheostats. Must be in first-class condition and fully guaranteed. Address LOCK BOX 63, Viroqua, Wis.

POSITIONS OPEN.

	PER MONTH.
5 Draftsmen, Electrical	$100
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
1 Electrical Superintendent	$85
1 Electrical Superintendent	$50
2 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.
SEE NEXT ISSUE.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One 50 K. W. Westinghouse Alternating Dynamo—1040 volts no load to 1140 full load—toothed armature, self-oiler, compound wound, one exciter, two rheostats, one volt meter, one amp. meter. Address HAMPTON ELECTRIC LIGHT & POWER CO., Hampton, Iowa.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

High-grade Machinery Being Replaced.

2-150 k. w. Stanley, 2-phase, 2200 volts, 60 cy.
2-150 k. w. Stanley, 3-phase, 5500 volts, 60 cy.
1-100 k. w. Rotary, 2 or 3 phase.
7-120 k. w. G. E. and Westinghouse, 133 cycles.
6-60 k. w. Westinghouse, 133 cycles.
1-60 k. w. Westinghouse, 60 cycles.
2-75 k. w. Westinghouse, 60 cycles, 2-phase.

DIRECT-CURRENT GENERATORS.

1-100 k. w. G. E, 110 and 220 volts, direct con.
1-120 k. w. Eddy, 120 volts, M. P. 4.
1-240 k. w. Walker, 3-bearing, 220 volts.

AUTOMATIC ENGINES.

1-12x16 Buckeye, 100-h. p.
1-11½x15 Taylor Beck, 100-h.p.
1-12x12 Green. 1-16x16 Erie Ball.
1-14x16 Buckeye, Style C.
1-12 and 23x16 Cross Compound, Erie Ball.

Write for anything needed in equipping the station.
The Steam and Electrical Equipment Co.,
Wood and Water Sts., Pittsburg, Pa.

SECOND-HAND STEAM ENGINES.

1—70-hp. Westinghouse	$250
2—60-hp. Westinghouse	200
1—65-hp. Sioux City Corliss, 12x24	700
1—12x16 self-contained Chandler & Taylor	200
25—Engines of standard makes with slide valves, of from 8 to 20 hp., each. Write for description.	100
1—Smith-Vaile Duplex Steam Pump, 2x8-x12	200
1—Fairbanks Duplex Steam Pump, 12x7-x12	150

DYNAMOS.

1—40 Arc Light Standard	$200
1—26 Arc Light T. H.	125
1—600 Light T. H. Generator and Exciter	300
20—Arc Lights, each	1
20—Street Shades, each	1

For sale by
ALLEN P. ELY & CO.
1110 Douglas St. OMAHA, NEB.

DEPARTMENT OF INTERIOR, Washington, D. C., August 30, 1902.—Sealed proposals, in duplicate, will be received at the Department until 2 o'clock P. M., on Wednesday, the first day of October, 1902, and then opened in the presence of such persons as may attend, for the construction of an Administration Building called Building "A;" for an addition to the Toner Building Kitchen; for the erection and completion of a Central Power and Heating Plant; Electric Power Plant; Power House, Chimney and Tunnels for the Government Hospital for the Insane at Washington, D. C., in accordance with the drawings and specifications, copies of which specifications and form of proposal may be had, and the drawings seen, on application at this Department. The right is reserved to reject any and all bids. THOS. RYAN, Acting Secretary.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw, Mich.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

Sales Representatives Wanted.

A large, successfull and well established machinery manufacturing company, West of Ohio, doing a constantly increasing business and having an enviable reputation with its present product is prepared to place upon the market a line of

ELECTRICAL MACHINERY

including alternating-current generators up to 1,000 K. W. and direct-current generators and motors of corresponding size.

Only high-grade sales representatives are wanted to sell on commission or otherwise.

Correspondence is desired with established firms or others who are properly equipped and are experienced in the sale of electrical machinery.

All communications will be considered confidential.

Address BOX 109, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

A thoroughly competent man to superintend an electric light and power plant in a city of 10,000 inhabitants: must be a business getter and thoroughly up-to-date on power and lighting contracts. Excellent opportunity for a hustler. Applications must be accompanied by a photograph of the applicant and testimonials from previous employers. These will be returned in any event; also state salary expected. Address BOX 115, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

IMMEDIATE SHIPMENT

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-inch, 24-inch, 22-inch Double Leather Belts.

BOILERS

One Geary Water Tube Boiler, 175 horsepower for 150 pounds pressure; almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 h. p. Berryman Heater.
600 h. p. Berryman Heater.
125 h. p. Berryman Heater.
500 h. p. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY CO.,
DAVENPORT, IOWA.

STATION EQUIPMENT COMPANY,

539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
150 K. W. 60-cycle Fort Wayne wood alternator, 1,100 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K. W. Edison bi-polar railway generators.
2—100 K. W. Edison bi-polar railway generators.
4—100 K. W. Edison bi-polar 140 volt generators.
1—45 K. W. Edison bi-polar 140 volt generator.
2—30 K. W. Edison bi-polar 140 volt generators.
1—30 K. W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.

All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank.
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, **E. H. CHENEY, Manager. 204 Dearborn St., CHICAGO.**

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

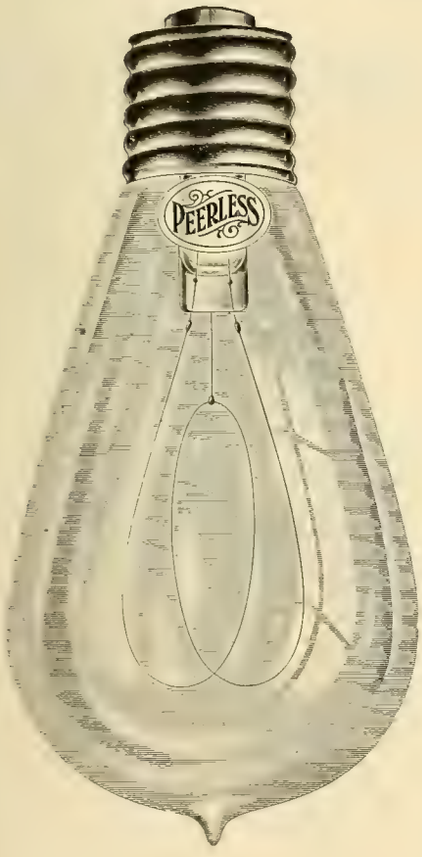
OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

PEERLESS INCANDESCENT LAMPS.



They're not the best on earth, but they are strictly high grade lamps, backed by all sorts of responsible guarantees.

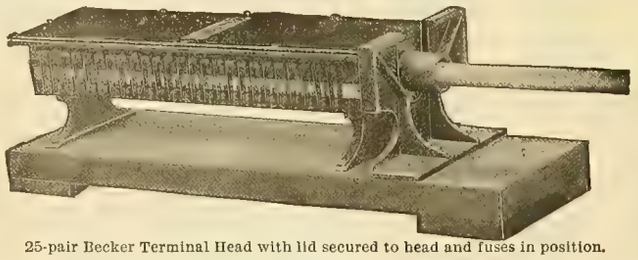
We can make all kinds of claims for them but we won't. What we will do is to guarantee to give you a lamp that will give the very best of service and satisfy you. If we don't, send them back at our expense. Write us to-day.

WESTERN ELECTRICAL SUPPLY CO., St. Louis, U. S. A.

Sample Lamps for Trial on Application.

PROTECTION

THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Illinois Electric Co., Chicago Agents. Post-Glover Electric Co., Cincinnati Agents. W. G. Nagel Electric Co., Toledo (O.) Agents.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

PATENTED GALVANIZED STEEL CABLE HANGER.

Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

Before attachment. In place on cable.

11½-inch "Spread," points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.

20-inch "Spread," points up or down.

Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want. Corner Brackets, Guy Shims and Special forgings Made to order.

THE NORTON TOOL CO., West Park, O.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

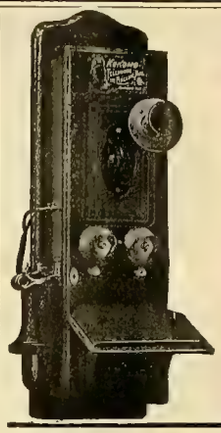
This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

THE TELEPHONE HAND-BOOK

BY HERBERT LAWS WEBB.

Price $1.00.

The only complete and practical work of its kind on the market.

PUBLISHED BY THE ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, Chicago

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co., 130 LA SALLE AVE., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. GEO. W. HOFFMAN 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg,. Chicago.

New and Revised Edition JUST ISSUED.

American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

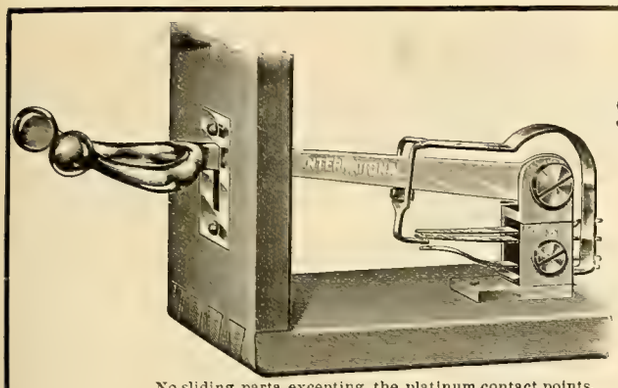
CHAPTER I.—History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V.—Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., *510 Marquette Building, CHICAGO, ILLINOIS.*

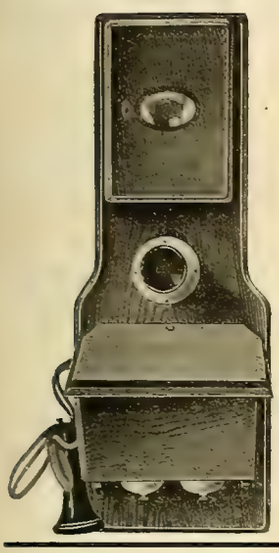


A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**



Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM
CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

APPRECIATION

"ONE THING IN PARTICULAR ABOUT

KELLOGG APPARATUS

THAT HAS ALWAYS PLEASED ME IS THIS.—YOUR APPARATUS AND ITS PARTS ARE ALWAYS UNIFORM AND ALIKE."

KELLOGG METHODS OF MANUFACTURE

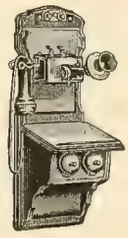
PRODUCE FINISHED PRODUCTS WHOSE QUALITY COUNTS.

WRITE FOR CATALOG. **KELLOGG SWITCHBOARD & SUPPLY CO.,** 229 So. Green St., CHICAGO, ILL.

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"



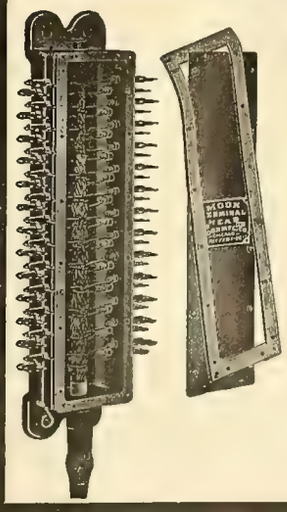
MULTIPLE BOARDS

STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

OUR SUCCESS

WE HAVE BEEN IN BUSINESS less than ten years, time after time we have increased our facilities, only to find that other additions were necessary. When we moved into our present quarters 36-58 Jackson Blvd. three years ago we thought we had sufficient space for ten years growth but although every foot of space has been utilized, our building has become so crowded that we have found it necessary to rent lofts on both Jackson Blvd. and Van Buren St. This gives us a large amount of additional space for the manufacture of the only RIGHT KIND OF TELEPHONES AND SWITCHBOARDS and will enable us not only to fill our orders with promptness but to maintain our reputation of producing better telephones and switchboard apparatus than our competitors. If you want to keep at the head of the procession use AMERICAN TELEPHONES AND SWITCHBOARDS.

AMERICAN ELECTRIC TELEPHONE CO.
39 W. JACKSON BLVD., CHICAGO, ILL.



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

MEDORA MILLING COMPANY

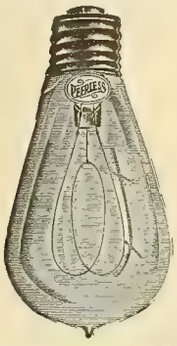
CHESTNUT POLES

20 ft. to 75 ft. LENGTHS.

LARGE STOCK CARRIED

MEDORA, IND.

LONG LIFE LAMPS



FULL CANDLE POWER. EVERY SHAPE, VOLTAGE AND CANDLE POWER IN STOCK. : : : : :

OUR IMPROVED PERFECTION LAMP GUARDS CAN'T BE BEAT. : : : :

Write now for Circular.

THE STANDARD ELECTRIC COMPANY,

113 W. 3RD ST., CINCINNATI, OHIO.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

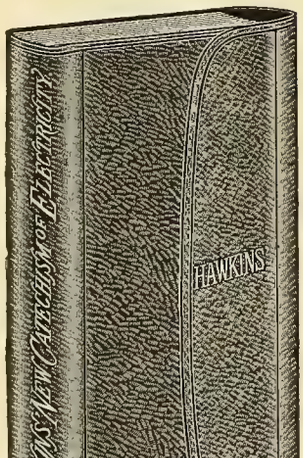
The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

"RELIANCE"

GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - WIS.

AGENTS WANTED EVERYWHERE.

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

146 Pages. 129 Ills. Cloth. PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BLDG., CHICAGO.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

OUR STOCK OF **TROLLEY POLES AND TROLLEY TIES**

is the biggest ever. Our shipping facilities among the best and prices—but wait till you write us.

"When we haven't the stock we don't quote," but when we do quote we get the order if it is get-able.

MALTBY LUMBER CO. :: :: Bay City, Mich.

Write Us

If you want **CEDAR POLES** POSTS, SHINGLES, Tie Plugs, Paving Blocks, Etc. It will pay.

THE MORSE CEDAR CO. Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

CEDAR POLES OF ALL LENGTHS AND SIZES . . . . .

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Building, • CHICAGO

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.

Mfrs. and Dealers in

Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.

LARGE STOCKS ON HAND.

Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

CEDAR POLES STREET RY. TIES PERRIZO SONS DAGGETT MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. **TIES.**

Wholesale Producers for 20 years.

BEATS THEM EVERY TIME!

That is what the engineers say about our JUNIPER POLES as compared with all other Poles.

THE STANDARD POLE & TIE CO., 44 BROAD ST., NEW YORK.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,

229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Preserve Your Copies

OF THE **WESTERN ELECTRICIAN.**

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, • • • • CHICAGO.

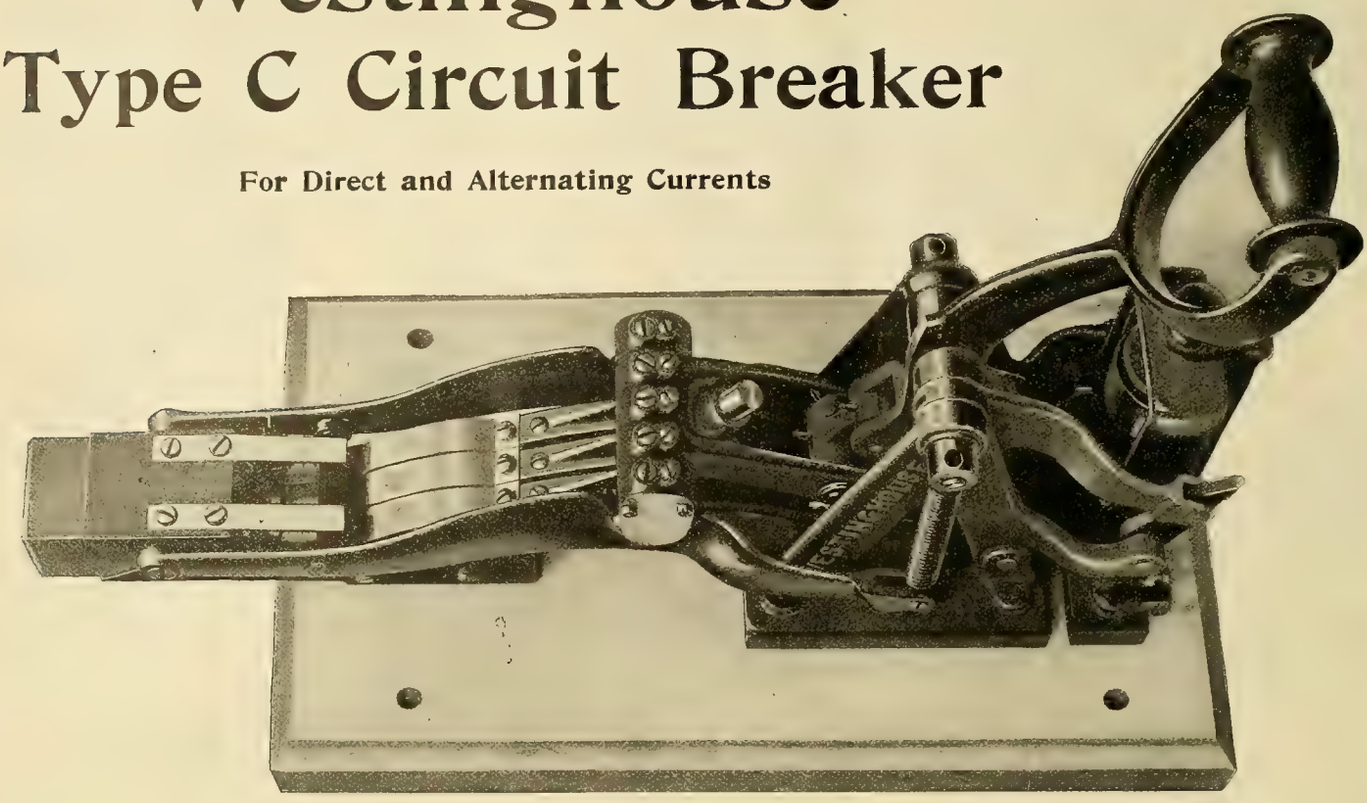
CEDAR POLES

LONG DISTANCE 'PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

Westinghouse
Type C Circuit Breaker

For Direct and Alternating Currents



Built in sizes of 200 to 10,000 amperes, in one, two, three and four pole combinations.

For illustrated booklet on Westinghouse Type C Circuit Breakers address nearest sales office.

85d2

Manufactured by the

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Sales Offices in All Large Cities.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**
The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors.
By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**
The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D.
This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1.25.**
A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.
This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.
The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.
The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.
The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

110-Volt Lamp.

"WOOD" ENCLOSED DIRECT CURRENT ARC LAMPS—FORM C

Embody modern ideas in design, practical skill in construction and the best of materials. The latest product in this line is

MULTIPLE TYPE

which is designed to operate on 110-volt incandescent circuits for interior service. An illustrated description contained in

BULLETIN 1029

gives most of the details of construction and special features of design. It's interesting reading. A postal to the nearest office will bring it to you.

FORT WAYNE ELECTRIC WORKS,

FORT WAYNE, IND.

BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
New York, N. Y., 40 New St.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
Yokohama, Japan, Bagnall & Hilles.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator; Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator.—CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion.—CHAPTER XXIII: Electric Motors; General Principles the same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers, Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

THE WORCESTER POLYTECHNIC INSTITUTE

EDMUND A. ENGLER, Ph.D., LL.D., President.

Courses of study in MECHANICAL, CIVIL, ELECTRICAL ENGINEERING, CHEMISTRY, AND GENERAL SCIENCE. Extensive laboratories in engineering, Electricity, Physics, General and Industrial Chemistry. Special facilities in Steam and Hydraulics. Catalogue showing positions filled by graduates MAILED FREE. Address

J. K. MARSHALL, Registrar, Worcester, Mass.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

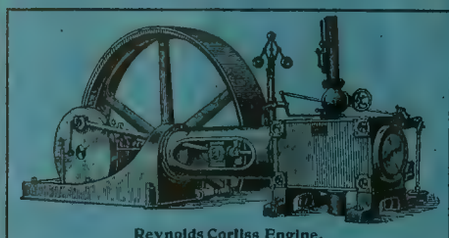
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.

RIEDLER PUMPS AND AIR COMPRESSORS.

STURTEVANT GENERATING SETS

ENGINES · MOTORS
BLOWERS · FORGES
MECHANICAL DRAFT

B. F. STURTEVANT CO.
BOSTON, MASS. NEW YORK · CHICAGO PHILADELPHIA · LONDON

STEAM HEATING
VENTILATING AND
DRYING APPARATUS

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

MODERN HEAT

ELECTRICITY.

AMERICAN ELECTRICAL HEATER CO.

Manufacturers Electric Heating Appliances.

Write for catalogue. 195-197 River St. DETROIT MICH

LARGE STOCK

NO DELAYS IN SHIPPING.

I. X. L. Weatherproof, or Grimshaw Rubber Covered Wire. Any size or quantity.

Electro Galvanized Conduit—American Circular Loom. Peerless Transformers. Columbia Carbons. Edison Leland Battery.

The best direct current Arc Lamp on the market, the "ANDERSON."

TRY US ON AN ORDER.

ST. LOUIS ELECTRICAL SUPPLY CO.,

NO. 1118 PINE ST., ST. LOUIS, MO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

C. & H. BARNETT COMPANY

PHILADELPHIA, PA.

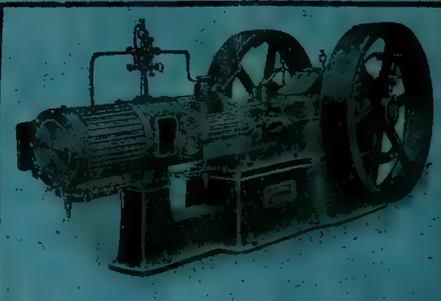
BUFFALO

HIGH SPEED

ENGINES

FOR

ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.

SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.

BUFFALO FORGE COMPANY

BUFFALO, N. Y., U. S. A.

STREET RAILWAY CONVENTION NUMBER.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 4, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 14.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office. 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

Platinum
In Sheet or Wire for all Purposes
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS,
Formerly C. F. Croselmire
CHAS. ENGELHARD, Gen. Mgr.,
25 to 255 New Jersey R. R. Ave., Newark, N. J.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. 101 Milk St., Boston.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.

STANDARD OF THE WORLD.
JUST A FEW LEADERS AND WE HAVE MANY MORE. SOMETHING IN OUR LINE IS SURE TO INTEREST YOU. ASK FOR PARTICULARS.
ERICSSON TELEPHONE CO., 296 Broadway, NEW YORK.

THE BEST VERMONT SLATE FOR Electrical Purposes.
It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

WESTON Electrical Instrument Co.,
Waverly Park, ESSEX CO., N. J.

Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Voltmeter, Style B.

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88. LONDON—Elliott Bros., No. 101 St. Martins Lane.

REFLECTORS!
SILVER-PLATED MIRROR REFLECTORS FOR INCANDESCENT CLUSTERS.
Made in many sizes and styles. Trimmed with prisms if desired.
We also manufacture
Silver and Opal Glass Inverted Double Cone Reflectors, Chandeliers and Sun Burners
For lighting and ventilating Churches, Theatres, Halls and Public Buildings.
Street and Ornamental Sign Lamps of Every Kind for Oil, Gas or Gasoline. Border Lights, Bunch Lights, Foot Lights and Gas Stands for Theatres.
SEND FOR CATALOG.
AMERICAN REFLECTOR & LIGHTING COMPANY,
271-273 FRANKLIN STREET, CHICAGO, ILL., U. S. A.

Mention the Western Electrician when writing for catalogues.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE

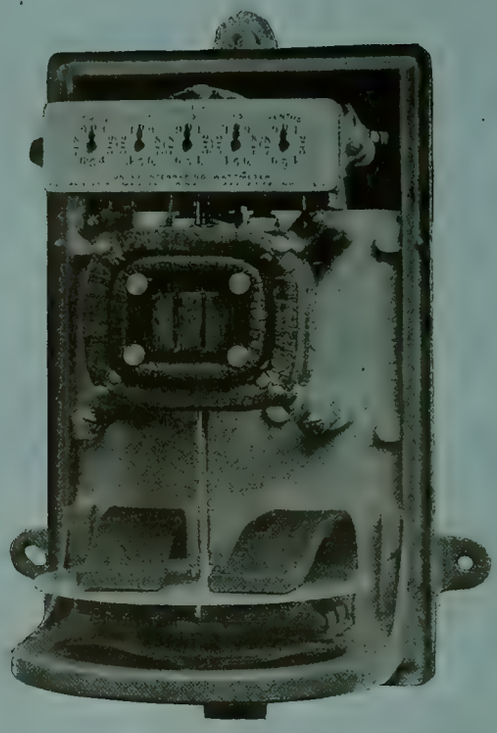
FOR DIRECT AND ALTERNATING CURRENTS

AN UP-TO-DATE METER

DESIGNED TO MEET THE REQUIREMENTS OF CENTRAL STATION PRACTICE

ACCURATE.

SENSITIVE.



DUST PROOF.

DIRECT READING.

Nonoxydizing Commutator and Brushes.
Permanent Magnets That Stay Permanent.
Armature Easily Removed for Inspection.
Spring Seated Jewel. Removable Spindle Point.
Large Dial With Circles in a Straight Line.

WRITE FOR PRICES

DUNCAN ELECTRIC MANUFACTURING CO.

LAFAYETTE, INDIANA, U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

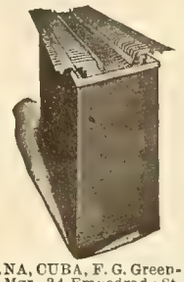
MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.



A DAY AND NIGHT SIGN

(FEDERAL ELECTRIC COMPANY PATENTS.)

A novelty in sign construction. Bear in mind that

FEDERAL ELECTRIC SIGNS are equally attractive at night and in daytime—a strong argument.

$280 PER YEAR net income per kilowatt of station investment is averaged from 300 of these signs in service in Chicago. Write for Bulletin No. 50; large size halftone engraving of this sign on fine enameled paper sent free.

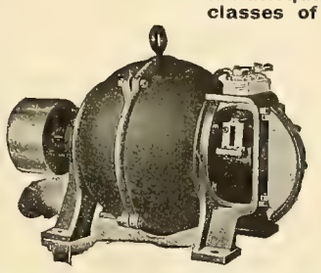
Federal Electric Co.
84 Market Street, CHICAGO, ILL.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



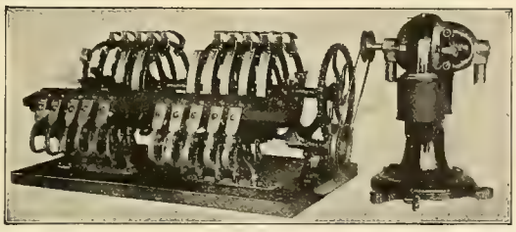
GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

EVERY CENTRAL STATION MANAGER SHOULD BECOME ACQUAINTED WITH OUR : : :

ELECTRIC SIGN FLASHERS

The most practical and simple device in the world for Flashing Electric Signs, Flags and all Electric Displays. We can convince every Central Station Manager, Electrical Contractor and Dealer that it's the greatest seller they ever handled.



Will increase the output of current, put your plant on a larger paying basis and open a new field of profit. Your customers will pay their current bills more willingly when using our flashers.

WRITE NOW FOR DETAILS.

Reynolds Electric Co. (Inc.) **221 Fifth Ave., CHICAGO, ILL.**

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..10
Akron Smoking Pipe Co.....—
Allen Company, L. B..... 15
Allis-Chalmers Company....28
American Battery Co.....—
American Creosote Works...24
Amer. Electrical Heater Co.—
Amer. El. Telephone Co.....21
American Electrical Works..15
American Platinum Works.. 1
American Refl. & Lighting Co. 1
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Babcock & Wilcox Co. 27
Baker & Company..... 3
Bario Vacuum Co..... 14
Barnett Company, G. & H....28
Barron & Co., J. S..... 7
Bayley & Sons Co., W.....22
Beardslee Chandelier Mfg. Co.14
Beardsley Gravity Dam & Construction Co..... .....—
Berthold & Jennings.....25
Besly & Co., Charles H.....23
Bonville, Edward 1
Bossert El. Construction Co..15
Brooks, Hall L 25
Brown & Leasure..... 14
Buffalo Forge Co.....28

Camp Company, H. B..... 6
Central Electric Co..... 5
Central Manufacturing Co .—
Central Telephone & El. Co..—
Century Glass Co.....28
Chase-Shawmut Company...15
Chicago & Alton Railroad... 19
C. & N. W. R. R..... 20
Chicago Edison Company..4, 16
Chic. Fuse Wire & Mfg. Co... 9
Chicago Insulated Wire Co..—
C., M. & St. P. R. R.....19
Chicago Pay Station Co.....20
Columbia Telephone Mfg. Co.20
Consumers Carbon Co.....15
Continuous Rail Joint Company of America.....19
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 5
Cutler-Hammer Mfg. Co.....13
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company 12
Dearborn Drug & Chem. Co 22
Diamond Meter Company .. —
Dicke Tool Company..... 24
Dixon Crucible Co., Joseph..22
Duncan Electric Mfg. Co.... 2
Edison Decorative & Miniature Lamp Department....14
Edison Mfg. Company..... 5
Edwards & Company..... 9
Electrical Engineer Institute.23
Electric Appliance Company.14
Electric Storage Battery Co.. 3
Electrician Pub. Company...28
Ely & Co., Allen P.....16
Ericsson Telephone Company 1

Faries Manufacturing Co....—
Federal Electric Company... 3
"For Sale" Advertisements..16
Ft. Wayne Elec. Works., Inc.27
Fowler, John H 25
Franklin Eng. & Elec. Co....19
Fulmer Lumber Co., D. M....25

General Electric Company... 8
General Incandescent Arc Light Company..... 7
General Incand. Lamp Co....—
Goltz Engineering Co.....28
Great Western Smelting & Refining Company... 16
Gregory Electric Company ..17

Hamblin & Russell Mfg. Co..15
Hartford Steam Boiler Inspection & Insurance Co...22
Hazard Manufacturing Co....28
Helios-Upton Company.....12
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....16
Holcomb-Lobb Co..... 25
Holmes Fibre Graph. Co.....19
Hopkins & Co., A. P.....25
Huebel Company, C. J.....24
Humphrey, Henry H.....14

Illinois Electrical Mfg. Co ..16
Illinois Electric Specialty Co.20
Illinois Maintenance Co.....16
Incandescent Electric Light Manipulator Company.....23
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools.... 9
International Tel. Mfg. Co. ..21

Jeffrey Manufacturing Co....22
Johnston, Thomas J.....15

Kartavert Manufacturing Co.28
Kellogg Switchboard & Supply Company.....19, 25
Klein & Son, Mathias.....24
Kohler Brothers. 14
Kokomo Tel. & El. M. Co....21

Leather Preserv. M. Corp....—
Leffel & Co., James.....22
Lindsley Brothers Company..25
Lowell Model Co..... 19

Machado & Roller..... 7
Maley, Martin..... 1
Maltby Lumber Company.. .25
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.22
Matthews & Bros., W. N.....15
Mayer, Geo M.....15
McLennan & Company, K....14
McNamara Brothers 1
Medora Milling Company....25
Metropolitan Tel. & El Co...20
Mica Insulator Company.....14
Miller Anchor Company 14
Miscellaneous Advs..... ..16
Monarch Fire Appl. Co.....23
Monon Railroad.....—
Moon Mfg. Co., The.....21
Morse Cedar Company.....25
Mott & Company, J. E.....25
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 24
New York Ins. Wire Co.....13
Norton Tool Company, The..21

Okonite Company, The....1, 11

Paragon Fan & Motor Co.....—
Parsell & Weed.....23
Peerless Automatic Smokeless Stoker Co.....23
Perrizo & Sons.....25
Phillips, Eugene F.....15
Phillips Insulated Wire Co..15
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co.....23
Pignolet, L. M.....14
Pittsburg & L. S. Iron Co.....25
Porter Cedar Company.....25

Rauscher, John 14
Reisinger, Hugo..... 7
Reliance Electric Company..22
Replogle Governor Works.. .—
Reynolds Electric Company. 3
Roebling's Sons Co., J. A.....26
Rose Electric Company 16

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 16
Schott, W. H. 14
Schureman & Hayden.....16
Scientific Exchange.....16
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 14
Smith Co., S. Morgan.....23
Southern Pacific R. R.....23
Spies Electric Company.....16
Sprague Electric Company... 3
Standard Electric Company.. 5
Standard Pole & Tie Co.... .24
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 13
Stanley Instrument Co.....13
Station Equipment Co.....16
Steam & Elec'l Equipment Co.16
Sterling & Son, W. C.....25
Sterling Electrical Mfg. Co.. 4
Sterling Electric Company...30
Sterling Varnish Co., The....14
Sterrett Pump Company 22
Stilwell-Bierce & Smith-Vaile Company.....23
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 21
Sturtevant Company, B. F....28

Toerring Company, C. J 14
Torrey Cedar Company..... .25
Triumph Electric Co.....19

Union Lumber Company 24
U. S. Electric Mfg. Co.....21

Valentine-Clark Co., The....25
Van Dorn-Elliott Elec. Co . 17
Vindex Electric Company....19
Vought-Berger Company 9
Vreeland, B. F. 24
Vulcanized Fiber Company 28

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....16
Western Electric Company... 7
Western El. Supply Co .....—
Westinghouse Electric & Manufacturing Company ..26
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....16
Whitmore, A. E.....25
Wickes Bros.....16
Willyoung, Elmer G.....—
Wisconsin Central R. R.....22
Wittenberg Cedar Co.....24
Worcester Company, C. H....25

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

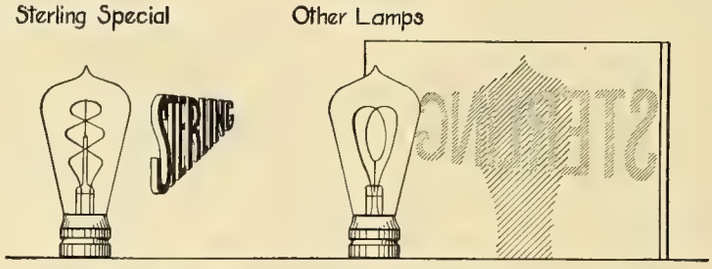
MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

STERLING PRIZE PUZZLE.

? WHAT IS IT ?



WHY IS IT ? ?

It is a lamp that gives an equal distribution of light, or, full rated candle power in all directions.

"THE STERLING SPECIAL."

Write for Booklet, Prices and Samples,

Study the above cut and explain

WHY such conditions as shown exist, then fill in the attached application and mail to our factory. We will ship you a lamp in accordance with your requirements whereby we will prove the truth of the above illustrated claim.

REMEMBER

It takes ***8 regular type*** 16 c. p. lamps to give ***96 c. p.***
It takes ***6 Sterling Special*** 16 c. p. lamps to give ***96 c. p.***
The saving demonstrated is 2 lamps 16 c. p. ***at 56 watts*** per lamp equaling ***112 watts.***

Application for sample of STERLING SPECIAL Lamp.

NAME.....
ADDRESS.....
C.-P..... VOLTAGE.....
BASE..... WATTAGE.....

Write for catalogue, descriptive matter, samples and prices, to

STERLING ELECTRICAL MFG. CO.,
WARREN, OHIO.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)

PITTSBURGH TYPE K TRANSFORMERS AND COLUMBIA LAMPS

PITTSBURGH TYPE K.

ARE MONEY SAVERS.

OKONITE IT NEVER DISAPPOINTS

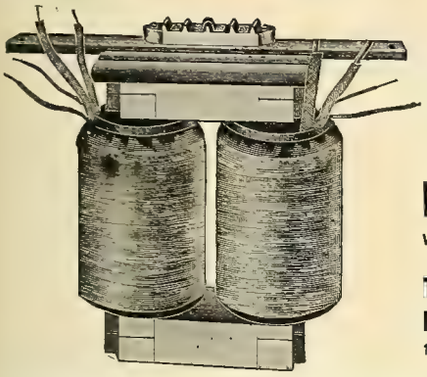
Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

TRANSFORMERS.



OUR CLAIMS ARE:

LOW CORE LOSS,
CLOSE REGULATION,
HIGH INSULATION.

BEST TO OPERATE.
TO BUY.

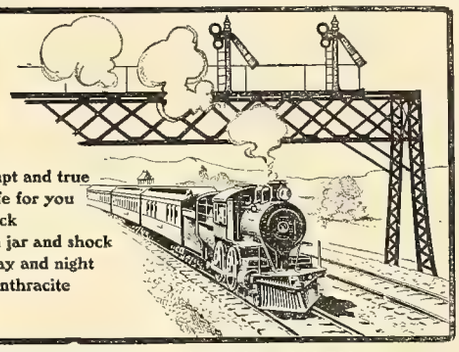
We carry a complete stock on hand.

THE STANDARD ELECTRIC COMPANY,

113 W. Third St., Cincinnati, O.

Lackawanna Railroad

THIS IS THE ROAD OF ANTHRACITE.



These are the signals prompt and true
That make the journey safe for you
Over the bed of ballast rock
That keeps the trains from jar and shock
That smoothly run both day and night
On the dustless Road of Anthracite

ALL SIGNALS OPERATED EXCLUSIVELY BY

EDISON PRIMARY BATTERIES

Formerly Known as Edison-Lalande.

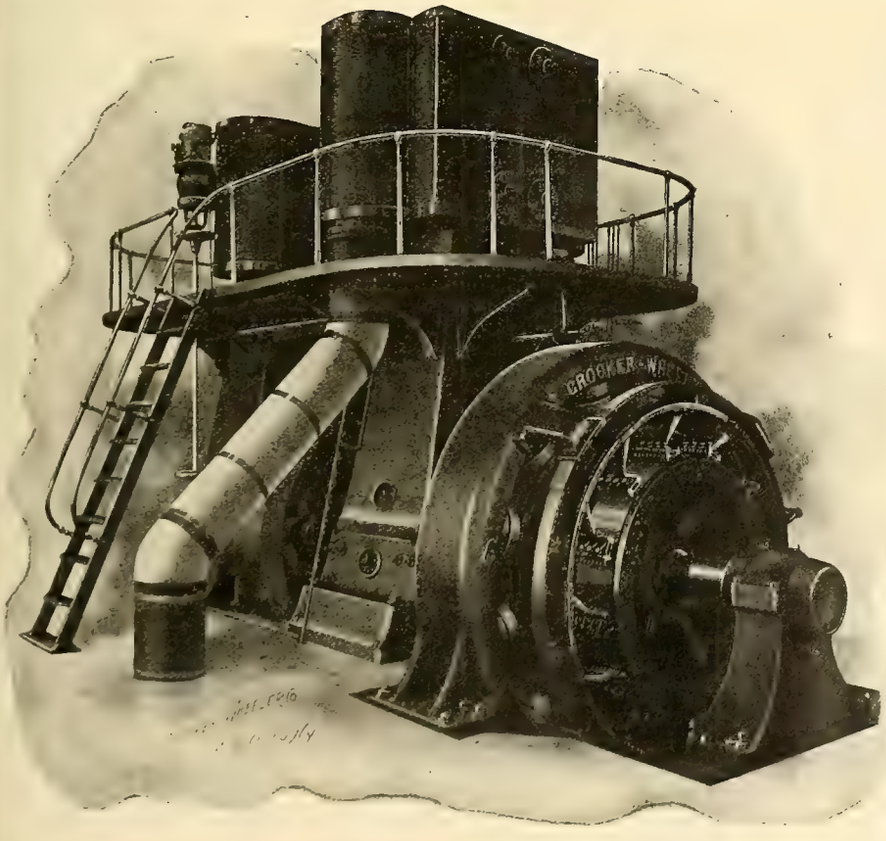
FULL DESCRIPTION IN BOOKLET NO. 4.

EDISON MANUFACTURING COMPANY

Factory, ORANGE, NEW JERSEY, U. S. A. New York Office, 83 CHAMBERS STREET

Chicago Office, 144 WABASH AVENUE

CROCKER-WHEELER COMPANY



A 400 K. W. GENERATOR

at the Rochester Power House of the Detroit United Railway.

Compact in Form.
Strong in Construction.
Correct in Design.
Cool in Operation.
Remarkable in Endurance.

Sales Offices in All Large Cities.

OFFICE AND WORKS - - AMPERE, N. J.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

INSTALLERS OF Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Miller Anchor Company.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Babcock & Wilcox Co.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
American Creosote Works.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.
Goltz Engineering Co.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards
Hamblin & Russell Mfg. Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co., Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
American Creosote Works.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Union Lumber Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Rectors.
American Refl. & Lighting Co.
Faries Manufacturing Co

Re-Winding Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.
Van Dorn-Elliott Elec. Co.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Ely & Co., Allen P.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & LightingCo.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Stokers.
Peerless Automatic Smokeless Stoker Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Helios Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS.
FOR DIRECT CURRENT.
FOR ALTERNATING CURRENT
ARC LAMPS.

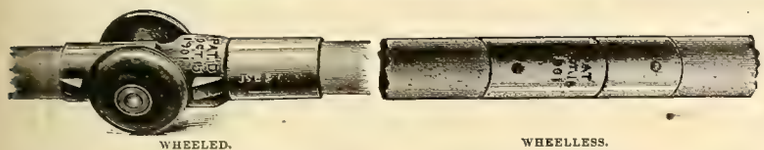
ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY, NEW YORK.

There are no Carbons better than the "Electra" and none "just as good."



WHEELED. WHEELLESS.

Villard Automatic Wheeled and Wheelless Conduit Rods

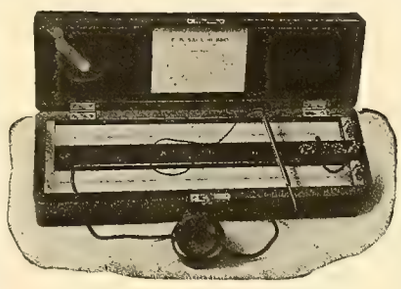
Are Coupled and Uncoupled Instantly and with Ease.

Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed, and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa.
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.



List price of this four-scale range, $45.00

THE SAGE OHMMETER

is unquestionably the ***best*** resistance measuring device on the market. No other approaches it in accuracy, length of scale, finish or grade of material.

We satisfied ourselves fully of its vast superiority before taking over the exclusive manufacturing and selling rights.

We carry a large stock and are pleased to announce a

MARKED REDUCTION FROM FORMER PRICES.

Send for discounts to **MACHADO & ROLLER,**
203 BROADWAY, NEW YORK CITY,
General selling agents for Whitney Electrical Instrument Co.
OR TO
Electric Appliance Co, Chicago. **Electrical Engineering Co., Minneapolis**
Western Elec'l Supply Co., St. Louis. **Standard Electric Co., Cincinnati.**

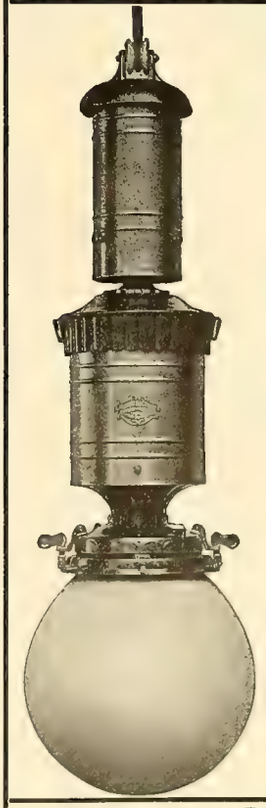
G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I.

TRADE **G. I.** MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

Type 405 Arc Lamps



For

Street Railway Lighting

This lamp will operate uniformly on a circuit with a

Fluctuating Voltage.

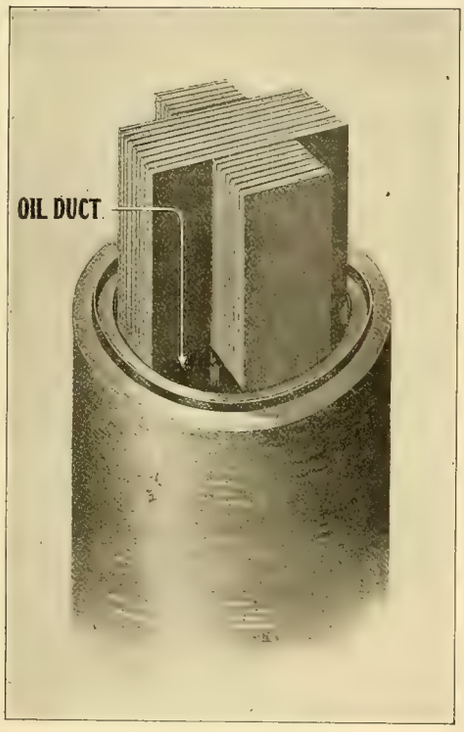
Write for Bulletin Number 7008.

Western Electric Company,
Chicago. Saint Louis. Philadelphia. New York.

GENERAL ELECTRIC COMPANY'S

TYPE "H" TRANSFORMERS

CORE TYPE.



In larger sizes of Type H Transformers, where it would not be economical to limit the thickness of coils to one and one-half inches, ducts for the circulation of cooling oil are provided between the windings and the iron core.

Unequal expansion of transformer windings, which always causes weakening of the mechanical and electrical strength of the insulation, can be avoided only when temperatures throughout the windings are maintained perfectly uniform.

It is evident that this uniform heating can exist only when all parts of the winding are at a uniformly short distance from the cooling oil.

Type H Transformers--even of the largest size--never have any part of the copper more than one and one-half inches from the cooling oil. Therefore TEMPERATURES AND EXPANSIONS ARE UNIFORM in all parts--a result even more desirable than low average temperature.

PRINCIPAL OFFICE, SCHENECTADY, N. Y.

New York Office, 44 Broad Street. Sales Offices in All Large Cities.

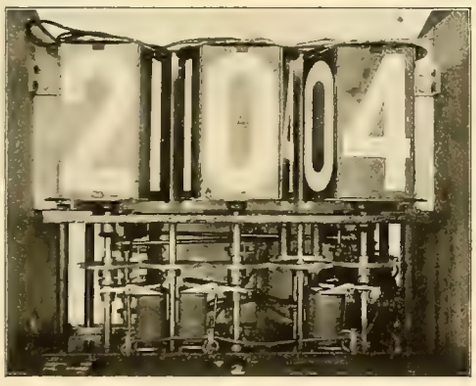
THE ELECTRIC CARRIAGE-CALL ANNUNCIATOR

Will Prove a Good Seller This Winter.

CALL COMPLETE FOR SERVICE.

It is designed to overcome the annoyance and delay which follows the old style plan of "calling" carriages after shopping, the theatre, opera or reception.

It is an absolutely perfect device. It can be depended upon always to work. It is most simple in operation.



INTERIOR VIEW OF CALL.

One illustration shows the annunciator in perspective, while the other shows the arrangement of gears and magnetic clutches.

They are giving satisfaction where now in use, and are easily installed.

Correspondence invited.

EDWARDS & CO.,

144th Street and Fourth Ave., - - NEW YORK.

Promoted to Chief Electrician

I had been employed but about six months when I realized that I must learn more or else always be a back number. I accordingly enrolled in the I. C. S. After seven months' study my promotion began. I gradually rose until today I am chief electrician of the smelting plants of this city. My salary has increased proportionally. I attribute my success entirely to the thorough methods employed by the Schools.

E. J. KINGSLEY, 608 Summit St., Pueblo, Colo.

We have hundreds of endorsements just as strong and convincing as the foregoing. You owe it to yourself to find out just what we can do for *you*. Our advice has put many a man on the road to progress and prosperity. You should ask it at once.

Fill Out and Send in the Coupon TODAY!

International Correspondence Schools, Box 1002, Scranton, Pa.

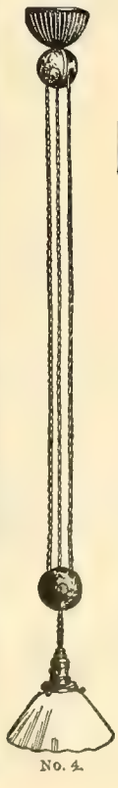
Please explain how I can qualify for position marked **X** below.

Electrical Engineer	Foreman Blacksmith	Sanitary Engineer
Elec. Machine Designer	Foreman Molder	Heating and Vent. Eng.
Electrician	Refrigeration Engineer	Contractor and Builder
Electric Lighting Supt.	Steam Engineer	Arch. Draftsman
Electric Railway Supt.	Marine Engineer	Sign Painter
Telephone Engineer	Civil Engineer	Letterer
Telegraph Engineer	Hydraulic Engineer	Analytical Chemist
Wireman	Municipal Engineer	Sheet-Metal Draftsman
Dynamo Tender	Bridge Engineer	Ornamental Designer
Motorman	Railroad Engineer	Navigator
Mechanical Engineer	Surveyor	Bookkeeper
Machine Designer	Mining Engineer	Stenographer
Mechanical Draftsman	Architect	Teacher
Foreman Machinist	Cotton Mill Supt.	To Speak French
Foreman Toolmaker	Woolen Mill Supt.	To Speak German
Foreman Patternmaker	Textile Designer	To Speak Spanish

Name _____ *Age* _____

Street and No. _____ *City* _____

State _____



No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

THE TELEPHONE HAND-BOOK

BY

HERBERT LAWS WEBB.

Price $1.00.

The only complete and practical work of its kind on the market.

PUBLISHED BY

THE ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, Chicago

A NEW PAPER-WEIGHT.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

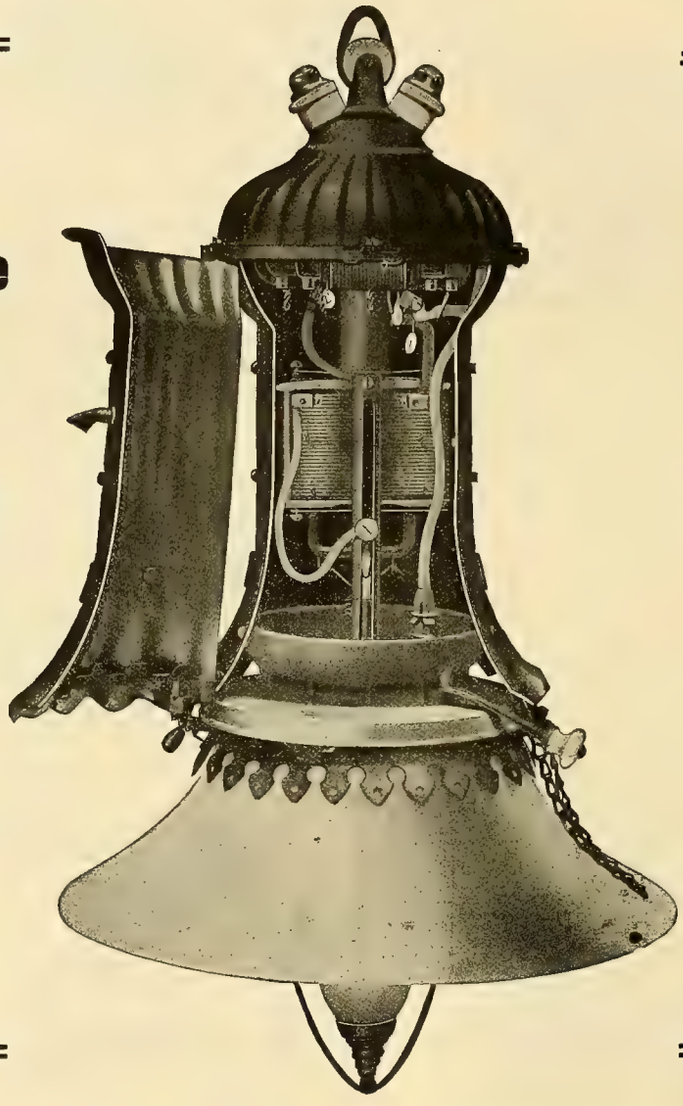
853 BROADWAY, NEW YORK.

358 DEARBORN ST., CHICAGO, U. S. A.

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market.
It's good to look at and built to stand the most severe service.
Never has been beaten in a competitive test.



Their Efficiency and Regulation are Perfect.
Easiest lamp to trim made.
Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. C. POMEROY,
No. 309 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
C. A. THOMSON,
No. 136 Liberty Street.

Longevity and Amphibiousness

are two qualities most desired in

RUBBER INSULATION.

Okonite

The Standard for Rubber Insulation

COMBINES BOTH

The Okonite Company, Ltd.,

253 Broadway,
NEW YORK.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

Convention Report Number.

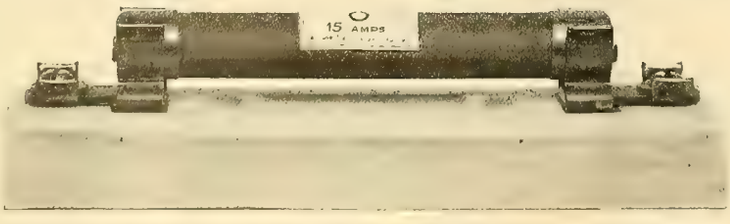
The WESTERN ELECTRICIAN of October 11, 1902, will contain the Report of the Street Railway Convention to be held in Detroit, October 8, 9 and 10.

Every street railway man will read the WESTERN ELECTRICIAN'S Report with interest, because it will be the first complete report of the meeting obtainable.

An attractive advertising announcement in this number would be of inestimable benefit to your business. This issue will go to press October 10th, and copy should be in our office by October 9th at the latest.

WESTERN ELECTRICIAN,
510 Marquette Bldg., Chicago.

CAR-HEATER CUT-OUT.



"TYPE C."

FITTED WITH OUR SPRING CLIP BULLSEYE INDICATING FUSES.

All Interchangeable from 1 to 15 Amperes.

GIVE THEM A TRIAL. WRITE FOR PRICES.

D. & W. FUSE CO., Providence, R. I.

OFFICES:

BOSTON: Pettingill-Andrews Co.
NEW YORK: Western Electric Co. A. Hall Berry.
PHILADELPHIA: Western Electric Co.
CHICAGO: Central Electric Co.
ST. LOUIS: Western Electrical Supply Co.

R. W. LYLE, President. B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Co.

VITRIFIED SALT GLAZED CONDUITS

39-41 Cortlandt Street, NEW YORK.

Baltimore—United Traction Co. awards us contract 200,000 feet of conduit.

Richmond, Va.—Richmond Telephone Co. awards us 200,000 feet of conduit.

Atlanta, Ga., New Castle, Pa.. Perth Amboy, N. J., Trenton, N. J., many other cities.

LARGEST PLANT — BEST STOCK — SKILLED WORKMEN.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

Crimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FLOTATION IN AIR

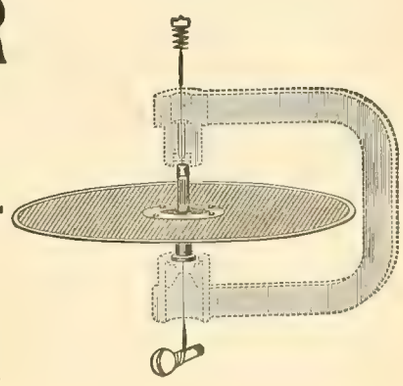
OF THE MOVING PARTS OF STANLEY RECORDING WATTMETERS FOR ALTERNATING CURRENT IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION "ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.



SALES OFFICE, 158 BROADWAY, NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS, JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

PACKARD MOGUL

The ***Packard*** Mogul Lamp is in a class by itself—the highest attainment in incandescent lighting. It has many advantages over 16-candlepower incandescent lamps or the so-called incandescent arc lamp.

200 and 300 candlepower in stock; 500 candlepower made to order. Furnished in series to work on street-railway and power circuits. Send for new catalogue giving full data.

ELECTRIC APPLIANCE COMPANY, CHICAGO.

ELECTRICAL SUPPLIES.

EDISON MINIATURE LAMPS

Have been for twenty years

The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

General Electric Company, Harrison, N. J.

M. I. C. COMPOUND

HIGH INSULATOR FOR ARMATURES, FIELD COILS, SPOOLS, TRANSFORMERS, MOTOR FRAMES, CAR TRUCKS, ETC.

Four Grades to suit all Requirements. Non-Corrosive, no Carbon Bisulphide. Impervious to Moisture, Oil or Acid. Send for Price List and Samples.

MICA INSULATOR CO.,

NEW YORK. CHICAGO.

ARC LAMPS — **PROMPT DELIVERIES** — **ARC LAMPS**

39 Cortlandt St. — 19th & Allegheny Ave.

Our Factory

is working 24 hours a day, and we can fill orders promptly.

Philadelphia. Paris. Buffalo.

NEW YORK CITY — C. J. TOERRING CO. — PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,

156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

Send for Circular.

L. M. PIGNOLET.

78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building,

CHICAGO.

HENRY H. HUMPHREY,

Consulting, Electrical and Mechanical Engineer.

CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.

Suite 1305, Chemical Bldg., St. Louis.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.

SEND FOR FREE SAMPLE STICK.

For sale by all supply houses, or

It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

BEARDSLEE CHANDELIER M'F'G CO.

256 AND 257 So. CANAL ST. CHICAGO

GAS & ELECTRIC FIXTURES FOR THE TRADE.

CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO.,
Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO.,
25 Colmore Row, Birmingham, England.

THE BEST IS THE CHEAPEST

In the best there is more profit for Dealers and Contractors.

A Fine Push

MAKES ALL THE BELLS WORK NICE.

Write for Prices and Samples.

JOHN RAUSCHER, St. Paul Minn.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,

Cambridgeport, Mass.

CHICAGO, Monadnock Block.

THE MILLER ANCHOR.

Write us for Prices on Anchors and Augers. All Sizes Made.

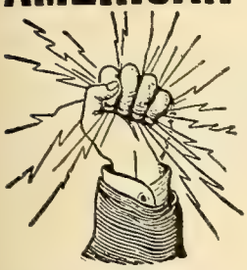
MILLER ANCHOR CO.

NORWALK, OHIO.

FRANK N. PHILLIPS, PRESIDENT. E. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

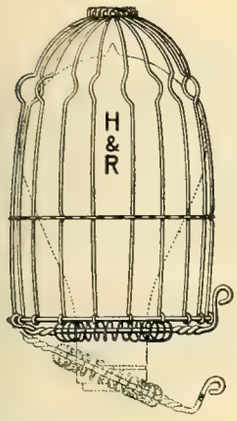
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

"NEVER BREAK"

ELECTRIC LIGHT GUARD.

SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,

Counsellor at Law,

No. 66 Broadway, - NEW YORK CITY.

Patent Causes. Patent Soliciting.

THE ALLEN SOLDERING STICK

The favorite with the electrical trade.

No Acid Bottle to spill, break or handle.

ONCE TRIED, ALWAYS USED.
LARGE ALLEN STICK FREE.

L. B. ALLEN CO.

(Inc.)

1345 Columbia Ave., Chicago

Designs for **PATENTS—WORKING DRAWINGS**
FOR SPECIAL AND AUTOMATIC MACHINERY.
Developing of **ELECTRICAL INVENTIONS** a Specialty.
GEO. M. MAYER, M. E., MONADNOCK BLK., CHICAGO, ILL.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

STOMBAUCH GUY ANCHORS

STOMBAUCH GUY ANCHOR

THEY ARE
- Easy to install.
- Cheaper than other guys.
- One piece. No moving parts.
- Necessary for well guyed poles.
- Operated like a corkscrew.
- Mechanically correct.
- Indestructible by fire or frost.
- Carefully made.
- Anchors that pay dividends.
- Labor savers.

STOMBAUCH GUY ANCHOR

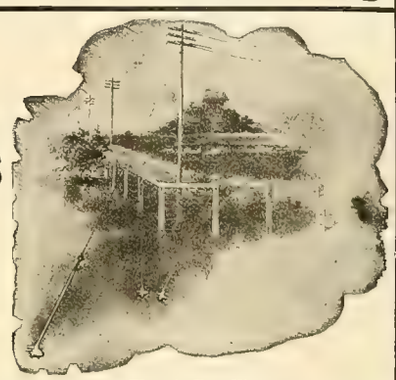
STOMBAUCH GUY ANCHORS

Write for prices, to

W. N. MATTHEWS & BRO.

603 Carleton Building,

ST. LOUIS.



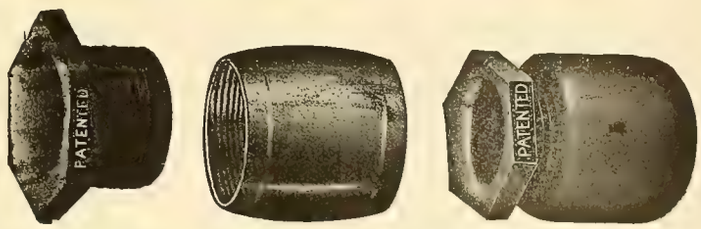
Worm's-Eye View.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.

(SOLE MANUFACTURERS.)

BOSTON, MASS.

THOS. G. GRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.

WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a first-class electrician, engineer and machinist of 12 years' practical and technical experience in erecting and running Electric, Steam, Refrigeration and Ice plants. Thoroughly understands the care and economical management of same. Age thirty-two. Strictly sober and reliable. A1 references. Address BOX 121, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent of electric-light and power plant, or as foreman of construction, by a young man thoroughly acquainted with the business in all its parts. Has had 10 years' experience. Prefers West or South on account of health. Address BOX 120, care of Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By young man having a university education in electrical and mechanical engineering, and who is an associate member of the American Institute of Electrical Engineers. Desires to associate himself with some firm or manufacturing concern where he can advance. Best of references. N. M. SNYDER, care Union Electric Light & Power Co., 10th and St. Charles Sts., St. Louis, Mo.

WANTED.

Experienced telephone traveling salesmen; acquainted with Northwest trade preferred, but not essential.

THE VOUGHT-BERGER COMPANY,
Makers of Telephones and Switchboards,
La Crosse, Wis.

WANTED SALESMAN.

By a large Hard Rubber Manufacturer, to introduce and develop a Hard Rubber department. Must have good acquaintance with electrical trade and a knowledge of where hard rubber is used. Address BOX 122, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITIONS OPEN.

	PER MONTH.
5 Draftsmen, Electrical	$100
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
1 Electrical Superintendent	$85
1 Electrical Superintendent	$50
2 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa, 95-97 Liberty St., New York City. 1214 Marquette Bldg., Chicago, Ill. Saginaw, Mich.

FOR SALE.

Two standard machines for manufacture of wooden insulator pins. One combination machine for manufacture of either wooden bracket or insulator pins. Address INDIANAPOLIS ARM, BRACKET & PIN CO., Indianapolis, Ind.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Telephone exchange in one of the best towns in Northern Indiana. Address BOX 114, care Western Electrician, 510 Marquette, Bldg., Chicago.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

SECOND-HAND STEAM ENGINES.

1—70-hp. Westinghouse	$250
2—60-hp. Westinghouse	200
1—65-hp. Sioux City Corliss, 12x24	700
1—12x16 self-contained Chandler & Taylor	200
25—Engines of standard makes with slide valves, of from 8 to 20 hp., each. Write for description.	100
1—Smith-Vaile Duplex Steam Pump, 2x8-x12	200
1—Fairbanks Duplex Steam Pump, 12x7-x12	150

DYNAMOS.

1—40 Arc Light Standard	$200
1—26 Arc Light T. H.	125
1—600 Light T. H. Generator and Exciter.	300
20—Arc Lights, each	1
20—Street Shades, each	1

For sale by

ALLEN P. ELY & CO.
1110 Douglas St. OMAHA, NEB.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., September 29, 1902. Sealed proposals will be received at this office until 2 o'clock P. M., on the 4th day of November, 1902, and then opened for a conduit and electric wiring system for the U. S. Public Building at Cheyenne, Wyo., in accordance with drawings and specifications, copies of which may be obtained at this office, or at the office of the Superintendent of Construction, at Cheyenne, Wyo., at the discretion of the Supervising Architect, JAMES KNOX TAYLOR, Supervising Architect.

60-K. W. EDISON, 500-VOLT.
For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

MOTORS WANTED.
500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

Western Electrician

WANT ADS

Bring Results.

A. C. SCHOONMAKER CO.
126A Liberty Street, New York City,
DYNAMOS, MOTORS, TRANSFORMERS, METERS AND ARC LAMPS.

1 20x18½ Harrisburg Ideal Engine.
1 14x13 Armington & Sims Engine.
1 16x16 Erie Ball Engine.
1 15x15 Erie Ball Engine.
1 12x12 Erie Ball Engine,
2 120-kw G. E. single phase Alternators.
1 100-kw Card M. P. 500-volt Generator.
1 200-kw M. P. Westinghouse Railway Generator.
200-kw in T.-H., G. E. Transformers.
2 60-kw G. E. Transformers.
497 Improved M. G. E. Arc Lamps.
2 15 hp M. P. 500-volt Motors.
2 10-hp M. P. 500-volt Motors.
2 8-hp M. P. 500-volt Motors.
2 5-hp M. P. 500-volt Motors.
3 3-hp M. P. 500-volt Motors.

Railway Generators.

1—200 K. W. Siemens & Halske direct-connected to automatic engine.
1—200 K. W. Westinghouse M. P. 6-belted generator.
1—150 K. W. Westinghouse, M. P.
1—100 K. W. G. E., M. P. 4.
1—110 K. W. Westinghouse, M. P.
1— 75 K. W. Westinghouse, M. P.

CORLISS ENGINES.

1—20x48 Harris Corliss.
1—18x48 Brown Corliss.
1—16 and 27x16 Westinghouse Compound, 250 H. P.
1—100 K. W., G. E., 220 volts or 110-volt direct-connected unit.
1—240 K. W. Walker generator, M. P. 250 volts.
We have power equipments of all kinds, see recent advertisements.

THE STEAM AND ELECTRICAL EQUIPMENT CO.,
Wood and Water Streets, Pittsburg, Pa.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

IT'S UP TO YOU.
We pay highest market prices for
SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.
WRITE US.
We Manufacture Copper Hard Babbitt
the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.
GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

Electrical Machinery Bought, Sold and Exchanged. **REPAIRS** Switchboards Built to meet Specifications.
ILLINOIS ELECTRICAL MFG. CO.,
Lowest Prices. PEORIA, ILL. Write Us.

IMMEDIATE SHIPMENT

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-inch, 24-inch, 22-inch Double Leather Belts.

BOILERS.

One Geary Water Tube Boiler, 175 horsepower for 150 pounds pressure; almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 h. p. Berryman Heater.
600 h. p Berryman Heater.
125 h. p. Berryman Heater.
500 h p. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY CO.,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. GEO. W. HOFFMAN, 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

STATION EQUIPMENT COMPANY,

539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
150 K. W. 60-cycle Fort Wayne wood alternator, 1,100 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K.W. Edison bi-polar railway generators.
2—100 K.W. Edison bi-polar railway generators.
4—100 K.W. Edison bi-polar 140 volt generators.
1—45 K.W. Edison bi-polar 140 volt generator.
2—30 K.W. Edison bi-polar 140 volt generators.
1—30 K.W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.

All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, E. H. CHENEY, Manager. 204 Dearborn St., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

Wanted for Spot Cash

Railway Generators,
Power Generators,
Dynamos, Direct and Alternating,
Motors of all **Descriptions.**

Send complete description and get our cash offer. We carry the largest stock of Second-hand Electrical Apparatus in this country and can pay highest prices.

Gregory Electric Co.,

THE ELECTRICAL BARGAIN HOUSE,

54-62 South Clinton Street, CHICAGO.

CONSTRUCTION TOOLS

We are prepared to make prompt delivery of

PIKE POLES
POLE RAISERS
DIGGING BARS
TAMPS
SHOVELS
SPOONS
CROSS ARM BRACES
POLE BANDS
WASHERS

And other iron work for telephone and railway construction.

Catalogue on request.

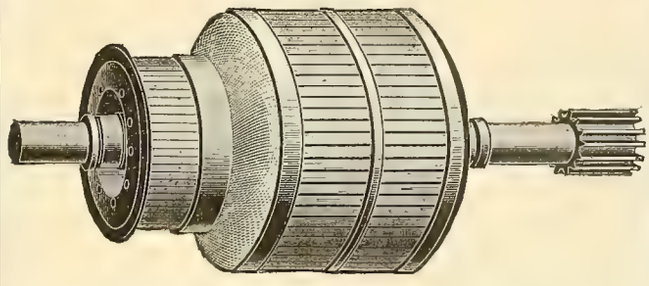
W. H. ANDERSON & SONS

Established, 1871. Incorporated, 1902.

ST. AUBIN AVE., DETROIT, MICH.

THE VAN DORN-ELLIOTT ELECTRIC CO.

Manufacturers of



ARMATURE AND Field Coils,

COMMUTATORS, ETC.

Armatures, Transformers and Fields of all Types Rewound.

ALL OUR WORK GUARANTEED.

Cleveland, Ohio.

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

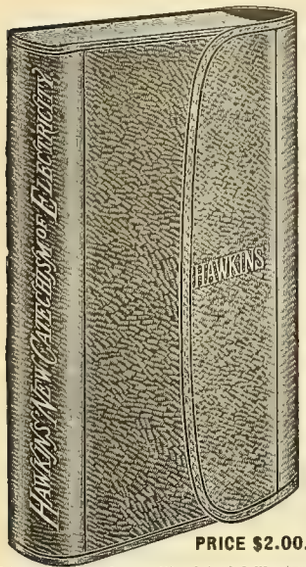
This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.

Electrician Publishing Co.,

510 Marquette Building, CHICAGO.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,

510 Marquette Bldg., Chicago.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated. Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VHI: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wail Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

RELIABILITY

is without doubt the all important consideration in telephones for INTERURBAN RAILWAYS. That

KELLOGG TELEPHONES

can be depended upon to do their work is proved daily in the largest exchanges in the United States.

Kellogg Apparatus is cheaper than ordinary apparatus when the cost of maintenance is considered.

Street railway men attending the American Street Railway Convention held in Detroit, October 8, 9 and 10 are cordially invited to visit our exhibit in the Light Guard Armory where highest grade telephone apparatus may be seen in operation.

No equipment too small or too large to receive our most careful attention.

KELLOGG SWITCHBOARD & SUPPLY CO.,

229 So. Green St., CHICAGO.

FIBRE-GRAPHITE COMMUTATOR BRUSH — SELF-LUBRICATING — NOISELESS

There's No Friction

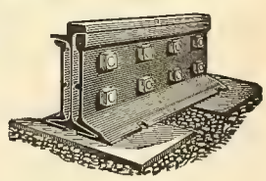
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

TRANSFORMERS.

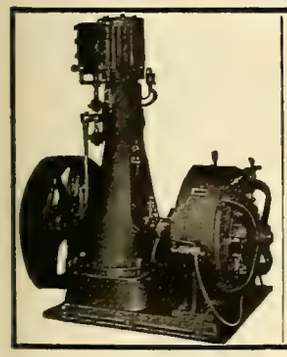
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

CONTINUOUS RAIL JOINT CO. OF AM.



GENERAL OFFICES: CENTURY BUILDING,
NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" — CINCINNATI, O.

GASOLINE MOTORS

—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY
CHICAGO AND ST. LOUIS
CHICAGO AND PEORIA
ST. LOUIS AND KANSAS CITY

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark. DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent,
Chicago, Ill.

It's No Secret...

That the proper illustration in an **Ad.** pays for itself and the entire space of the ad.
WE MAKE THE PROPER KIND ...
— TRY THEM AND SEE —

Real order fetchers
Full of force...

Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.

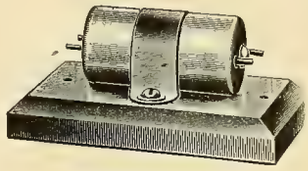
STERLING

CONDENSERS AND REPEATING COILS

Like all STERLING apparatus, are BEST and CHEAPEST.

TRY THEM!

1 Microfarad, 70c.
2 Microfarads, 80c.



Highest Efficiency for All Classes of Service.

$2.00

STERLING ELECTRIC COMPANY,

LAFAYETTE, - - - - INDIANA.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

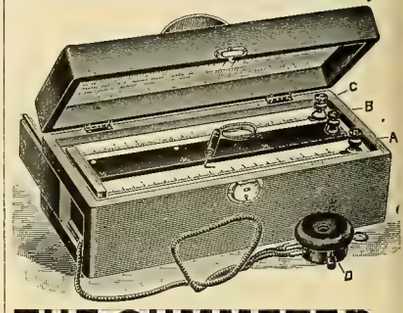
CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

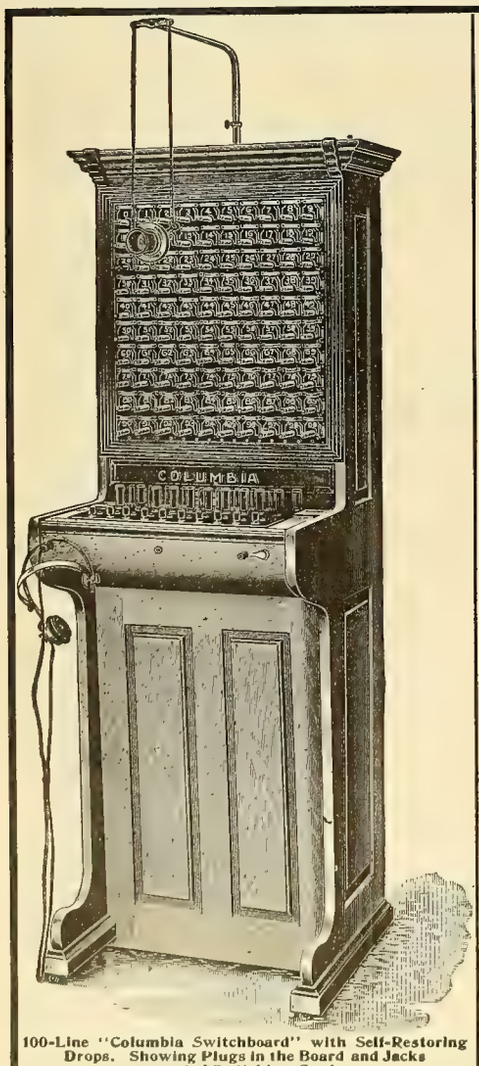
"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1	200	lines and	telephones
Ennis, Tex.,	"	"	1,200	"	"
Norwalk, Ohio,	"	"	2,400	"	"
Frankfort, Mich.,	"	"	250	"	"
Dundee, Mich.,	"	"	200	"	"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

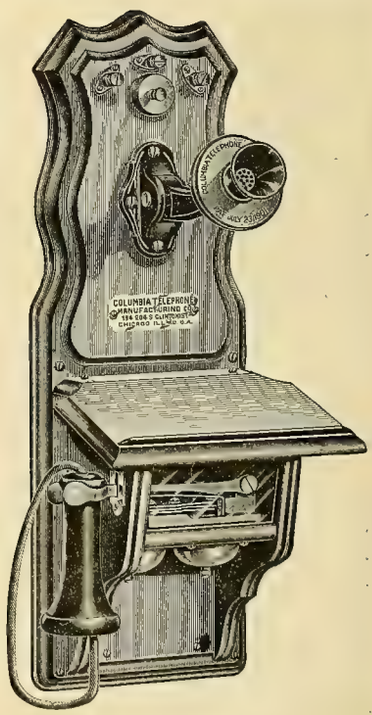
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

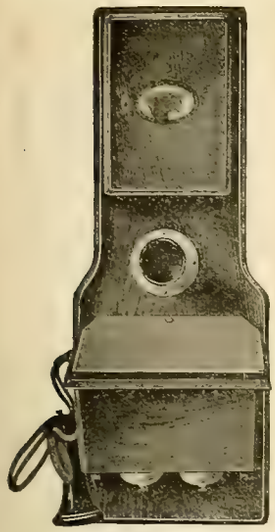
INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



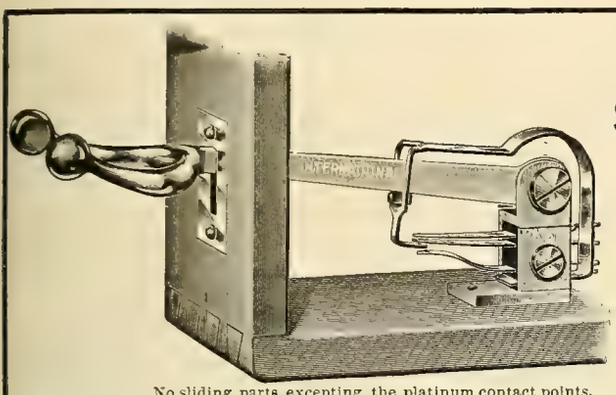
Central Energy Wall Set.



Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

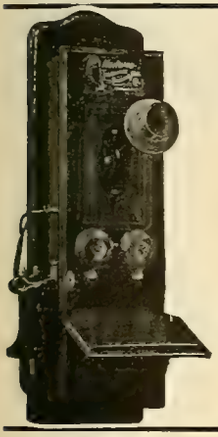


A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. Co.**



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger
for straight lines and corners, SOLID FORCED STEEL, Japanned or galvanized.
No. 1. Light, 1¾x ⅜in.
No. 2. Medium, 1¾x½ in.
No. 3. Heavy, 2x½ in.
Nos. 2 and 3 always in stock.

DEAD END HANGER.
Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.
Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties, and up-to-date. Tell us what you want.
Corner Brackets, Guy Shims, and Special Forgings made to order.

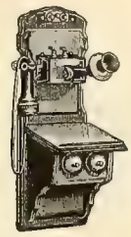
3-Bolt Guy Clamp.
Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.

IMPROVED TELEPHONE APPARATUS.

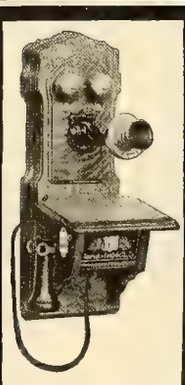
EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"



MULTIPLE BOARDS

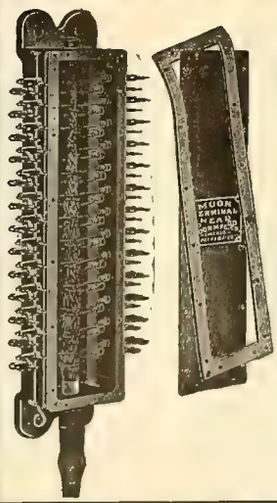
STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

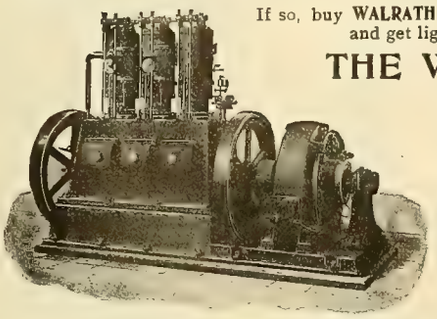
GET RICH WITH MONEY SAVED ON COAL AND REPAIR BILLS

BY USING DEARBORN BOILER COMPOUNDS MADE TO SUIT THE WATER AS PER ANALYSIS

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. PRICE, $3.50.

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

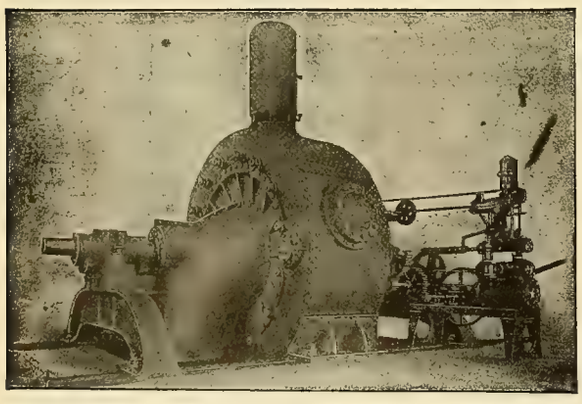
MILWAUKEE, - - WIS.

AGENTS WANTED EVERYWHERE.

GRAPHITE RESISTANCE.

Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particu'ars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.



SAMSON TURBINE

UNEXCELLED FOR DRIVING

ELECTRICAL MACHINERY.

Special Features:

HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

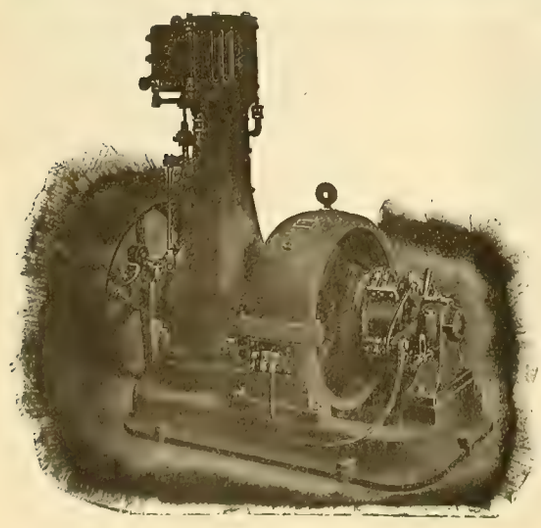
JAMES LEFFEL & CO.,

SPRINGFIELD, O., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,

MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

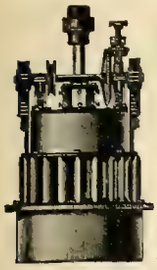
THOROUGH INSPECTIONS

AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

GOOD REASONS FOR USING THE

PEERLESS AUTOMATIC SMOKELESS STOKER

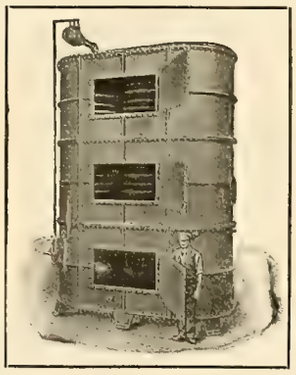
1. It saves fuel. Absolute elimination of smoke.
2. Increases boiler power and efficiency.
3. Burns successfully all kinds of fuel, also factory refuse.
4. Increases the draft, regardless of size or height of chimney.
5. Leaves the flues or tubes free from soot.
6. Simple in construction, repairs being reduced to minimum.
7. High temperature attained in furnaces.
8. Smoke, soot and cinder nuisances abated.
9. Renders blower fans useless, burning gasses formerly forced off unconsumed.

Subject to 30 Days' Trial. **Send for Catalogue.**

Peerless Automatic Smokeless Stoker Co.

11 BROADWAY, NEW YORK.

When You Save Steam,



You Economize in Fuel, and

ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

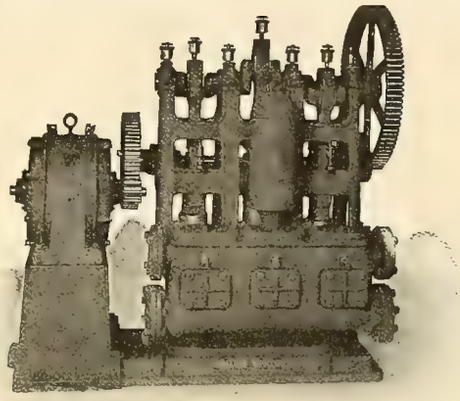
We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,

Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS



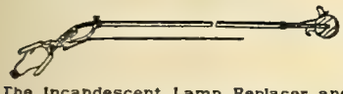
The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

Kilfyre DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO,
247-249 Pearl St., New York City.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c.p lamp at any height or angle.

Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

The Franklin Model Shop

Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.

Write for our free Illustrated Book,
"Can I Become an Electrical Engineer."

We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.

Electrical Engineer Institute,
Dept. K. 240-242 W. 23d St., New York.

A Prosperous State.

The whole great empire of California is rapidly developing. It was long said of this sunny and attractive region that "man cannot live upon climate," but when it was seen that Southern California had something more substantial than sunshine to offer, cities rose like exhalations, and deserts became fruitful fields. The same discovery is being made in Northern and Central California. The climate is seen to be a unit throughout the state, and industrial opportunities are seen to go with the climate, and business advantages with the winterless skies.

San Francisco's trade has nearly doubled in the past few years, and her foreign tonnage since 1895 has been multiplied by fifteen. Banks and savings banks show an enormous increase in commercial deposits and in the savings of the people, while a glance at the records of the building trades shows everywhere immense activity. There are no indications of a local or temporary boom. The growth of irrigation and the multiplication of farms; the discovery of oil and its widening use as fuel in mines and manufactories, and on engines and steamers; the enlarging markets for California products in China, Japan, Hawaii and the Philippines, and the increasing trade with the west coast of Central and South America and with Australia, is sufficient to show that the prosperity of the state has a natural and healthful root.

Settlers' rates, based upon a $33 fare from Chicago, during September and October, are bringing in a host of home-seekers. This is a daily rate, and particulars may be had at any agency of the Southern Pacific. With the best climate, from the fewest acres, with the least labor, California will yield a wider range of harvest, and pay larger profits, and more dividends in comfort, than any land in the world.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

Subscription Blank—Foreign.

WESTERN ELECTRICIAN
....EVERY SATURDAY....
CHICAGO { SUITE 610 MARQUETTE BLDG. / NEW YORK { 193 TIMES BLDG.

.....1901.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago, U. S. A.

Gentlemen:

Inclosed find $\$5.00$ / $\$2.50$, for which please send THE WESTERN ELECTRICIAN weekly to the following address for 12 / 6 months; this order to go into effect with current number.

Name.....

Address.....

$5.00 a Year (52 Numbers)
$2.50 6 Months (26 ")

HEART PINE!

That is what our Cross-arms are made of.

We manufacture our own Cross-arms at our Mills at Brooksville, Florida.

NO MIDDLEMAN'S PROFIT.

The Standard Pole & Tie Co.

44 Broad Street, NEW YORK CITY.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

POLES! REDWOOD AND PINE TIES!

We make a specialty of

SAWN REDWOOD POLES.
REDWOOD TIES FOR SLEEPERS.

UNION LUMBER CO.,

CROCKER BLDG., SAN FRANCISCO, CAL.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

WESTERN CEDAR POLES

LOW PRICES.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver. Colo. (Main Office.)

AMERICAN CREOSOTE WORKS, NEW ORLEANS, LA.

ROUND AND SAWN TELEGRAPH POLES,
CROSS-ARMS, CROSS-TIES, CONDUITS.

Write for catalogue, with U. S. Agricultural Dept. reports on durability, showing life of over thirty years a certainty. The newest and most modern plant in the country.

CAPACITY, 18,000,000 FEET B. M. PER ANNUM.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Subscription Blank—Domestic.

WESTERN ELECTRICIAN
....EVERY SATURDAY....
CHICAGO { SUITE 510 MARQUETTE BLDG.
NEW YORK { 193 TIMES BLDG.

.....1901.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

Gentlemen:

Inclosed find $\$3.00$ / $\$1.50$, for which please send THE WESTERN ELECTRICIAN weekly to the following address for $\frac{12}{6}$ months; this order to go into effect with current number.

Name.....

Address.....

.....

$3.00 a Year (52 Numbers)
$1.50 6 Months (26 ")

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

St. Ry. Delegates:

Don't forget to call at our booth Wednesday at Detroit, if you don't get around before. We must show you our **POLE and TIE YARD.** It isn't far, and you won't find another like it in a good many days' travel.

MALTBY LUMBER CO.

BAY CITY, MICH.

MIXED CARS.

We Can Load Mixed Cars of

TELEPHONE POLES, CEDAR SHINGLES AND POSTS

Choice Stocks, Right Prices. Write us at once and tell us just what you require.

THE MORSE CEDAR CO., - Saginaw, Michigan.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand.

CEDAR POLES OF ALL LENGTHS AND SIZES

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

THE HOLCOMB-LOBB COMPANY
CEDAR POLES & POSTS
745 MARQUETTE BLDG. CHICAGO ILL.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

DON'T FORGET US
if you need
CHESTNUT POLES
For TELEPHONE, ELECTRIC LIGHT or STREET RAILWAY Purposes.
Large Assortment.
The Medora Milling Co.,
MEDORA, IND.

WHITE CEDAR POLES.

HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES

LONG DISTANCE PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA MICH.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO SONS DAGGETT MICH.

POLES

W. C. STERLING & SON, MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.
TIES.

CEDAR POLES

IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES

THE VALENTINE-CLARK CO.,
234 LA SALLE ST., CHICAGO.
YARDS: PINCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

The

Westinghouse Wattmeter

Westinghouse Integrating Wattmeter.

has a fine jewel movement, frictionless counting train, and a moving element very much lighter than that of any other meter. The result is a high-grade instrument of precision, which *accurately records the lightest of loads*, independent of power factor, frequency, temperature, wave form, etc.

FOR ILLUSTRATED BOOKLET ADDRESS
THE NEAREST SALES OFFICE OF THE

Westinghouse Electric & Manufacturing Co.,

Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. **LAMP CORD.**

POWER CABLES.
TELEPHONE CABLES. **OFFICE WIRE.**

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

JUST ISSUED.

MODERN ELECTRIC RAILWAY MOTORS.

BY GEO. T. HANCHETT, M. E.

FIRST PRACTICAL WORK ON RAILWAY MOTORS.

CONTENTS.—Chapter I.—Forms of Field Magnets. II.—Armature Winding Diagrams. III.—Field Coil Construction and Arrangement. IV.—Armature Construction. V.—Commutator and Brush Holder Construction. VI.—Motor Casings. VII.—Motor Suspensions. VIII.—Bearings and Gears. IX.—Lubrication. X.—General Dimensions and Data. XI.—Management and Repair. XII.—Railway Motor Design.

200 Pages. 157 Illustrations and Table. Price $2.00.

THIS is a book unique in its treatment of electric railway equipment. The first ten chapters are devoted to minute description of the details of electric railway motors that are in use to-day. Each organ of an electric railway motor is taken up in turn, described and illustrated by examples of present and past practice, and its operation explained in the light of practical experience. In short, the review of current practice is of such a nature as to bring out the reason why the electric railway motor is built as it is to-day. For example, field magnets of different types of motors are illustrated and compared, and their features of merit and faults pointed out. Armatures, armature windings, brush holders, suspensions and other details are similarly treated, each detail, however minute, being exhaustively considered. The last two chapters are devoted, one to the management and repair of electric railway motors, and the other to railway motor design, a complete design being worked out as an example. A table gives authoritative data of all types of railway motors in common use, both in America and Europe. **Sent postpaid on receipt of price.**

ELECTRICIAN PUBLISHING CO, 510 MARQUETTE BLDG., CHICAGO.

—THE—

MOTORMAN'S GUIDE,

A PRACTICAL TREATISE

—ON—

Street Railway Motors;

—OR—

How to Become a Practical Motorman.

By J. W. GAYETTY.

Price, = = = = = = 50c.

CONTENTS.

1. Introduction. 2. Car wiring. 3. How to locate trouble in your car while on the road. 4. How to cut out a motor. 5. Information on "K" controllers. 6. How to locate trouble in a reversing switch and how to overcome it. 7. How to reverse a car in order to obtain best effects. 8. Points about motors that should be looked after closely. 9. Short circuits. What a short circuit means and how to locate it. 10. Information on incandescent light circuits. 11. Electric motor force, or how armature rotation is obtained. 12. How to increase the speed of a motor by changing two connections. 13. General information on Westinghouse motors. 14. Westinghouse fuse block. 15. Westinghouse lightning arresters. 16. Westinghouse lamp circuit. 17. Information on open circuits and sparking brushes. 18. Some questions you may be called upon to answer. 19. Points of interest to all. 20. Conclusion. 21. Diagram of car.

EXTRACT FROM INTRODUCTION.

"Recognizing the fact that not one motorman in twenty thoroughly understands his motors, I feel that I am giving them great value for their money, and at the same time furnishing them with the means of holding a position on any line they may be employed on. While serving as foreman in different car houses, the author has been able to gain a great many pointers that will come up on the examination of motormen and conductors, and having possessed these, together with my knowledge of electricity, I feel perfectly safe in stating that they cannot ask you any question that I have not honestly and correctly answered in this little book. If you wish to learn the value of this book, go to your electrician, or man in charge of your motors, and ask him for information, and then, and not until then, will you learn the true value of this book. It has always been understood by all electricians or foremen of car houses, that no information of any importance be given to any one outside of their class, and consequently most men running cars to-day are ignorant of their motors."

Send for Copy.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BLDG., CHICAGO.

"WOOD" ARC LAMPS

FOR POWER CIRCUITS

500 VOLTS

For street railway circuits in summer parks these lamps are exceptionally well adapted. They are perfectly designed and constructed and operate

FIVE IN SERIES

on circuits of 500 to 575 volts. With a few changes they may be adapted to direct current series circuits for city lighting.

BULLETIN 1028

completely describes these lamps with illustrations of many features of design and construction. A postal brings it.

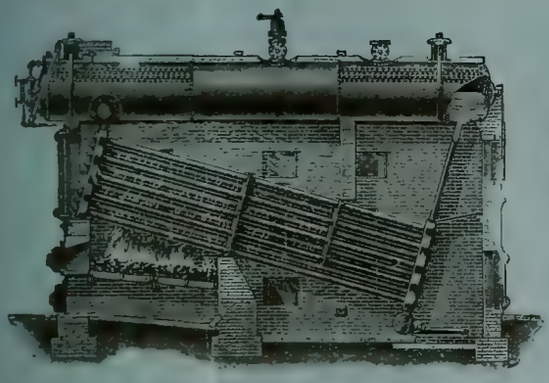
FORT WAYNE ELECTRIC WORKS

MAIN OFFICE AND FACTORY: FORT WAYNE, IND.

SALES OFFICES IN ALL LARGE CITIES.

ONE MILLION HORSEPOWER

—OF—



Babcock & Wilcox Boilers

ARE IN DAILY USE IN

ELECTRICAL GENERATING PLANTS.

They are used in a greater percentage of

THE WORLD'S BEST POWER PLANTS

than any other single detail of steam machinery of any one make.

SEND FOR OUR BOOK "STEAM."

BRANCH OFFICES:

BOSTON, 38 Federal Street.
PHILADELPHIA, 1110-1112 North Am. Bldg.
SAN FRANCISCO, 32 First Street.
PITTSBURGH, 1218 Frick Building.
NEW ORLEANS, 339 Carondelet Street.

The Babcock & Wilcox Co.,

85 Liberty St., NEW YORK.

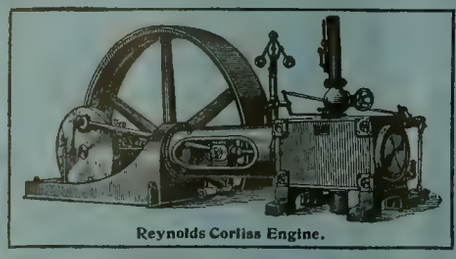
BRANCH OFFICES:

CHICAGO, 1215 Marquette B'dg.
ATLANTA, GA., 817 Equitable Bldg.
CLEVELAND, 706 New England Bldg.
MEXICO CITY, 7 Avenida Juarez.
HAVANA, CUBA, 116½ Calle de la Habana.

METAL LETTERS
FOR ELECTRIC SIGNS
Durable, Fireproof, Waterproof.

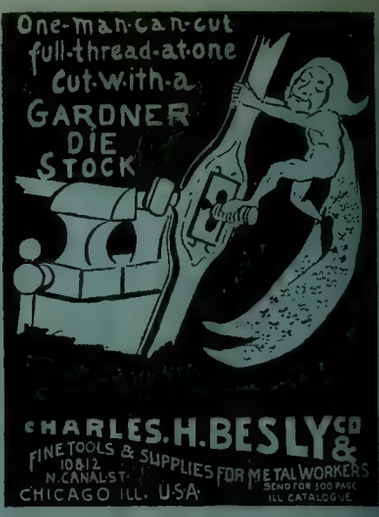
20 inches high. 6 lights to height of letter. Complete electric signs for indoor or outdoor display. Write for Bulletin No 3.
GOLTZ ENGINEERING CO.,
1502 Monadnock Block, CHICAGO.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



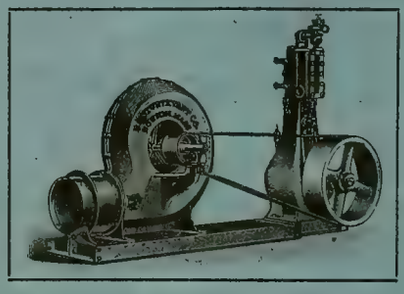
Reynolds Corliss Engine.

Sole Builders of.
REYNOLDS CORLISS ENGINES
For All Power Purposes
SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.



CHARLES H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
101&12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE

STURTEVANT
BLOWERS
ARE BUILT IN ENDLESS VARIETY



HIGH PRESSURE BLOWERS FOR

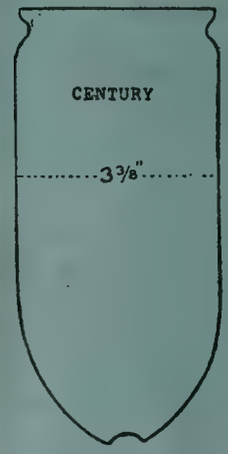
Cupola Furnaces and Forges are capable of producing pressures up to 16 ounces per square inch. The shells are of cast iron, the shafts of high-grade steel, carefully finished, and the wheels of thin galvanized steel mounted on extra strong arms and accurately balanced. The great length and special oiling features of the journal boxes render them practically non-heatable. They can be arranged on adjustable beds so that belts can be tightened while running.

B. F. STURTEVANT CO.
BOSTON, MASS.
New York Philadelphia Chicago London

HAZARD MANUFACTURING CO.
HIGH-GRADE RUBBER COVERED, WEATHERPROOF WIRES AND CABLES.
MAGNET, OFFICE, ANNUNCIATOR WIRE.
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa.
NEW YORK OFFICE, 80 Dey St.
CHICAGO OFFICE, 1201-2 Marquette Bldg

VULCANIZED FIBRE.
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.
HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

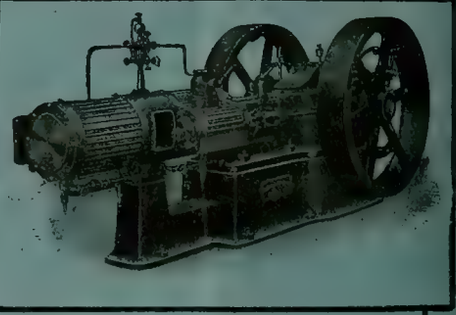


ALL STYLES OF
GLOBES AND SHADES
FOR ALL TYPES OF LAMPS.
WE ARE THE ONLY HOUSE IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.
WE CAN MAKE ANY STYLE YOU DESIRE.
WRITE FOR CATALOGUE.
THE CENTURY GLASS COMPANY, BELLAIRE, OHIO.

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO
HIGH SPEED ENGINES
FOR ELECTRIC LIGHT AND POWER SERVICE.



TYPES:
HORIZONTAL
VERTICAL
SIMPLE
COMPOUND.
SIMPLICITY OF DESIGN.
DURABILITY OF CONSTRUCTION.
HIGHEST STEAM ECONOMY.
CLOSE REGULATION.
BUFFALO FORGE COMPANY
BUFFALO, N. Y., U. S. A.

STREET RAILWAY CONVENTION REPORT NUMBER.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 11, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 15.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT. H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

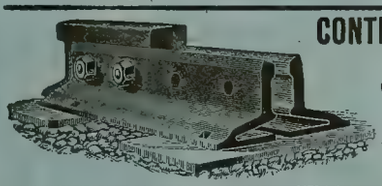
AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co. 152-156 Lake St.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 93 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.


CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.
3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50, $6, $8.50. Complete $12.50. Write for circular 16.
PARSELL & WEFD, 129-131 W. 31st Street, New York.
The FRANKLIN Model Shop

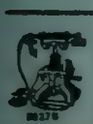
BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 60c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.


Ericsson's motto is, 'The recollection of quality remains long after the price is forgotten". We say this because we mean it. We have satisfied many and knowing we can satisfy you we want you to know it. We equip new and re-equip old exchanges.
ERICSSON
we have equipments for private houses, stables, factories and offices, for indoor and outdoor use.
ERICSSON TELEPHONE CO.,
296 BROADWAY, NEW YORK CITY.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
LONDON—Elliott Bros., No. 101 St. Martin's Lane.

Weston Standard Illuminated Dial Station Ammeter, Style B.
Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 86

ESTABLISHED 1878.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 95 Queen Victoria Street, London, England.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

Mention the Western Electrician, when writing for catalogues.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE

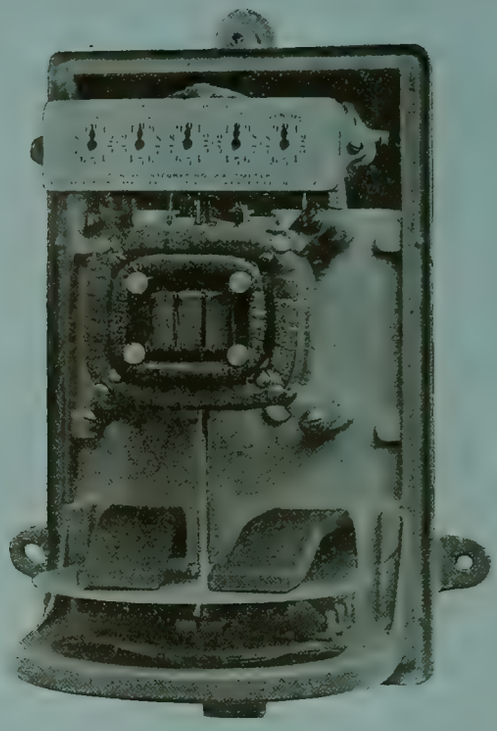
FOR DIRECT AND ALTERNATING CURRENTS

AN UP-TO-DATE METER

DESIGNED TO MEET THE REQUIREMENTS OF CENTRAL STATION PRACTICE

ACCURATE.

SENSITIVE.



DUST PROOF.

DIRECT READING.

Nonoxydizing Commutator and Brushes.
Permanent Magnets That Stay Permanent.
Armature Easily Removed for Inspection.
Spring Seated Jewel. Removable Spindle Point.
Large Dial With Circles in a Straight Line.

WRITE FOR PRICES

DUNCAN ELECTRIC MANUFACTURING CO.

LAFAYETTE, INDIANA, U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

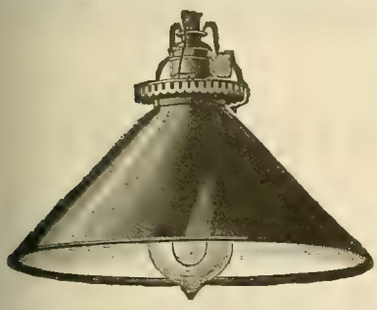
Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | BOSTON, 60 State Street. | BALTIMORE, Continental Trust Building. | DETROIT, Michigan Electric Company.

ST. LOUIS, Wainright Building. | NEW YORK, 100 Broadway. | CHICAGO, Marquette Building. | CLEVELAND, New England Building. | SAN FRANCISCO, Nevada Block. | HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

REFLECTORS!



Light is useless if you can't have it where you want it.

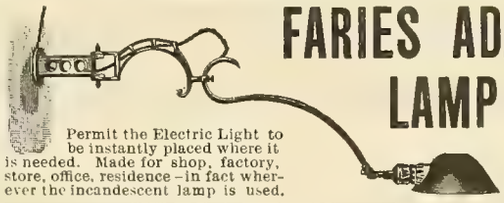
Paragon Reflectors throw the light **just where you want it.**

Our Incandescent Reflectors are neat and are superior to all others. They are green outside, glossy enamel white inside. Reflecting surface. Made in various styles and sizes. Get our catalog.

American Reflector & Lighting Co.,

271-273 FRANKLIN ST., CHICAGO.

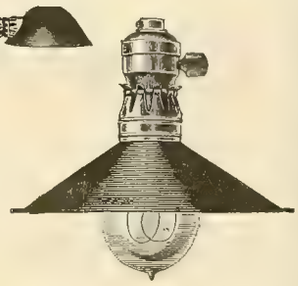
FARIES ADJUSTABLE LAMP HOLDERS



Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.

WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers. | Send for Catalogue No. 10, just issued.

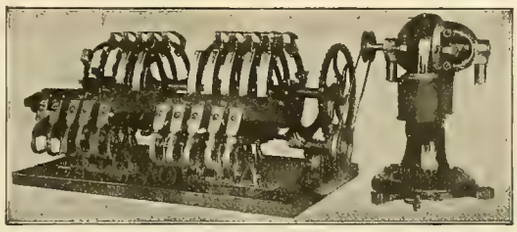


FARIES MFG. CO., DECATUR ILL.

EVERY CENTRAL STATION MANAGER SHOULD BECOME ACQUAINTED WITH OUR : : :

ELECTRIC SIGN FLASHERS

The most practical and simple device in the world for Flashing Electric Signs, Flags and all Electric Displays. We can convince every Central Station Manager, Electrical Contractor and Dealer that it's the greatest seller they ever handled.



Will increase the output of current, put your plant on a larger paying basis and open a new field of profit. Your customers will pay their current bills more willingly when using our flashers.

WRITE NOW FOR DETAILS.

Reynolds Electric Co. (Inc.)

221 Fifth Ave., CHICAGO, ILL.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. | New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.—
Akron Smoking Pipe Co. 1
Allen Company, L. B. 15
Allis-Chalmers Company. 28
American Battery Co. 15
American Creosote Works. 24
Amer. Electrical Heater Co. 28
Amer. El. Telephone Co. 21
American Electrical Works. 15
American Platinum Works. 15
American Refl. & Lighting Co. 3
Amer. Steel & Wire Company 1
Anderson & Sons, W. H. 24

Babcock & Wilcox Co. 23
Baker & Company. 3
Bario Vacuum Co. 14
Barnett Company, G. & H. 28
Barron & Co., J. S. 20
Bayley & Sons Co., W. 22
Beardslee Chandelier Mfg. Co.—
Beardsley Gravity Dam & Construction Co. 10
Berthoid & Jennings. 25
Besly & Co., Charles H. 28
Bonsall, Edward. 16
Bossert El. Construction Co. 28
Brooks, Hall D. 25
Brown & Leasure. 14
Buffalo Forge Co. 28

Camp Company, H. B. 6
Central Electric Co. 5
Central Manufacturing Co. 25
Central Telephone & El. Co. 20
Century Glass Co. 28
Chase-Shawmut Company. 15
Chicago & Alton Railroad. 26
C. & N. W. R. R. 22
Chicago Edison Company. 4, 16
Chic. Fuse Wire & Mfg. Co.—
Chicago Insulated Wire Co. 1
C., M. & St. P. R. R. 10
Chicago Pay Station Co. 20
Christensen Engineering Co 9
Columbia Telephone Mfg. Co.—
Consumers Carbon Co. 1
Continuous Rail Joint Company of America. 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company. 4
Cutler-Hammer Mfg. Co. 5
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company —
Dearborn Drug & Chem. Co. 22
Diamond Meter Company. 4
Dicke Tool Company.—
Dixon Crucible Co., Joseph. 22
Duncan Electric Mfg. Co. 2

Edison Decorative & Miniature Lamp Department. 14
Edison Mfg. Company. 26
Edwards & Company. 12
Electrical Engineer Institute.—
Electric Appliance Company. 14
Electric Storage Battery Co. 3
Electrician Pub. Company. 26
Ericsson Telephone Company 1

Faries Manufacturing Co. 3
Federal Electric Company.—
"For Sale" Advertisements. 16
Ft. Wayne Elec. Works., Inc. 27
Fowler, John H. 25
Franklin Eng. & Elec. Co.—
Fulmer Lumber Co., D. M. 25

General Electric Company. 10
General Incandescent Arc Light Company. 12
General Incand. Lamp Co.—
Goltz Engineering Co. 28
Great Western Smelting & Refining Company.—
Gregory Electric Company. 17

Hamblin & Russell Mfg. Co. 17
Hartford Steam Boiler Inspection & Insurance Co.—
Hazard Manufacturing Co.—
Helios-Upton Company. 5
Hobart Elec. Mfg. Company. 1
Hoffman, G. W. 16
Holcomb-Lobb Co. 25
Holmes Fibre-Graph. Co.—
Hopkins & Co., A. P. 25
Huebel Company, C. J. 24
Humphrey, Henry H. 14

Illinois Electrical Mfg. Co. 16
Illinois Electric Specialty Co. 20
Illinois Maintenance Co. 16
Incandescent Electric Light Manipulator Company.—
Indiana Rub. & Ins. W. Co. 1
India Rubber & Gutta Percha Insulating Company.—
Internat'l Corres. Schools.—
International Tel. Mfg. Co. 21

Jeffrey Manufacturing Co. 22
Johnston, Thomas J. 15

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company. 20, 25
Klein & Son, Mathias. 24
Kohler Brothers. 14
Kokomo Tel. & El. M. Co. 21

Leather Preserv. M. Corp. 10
Leffel & Co., James. 22
Lindsley Brothers Company. 25
Lowell Model Co.—

Machado & Roller.—
Maley, Martin.—
Maltby Lumber Company. 25
Manhattan Elec. Supply Co.—
Marinette Iron Wks. Mfg. Co. 22
Matthews & Bros., W. N. 15
Mayer, Geo. M. 15
McLennan & Company, K. 14
McNamara Brothers. 16
Medora Milling Company. 24
Metropolitan Tel. & El Co. 20
Mica Insulator Company.—
Miller Anchor Company. 14
Miscellaneous Advs. 16
Monarch Fire Appl. Co.—
Monon Railroad. 16
Moon Mfg. Co., The. 21
Morse Cedar Company. 25
Mott & Company, J. E. 16
Munsell & Co., Eugene. 14

National India Rubber Co.—
Naugle Tie Co., E. E. 24
New York Ins. Wire Co. 5
Norton Tool Company, The. 21

Okonite Company, The. 1, 8
Osburn Flexible Conduit Co 13

Paragon Fan & Motor Co.—
Parsell & Weed. 1
Perrizo & Sons. 25
Phillips, Eugene F. 15
Phillips Insulated Wire Co. 15
Phœnix Glass Company.—
Phosphor-Bronze S. Co. 23
Pignolet, L. M. 14
Pittsburg & L. S. Iron Co. 25
Porter Cedar Company. 25

Rauscher, John.—
Reisinger, Hugo.—
Reliance Electric Company. 22
Replogle Governor Works.—
Reynolds Electric Company. 3
Roche, Wm. 10
Roebling's Sons Co., J. A. 26
Rose Electric Company. 16
Sargent & Lundy.—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.—
Schott, W. H. 14
Schureman & Hayden. 16
Scientific Exchange. 16
Shelby Electric Company. 1
Simplex Electrical Co., The. 1
Simplex Elec. Heating Co. 14
Smith Co., S. Morgan. 23
Southern Pacific R. R.
Spies Electric Company. 1
Sprague Electric Company. 11
Standard Electric Company. 14
Standard Pole & Tie Co. 25
Standard Underg. Cable Co.—
Standard Varnish Works. 10
Standard Vitrified Cond. Co. 7
Stanley Instrument Co. 5
Station Equipment Co. 16
Steam & Elec'l Equipment Co. 16
Sterling & Son, W. C. 25
Sterling Electrical Mfg. Co. 15
Sterling Electric Company.—
Sterling Varnish Co., The. 1
Sterrett Pump Company. 22
Stilwell-Bierce & Smith-Vaile Company. 23
Stow Mfg. Company. 1
Stromberg-Carlson Tel. Mfg. Company. 21
Sturtevant Company, B. F. 28
Taylor Chemical Co. 18
Toerring Company, C. J. 14
Torrey Cedar Company. 25
Triumph Electric Co. 15

Union Lumber Company. 24
U. S. Electric Mfg. Co. 21

Valentine-Clark Co., The.—
Van Dorn-Elliott Elec. Co. 17
Vindex Electric Company.—
Vought-Berger Company. 17
Vreeland, B. F. 24

Vulcanized Fiber Company. 28

Wagner Electric Mfg. Co. 7
Walsh's Sons & Company. 16
Western Electric Company. 7
Western El. Supply Co. 19
Westinghouse Electric & Manufacturing Company. 26
Weston Electrical Inst. Co. 1
Whitehead Machinery Co. 16
Whitmore, A. E. 25
Wickes Bros. 16
Willyoung, Elmer G. 17
Wisconsin Central R. R. 22
Wittenberg Cedar Co. 25
Worcester Company, O. H. 25

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

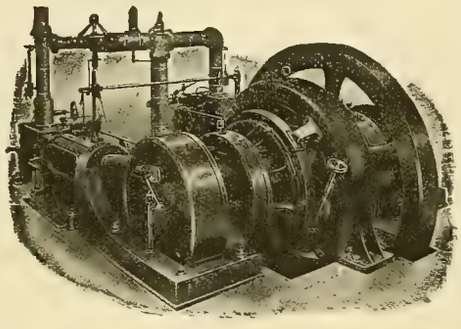
CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

Crocker-Wheeler Company.

ELECTRIC RAILWAY GENERATORS

That successfully conform to the exacting demands of this service.



Sparkless under sudden change of load,

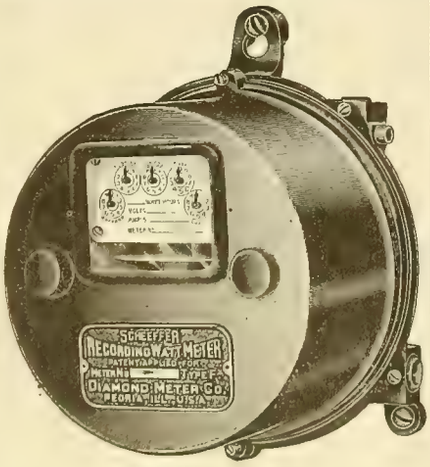
Cool in operation,

Carry heavy overloads easily,

And endure a continuance of hard service.

SALES OFFICES IN ALL LARGE CITIES.

Office and Works, - - - AMPERE, N. J.



METER WITH CASE.

SCHEEFFER
INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

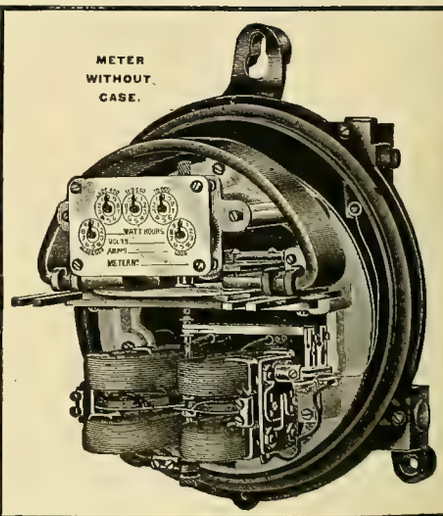
IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

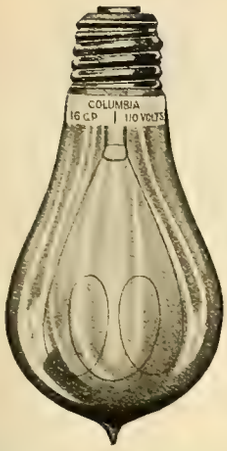
A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.



METER WITHOUT CASE.



COLUMBIA LAMPS

ARE MONEY SAVERS.

Uniform Candle Power
Highest Efficiency
Longest Life

No Need to Wait
Lamps Shipped
from Chicago Stock

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

FLOTATION IN AIR

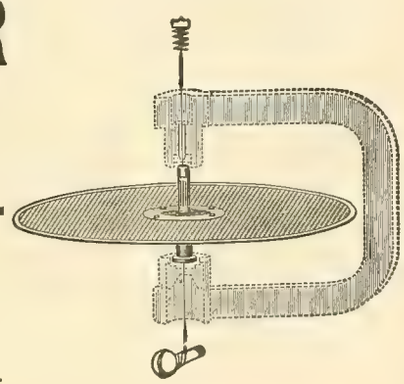
OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO FRICTION. NO LOST REVENUE. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.



SALES OFFICE,
158 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

INSTALLERS OF Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Miller Anchor Company.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Roche, Wm.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Babcock & Wilcox Co.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Wead.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
American Creosote Works.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.
Goltz Engineering Co.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Electric Specialty Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
Standard Electric Company.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
American Creosote Works.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Holcomb-Lobb Co.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Medora Milling Company.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Union Lumber Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.
Van Dorn-Elliott Elec. Co.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks.
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Helios Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

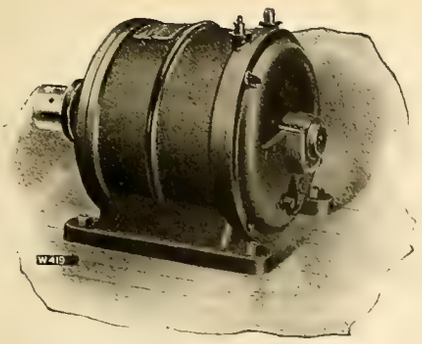
Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Baric Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.



TYPE "B" MOTOR CAN BE MOUNTED ON SIDEWALL OR HUNG INVERTED FROM CEILING.

REMEMBER

that by encouraging the use of our

Single Phase Self Starting A.C. Motors

on your circuits, you can materially increase your day load and consequently make your investment earn you

INCREASED DIVIDENDS.

If you are not acquainted with their many salient features, write us, *we will be pleased to point them out.*

WAGNER ELECTRIC MANUFACTURING COMPANY

ST. LOUIS, MO., U. S. A.

R. W. LYLE, President. B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Co.

VITRIFIED SALT GLAZED CONDUITS

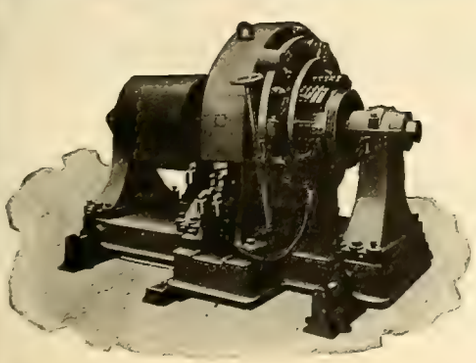
39=41 Cortlandt Street, NEW YORK.

Baltimore—United Traction Co. awards us contract 200,000 feet of conduit.

Richmond, Va.—Richmond Telephone Co. awards us 200,000 feet of conduit.

Atlanta, Ga., New Castle, Pa.. Perth Amboy, N. J., Trenton, N. J., many other cities.

LARGEST PLANT — BEST STOCK — SKILLED WORKMEN.



High Grade Apparatus

MOTORS—GENERATORS
ARC LAMPS—SWITCHBOARDS
GENERAL SUPPLIES

WRITE FOR CATALOGUES AND BULLETINS.

Western Electric Company

Chicago—Saint Louis Philadelphia—New York

Longevity and Amphibiousness

are two qualities most desired in

RUBBER INSULATION.

Okonite

The Standard for Rubber Insulation

COMBINES BOTH

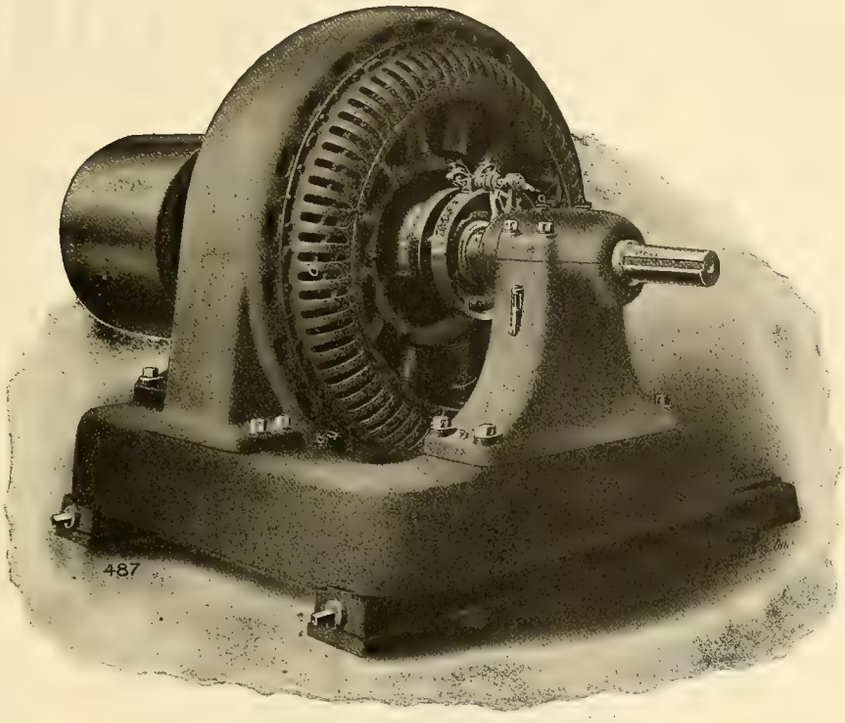
The Okonite Company, Ltd.,

253 Broadway,
NEW YORK.

"Ceco."

Electrical Machinery.

Direct and Alternating Current
For Lighting, Power and Railway Service.



250 K. W. Three-Phase "Ceco" Alternator.

"Ceco" apparatus is modern in design, accurate in construction and superior in performance. Our experience in manufacturing electrical apparatus is indicated by the fact that we have built

MORE THAN 6,500 MOTORS

FOR DIRECT CONNECTION TO OUR AIR COMPRESSORS USED WITH OUR AIR BRAKE EQUIPMENTS ON ELECTRIC CARS.

WRITE FOR CATALOGUE No. 27.

Christensen Engineering Company,

MILWAUKEE.

New Standard Specialties.

DRY CELL.

If kept out of the sun, in a cool dry place, this cell will not run down on the shelf in two years, and at the end of that time will be as good as other makes fresh from the factory. To maintain its superiority to all others, no expense is spared and only the best materials and chemicals are used in its manufacture.

This cell will save the consumer money, because a fewer number will perform a given amount of work four times as long as any other cell of equal size.

ELECTROMOTIVE FORCE 1.52 VOLTS.
CURRENT, - 14 TO 18 AMPERES.

..CATALOGUE FOR THE ASKING..

ELECTRIC FLASHLIGHT No. 1.

A RELIABLE LIGHT AT ALL TIMES.

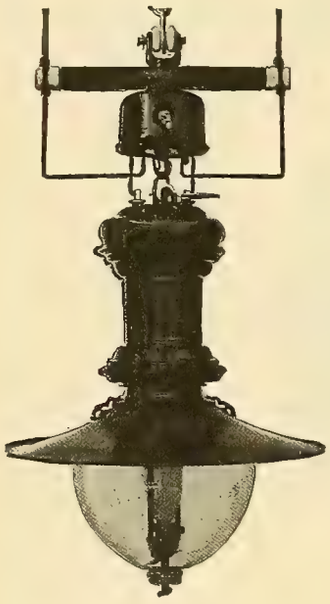
Patents Applied for in U. S., France and England.

SEND FOR CIRCULAR AND PRICES.

WILLIAM ROCHE,

No. 40 VESEY STREET, NEW YORK CITY.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.

FOR HIGH GRADE

INSULATING VARNISHES

ADDRESS

STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

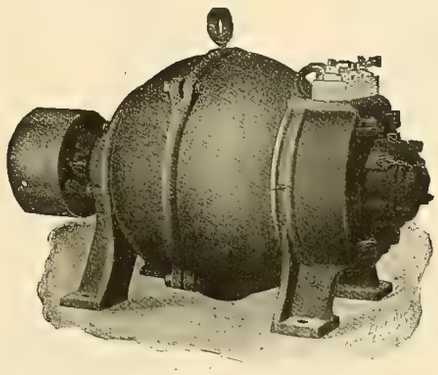
F. A. MILLER, General Passenger Agent, Chicago, Ill.

IRON ARMORED
CONDUIT

FLEXIBLE METALLIC
CONDUIT

DIRECT CURRENT ELECTRIC

MOTORS



THE SPRAGUE ELECTRIC COMPANY

for many years has been closely identified with the principal achievements in the design and construction of direct-current electric motors, and is recognized as an authority upon the installation of power plants. Long experience in this class of work has resulted in the accumulation of a vast amount of valuable data, thus enabling the Sprague Company to produce the very best possible results to the customer. The Sprague Electric Company's motors are unequaled for efficiency and durability. Write for bulletins Nos. 03206 and 03207.

SPRAGUE

ELECTRIC COMPANY

General Offices: 527-531 West 34th St., New York.

Branch Offices:

Chicago. Boston. St. Louis. Baltimore.

FLEXIBLE STEEL
ARMORED CONDUCTORS

STEEL ARMORED
FLEXIBLE CORD

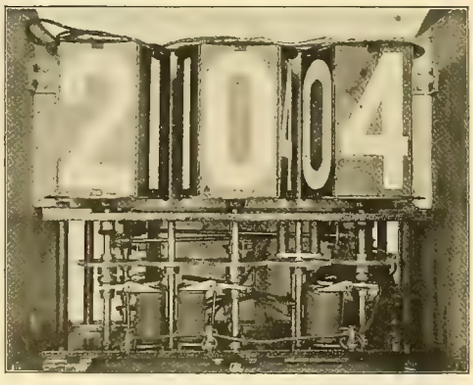
THE ELECTRIC CARRIAGE-CALL ANNUNCIATOR

Will Prove a Good Seller This Winter.

CALL COMPLETE FOR SERVICE.

It is designed to overcome the annoyance and delay which follows the old style plan of "calling" carriages after shopping, the theatre, opera or reception.

It is an absolutely perfect device. It can be depended upon always to work. It is most simple in operation.



INTERIOR VIEW OF CALL.

One illustration shows the annunciator in perspective, while the other shows the arrangement of gears and magnetic clutches.

They are giving satisfaction where now in use, and are easily installed.

Correspondence invited.

EDWARDS & CO.,

144th Street and Fourth Ave., - - NEW YORK.

G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I.

TRADE **G. I.** MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

THE

MOTORMAN'S GUIDE,

A PRACTICAL TREATISE

—ON—

Street Railway Motors;

—OR—

How to Become a Practical Motorman.

By J. W. GAYETTY.

Price, - - - - - - 50c.

CONTENTS.

1. Introduction. 2. Car wiring. 3. How to locate trouble in your car while on the road. 4. How to cut out a motor. 5. Information on "K" controllers. 6. How to locate trouble in a reversing switch and how to overcome it. 7. How to reverse a car in order to obtain best effects. 8. Points about motors that should be looked after closely. 9. Short circuits. What a short circuit means and how to locate it. 10. Information on incandescent light circuits. 11. Electric motor force, or how armature rotation is obtained. 12. How to increase the speed of a motor by changing two connections. 13. General information on Westinghouse motors. 14. Westinghouse fuse block. 15. Westinghouse lightning arresters. 16. Westinghouse lamp circuit. 17. Information on open circuits and sparking brushes. 18. Some questions you may be called upon to answer. 19. Points of interest to all. 20. Conclusion. 21. Diagram of car.

EXTRACT FROM INTRODUCTION.

"Recognizing the fact that not one motorman in twenty thoroughly understands his motors, I feel that I am giving them great value for their money, and at the same time furnishing them with the means of holding a position on any line they may be employed on. While serving as foreman in different car houses, the author has been able to gain a great many pointers that will come upon the examination of motormen and conductors, and having possessed these, together with my knowledge of electricity, I feel perfectly safe in stating that they cannot ask you any question that I have not honestly and correctly answered in this little book. If you wish to learn the value of this book, go to your electrician, or man in charge of your motors, and ask him for information, and then, and not until then, will you learn the true value of this book. It has always been understood by all electricians or foremen of car houses, that no information of any importance be given to any one outside of their class, and consequently most men running cars to-day are ignorant of their motors."

Send for Copy.

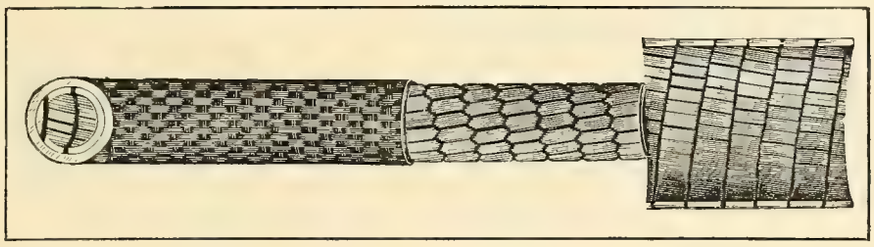
ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BLDG., CHICAGO.

FLEXDUCT

For Interior Wiring
The Superior Product

The interior of "Flexduct" remains intact under all circumstances because it is an inseparable part of the conduit.



Here are some of the advantages of "Flexduct."

The interior cannot be ripped out, because it is an inseparable part of the conduit—no possibility of ripping out the inside when installing wires too large for the conduit or when fishing wires through it.

With part of the interior of a conduit gone, and the insulating properties seriously impaired, the installation cannot possibly meet the requirements of first-class work.

When "Flexduct" is used, every foot is absolutely intact and uninjured.

"Flexduct" is positively moisture-proof—made so by closely weaving together a special fibre with a special warp and by treating the conduit with a special compound to fill up the pores.

Send for booklet—also a sample of "Flexduct," and carefully examine its smooth interior; its longitudinal interweaving; test its strength, and satisfy yourself that "Flexduct" is the best flexible conduit that has ever been manufactured for interior wiring.

Osburn Flexible Conduit Co.,

General Sales Offices, 21 Park Row, New York City.

TRY EXPERIMENTS

In what you will, but not in your incandescent lamps. *Packard* lamps have long been beyond any experimental stage. You can depend upon them. Made to meet the actual needs—practical, satisfactory. Our constantly growing list of large and small customers is evidence of this. We need one more name—yours.

ELECTRIC APPLIANCE COMPANY.

Electrical Supplies. CHICAGO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

INDIA MICA

We import directly from India and handle the output of the best mines. A large stock constantly on hand enables us to make prompt shipments. ALL OTHER QUALITIES. Prices low.

EUGENE MUNSELL & COMPANY,
NEW YORK AND CHICAGO.

ARC LAMPS

ARC LAMPS

The Light That Never Fails

Because the spools are guaranteed against burning out; the resistance cannot sag and short-circuit; the clutch is simple, reliable and well insulated, and the life is guaranteed over 200 hours.

Correspondence invited.

39 Cortlandt St. NEW YORK CITY.
C. J. TOERRING CO
19th & Allegheny Ave. PHILADELPHIA.

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

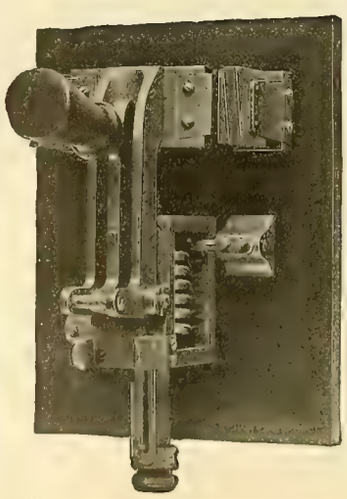
YOU NEED IT!

Gale's Commutator Compound.

The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen. Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., 909, 100 Sole Manufacturers, Washington Street, - CHICAGO.



CIRCUIT BREAKERS

THE ELDEN DIRECT AND ALTERNATING CURRENT.

COMPACT and SUBSTANTIAL.

PERFECT PROTECTION.
Oil and Air Break.

THE STANDARD ELECTRIC COMPANY,
CINCINNATI, - OHIO.

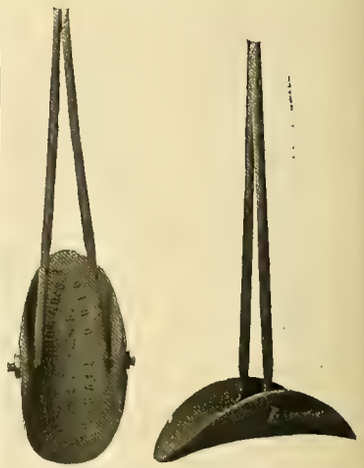
Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

THE MILLER ANCHOR.



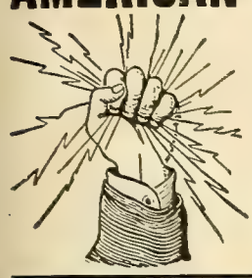
Write us for Prices on Anchors and Augers. All Sizes Made.

MILLER ANCHOR CO.
NORWALK, OHIO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. G. H. WAGENSEIL, Treasurer. G. R. REMINGTON, JR., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing.
Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1894. 171 S. Clinton St., Chicago, Ill.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

When you get our **STERLING** We send you lamps.
THE **Sterling Electrical Mfg. Co.** WARREN, OHIO.
We get your **STERLING** You send us coin.

FOR SAFE WIRING OF TERMINALS.

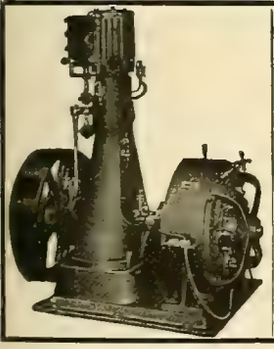
ENDORSED BY FIRE UNDERWRITERS.
Get THE ALLEN from your jobber.

THE ALLEN SOLDERING STICK.
Makes solder flow on any metal.
Is economical and safe.
Won't hurt your hands or tools.
L. B. Allen
This signature on a pink label protects you from expensive, unsafe imitations.
Write us for a sample.
L. B. ALLEN CO., Inc.,
1334 Columbia Ave., Chicago.

Designs for **PATENTS—WORKING DRAWINGS**
FOR SPECIAL AND AUTOMATIC MACHINERY.
Developing of **ELECTRICAL INVENTIONS** a Specialty.
GEO. M. MAYER, M. E., MONADNOCK BLK., CHICAGO, ILL.

Platinum

In Sheet or Wire for all Purposes
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS,
Formerly C. F. Croselmire
CHAS. ENGELHARD, Gen. Mgr.,
251 to 255 New Jersey R. R. Ave., Newark, N. J.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

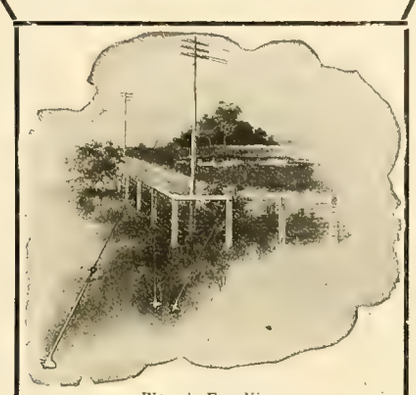
"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

STOMBAUGH GUYS
ARE USED
EXTENSIVELY
BY THESE
ELECTRIC RAILWAY COMPANIES:

W. N. MATTHEWS & BRO. DISTRIBUTORS


Worm's-Eye View.

SAINT LOUIS MO. SIUTE 603 CARLETON BUILDING.

Schenectady Railway Co.,
Schenectady, N.Y.
Amsterdam Street Railway Co.,
Amsterdam, N. Y.
Athens Electric Railway Co.,
Athens, Ga.
South Chicago City Railway Co.
Chicago, Ill.
St. Louis, Belleville and Suburban Railway Co,
East St. Louis, Ill.
Louisville, Anchorage and Pewee Valley Ry. Co,
Louisville, Ky.
Denver and Northwestern Railway Co,
Denver, Colo.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.
New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

An experienced central station steam heating man who is thoroughly up in business. State age, references, salary expected. Plant now under construction. City 25,000 population. Address H. D. FITCH, Bowling Green, Ky.

WANTED.

A thoroughly competent man, sober and industrious, to take charge of the light and water plant at Bethany, Mo. None but good men need apply. For particulars address CITY CLERK. Bethany, Mo.

WANTED.

Experienced telephone traveling salesmen; acquainted with Northwest trade preferred, but not essential.
THE VOUGHT-BERGER COMPANY,
Makers of Telephones and Switchboards,
La Crosse, Wis.

WANTED SALESMAN.

By a large Hard Rubber Manufacturer, to introduce and develop a Hard Rubber department. Must have good acquaintance with electrical trade and a knowledge of where hard rubber is used. Address BOX 122, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITIONS OPEN.

PER MONTH.

8 Draftsmen, Electrical.....$100
2 Draftsmen, Structural Steel.....$125
2 Draftsmen, Bridge ..... $75 up.
7 Armature Winders, must be gilt edge.....$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

SECOND-HAND
Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.
Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw,
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill. Mich.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.

Write for Catalogue B. Fair Haven, Vt.

FOR SALE.

Telephone exchange, 50 telephones; 30 miles toll line. Terms easy.
F. H. DAVIS,
La Crosse, Kansas.

FOR SALE.

An electric-light plant near Chicago. County seat town, located across line in Indiana. Plant on good paying basis, good city contract. Gross receipts last year $6,500. Price $10,000 cash. Owner's reason for selling, sickness. Full statement of plant given upon application. Address J. G. POMEROY, 309 Dearborn St., Chicago.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

NOTICE.

Sealed proposals will be received until November, 15, 1902, for the furnishing of one hundred arc lights to light the city of Baton Rouge. Specifications can be obtained by addressing EDWARD WAX, Secretary of the Water and Lighting Committee, Baton Rouge, La.

NOTICE.

Bids are invited until Oct. 20, on which date they will be opened at 501 Jackson Ave., Topeka, Kan., for furnishing material for the Council Grove Electric Light & Power Co. Specifications will be supplied on application. JOHN H. PACKER, Secy. and Gen. Mgr., Perry, Kan.

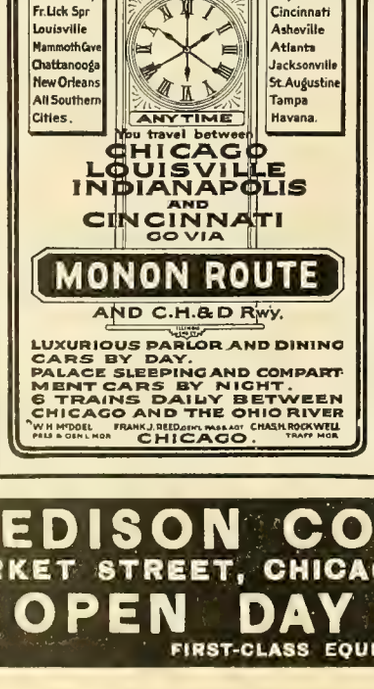
TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., September 29, 1902. Sealed proposals will be received at this office until 2 o'clock P. M., on the 4th day of November, 1902, and then opened for a conduit and electric wiring system for the U. S. Public Building at Cheyenne, Wyo., in accordance with drawings and specifications, copies of which may be obtained at this office, or at the office of the Superintendent of Construction, at Cheyenne, Wyo., at the discretion of the Supervising Architect, JAMES KNOX TAYLOR, Supervising Architect.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450
ROSE ELECTRIC CO., ST. LOUIS.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.



60-CYCLE ALTERNATORS.
2—75 K. W. 2,200 volts, 2-phase Westinghouse.
1—60 K. W. Westinghouse, 1,100 volts.
1—75 K. W. G. E., 3-phase, 2,300 volts.
1—250 K. W. G. E., 2,400 volts, 3-phase.
1—150 K. W. Westinghouse, 2,200 volts.

133-CYCLES.
3—120 K. W. G. E. Type A, 14—1,100 volts.
1—60 K. W. G. E. class A, 2,200 volts.
2—45 K. W. G. E. and Westinghouse, 1,100 volts.
4—60 K. W. Westinghouse, 1,100 volts.

D. C. GENERATORS.
1—240 K. W. Walker 250 volts.
1—100 K. W. G. E., 110 and 220 volts.
1—120 K. W. Eddy M. P., 110 volts.
4—100 K. W. G. E., 550 volts.

AUTOMATIC ENGINES.
2—15x25x14 Ball compound.

We have much fine machinery not listed. Write us your wants.

THE STEAM AND ELECTRICAL EQUIPMENT CO.,
Wood and Water Sts., Pittsburg, Pa.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

Electrical Machinery Bought, Sold and Exchanged. **REPAIRS** Switchboards Built to meet Specifications.
ILLINOIS ELECTRICAL MFG. CO.,
Lowest Prices. PEORIA, ILL. Write Us.

IMMEDIATE SHIPMENT

ENGINES.
34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
11¼x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-inch, 24-inch, 22-inch Double Leather Belts.

BOILERS.
One Geary Water Tube Boiler, 175 horsepower for 150 pounds pressure; almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 h. p. Berryman Heater.
600 h. p. Berryman Heater.
125 h. p. Berryman Heater.
500 h. p. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY CO.,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE.
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

STATION EQUIPMENT COMPANY,
539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—200 K. W. 60-cycle, two-phase Stanley alternators, 2,750 or 5,500 volts.
2—150 K. W. 60-cycle, three-phase Stanley alternators, 2,750 or 5,500 volts.
1—200 K. W., W. A. L. type, Ft. Wayne wood alternator, 133-cycle, three bearing, 1,100 or 2,200 volts, compound wound, complete with exciter.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K. W. Edison bi-polar railway generators.
2—100 K. W. Edison bi-polar railway generators.
4—100 K. W. Edison bi-polar 140 volt generators.
1—45 K. W. Edison bi-polar 140 volt generator.
2—30 K. W. Edison bi-polar 140 volt generators.
1—30 K. W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.
All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.
1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.
2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.
1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.
ILLINOIS MAINTENANCE COMPANY, E. H. CHENEY, Manager. 204 Dearborn St., CHICAGO.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

110-125 VOLT INCANDESCENT DYNAMOS.

1 16-Lt. Crocker-Wheeler.
2 16-Lt. Lundell.
1 20-Lt. Akron.
1 35-Lt. Westinghouse, multipolar.
1 50-Lt. Bernard.
1 50-Lt. Crocker-Wheeler.
1 50-Lt. New England, compound.
1 55-Lt. Bullock, multipolar, enclosed.
2 100-Lt. Northern, multipolar, comp.
1 110-Lt. Bain.
2 110-Lt. Edison, compound.
1 150-Lt. Jenney.
1 150-Lt. C. & C., compound.
1 160-Lt. Mather.
1 160-Lt. Commercial, compound.
1 180-Lt. Card, multipolar, compound.
1 200-Lt. Eddy.
1 200-Lt. Western Electric, compound.
2 210-Lt. Edison, compound, 12 K. W.
1 250 Lt. Commercial, compound.
1 250-Lt. Eddy, compound.
1 270-Lt. King, compound.
5 270-Lt. Edison, 15 K. W., compound.
1 270-Lt. Westinghouse, M. P., comp., 15 K. W.
1 270-Lt. C. & C.
2 300-Lt. Jenney.
1 300-Lt. Commercial.
1 350-Lt. C. & C., compound.
2 400-Lt. Westinghouse, M. P., 22½ K. W.
1 450-Lt. Rockford.
1 450-Lt. Commercial, comp., 25 K. W.
1 500-Lt. Jenney, compound, 30 K. W.
2 500-Lt. Siemens & Halske.
2 540-Lt. Edison, 30 K. W., compound.
3 540-Lt. Mather, compound.
1 800-Lt. Rockford.
1 800-Lt. Edison, 45 K. W., compound.
1 900-Lt. Jenney, compound.
2 1000-Lt. Edison, 60 K. W., compound.
1 1350-Lt. Wadell-Entz, 80 K. W.
1 1500-Lt. Keystone, M. P., compound.
1 1800-Lt. Triumph, M. P., compound.

220-250 VOLT GENERATORS.

1 8½ K. W. Edison.
1 10 K. W. El. Mach. Co., M. P., comp.
1 12 K. W. Edison.
1 12 K. W. Eddy.
1 12 K. W. Card.
1 15 K. W. Triumph, multipolar.
2 17½ K. W. Gen. Electric, M. P., comp.
1 20 K. W. Bullock, multipolar.
1 25 K. W. Triumph, multipolar.
1 25 K. W. C. & C., multipolar, comp.
1 30 K. W. Edison, compound.
1 125 K. W. Siemens & Halske, M. P.
3 75 K. W. Siemens & Halske, Churchward type, multipolar, brand new, for direct connection.
1 40 K. W. Northern M. P.
1 50 K. W. Northern M. P.

500-550 VOLT GENERATORS.

1 15 K. W. T.-H., D 15.
2 25 K. W. Bullock, multipolar.
1 30 K. W. Edison.
1 33 K. W. Wood, multipolar.
1 35 K. W. C. & C.
1 35 K. W. Bullock, multipolar.
5 45 K. W. Edison, compound.

ALL MACHINES IN STOCK AT OUR WAREHOUSE.

Large stock of Meters, Arc Lamps, Station Instruments and Supplies. All apparatus fully guaranteed in perfect operative condition. Send for Monthly Bargain Sheet with complete list and net prices.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

FOR SALE.

1 60 K. W. Edison, compound.
1 75 K. W. Akron, multipolar.
1 75 K. W. Bullock, multipolar.
2 90 K. W. Gen. Elec., M. P., 90, comp.

125-133 CYCLE ALTERNATING GENERATORS.

1 200-Lt. Ft. Wayne, 125 v., with exciter.
1 350-Lt. Slattery, 18 K. W., with exciter.
3 600-Lt. West'ghouse, 30 K. W., toothed armature, comp., with exciters.
3 600-Lt. General Electric, A 30, toothed armature, comp., with exciter.
3 650-Lt. Thomson-Houston, A 35, comp., with exciter.
4 650-Lt. Wood, 33 K. W., comp., toothed armature, with exciter.
1 750-Lt. Westinghouse, 37½ K. W., with exciter.
1 750-Lt. Brush, toothed armature, with exciter.
2 900-Lt. Westinghouse, 45 K. W., comp., toothed armt., with exciter.
3 1000-Lt. Wood, 50 K. W., toothed armt., compound, with exciter.
1 1200-Lt. Slattery, 60 K. W., new form B, slotted armature, distributed multicoil winding, latest type, with exciter.
3 1200 Lt. West'ghouse, 60 K. W., comp., toothed armature, with exciter.
6 1200-Lt. Gen. Electric, A 60, comp., toothed armature, with exciter.
1 1200-Lt. Stanley, inductor type, 60 K. W., either 1000 or 2000 volts, two-phase, with exciter.
2 1300-Lt. T.-H., A 70, comp, with exciter.
2 1500-Lt. Westinghouse, 75 K. W., with exciter.
2 1500-Lt. Wood, 75 K. W., comp., toothed armature, with exciter.
1 1800-Lt. Westinghouse, 90 K. W., comp., toothed armature, with exciter.
2 1800-Lt. Gen. Electric, 90 K. W., type A. S. 90, comp., slotted armature, with exciters.
1 1800-Lt. Standard, 90 K. W., inductor type, with exciter.
1 2000-Lt. Wood, 100 K. W., comp., toothed armature, with exciter.
12 2400-Lt. General Electric, 120 K. W., toothed armature, compound, with exciters.
1 2400-Lt. General Electric, 120 K. W., type A. S. comp., slotted armature, with exciter.
2 2400-Lt. West'ghouse, 120 K. W., comp., toothed armature, with exciter.
1 3000-Lt. General Electric, 150 K. W., monocyclic, toothed armature. comp., with exciter.
1 3000-Lt. Slattery, 150 K. W., three bearings, with exciter.
1 4000-Lt. Wood, 200 K. W., comp., toothed armature, three bearings, with exciter.
1 4000-Lt. Stanley inductor type, 200 K. W., 1100 or 2200 volts, two-phase, with exciter.
1 8000-Lt. West'ghouse, 400 K. W., slotted armature, three bearings, distributed windings, with exciter, extra fine.

60 CYCLE ALTERNATING GENERATORS.

1 300-Lt. Westinghouse, 15 K. W., comp., toothed armature, with exciter.
1 500-Lt. West'ghouse, 25 K. W., comp., toothed armature, with exciter.
1 900-Lt. West'ghouse, 45 K. W., comp., toothed armature, with exciter.
1 1200-Lt. 60 K. W., Siemens & Halske, Churchward type, brand new, multicoil distributed winding, slotted armature, with exciter.
1 1500-Lt. Warren-Medberry, 75 K. W., inductor type, with exciter.
1 Same as above, 2200 volts.
1 1500-Lt. Warren-Medberry, 75 K. W., two-phase inductor type, with exciter.
1 Same as above, 2200 volts.
2 1500-Lt. Westinghouse, 75 K. W., toothed armature, comp., with exciter.

220-250 VOLT MOTORS.

1 1 H. P. Jenney.
1 1 H. P. C. & C.
1 1 H. P. Northern, M. P.
1 1 H. P. Towle.
2 1 H. P. New England.
1 3 H. P. Thomson-Houston.
1 3 H. P. Sprague.
1 3 H. P. Thresher.
1 3 H. P. Mather, square top.
1 3½ H. P. Card, printing press motor, multipolar, direct connection.
1 4 H. P. Edison.
2 4 H. P. Lundell.
1 4 H. P. New England.
1 4 H. P. E. & C. multipolar.
1 5 H. P. Westinghouse, M. P.
1 7½ H. P. Waddell-Entz.
1 7½ H. P. Northern, multipolar.
1 7½ H. P. New England, multipolar.
1 10 H. P. Gen. Elec., M. P., type C. E.
1 10 H. P. Edison, 8½ K. W.
1 10 H. P. C. & C., M. P.
1 12 H. P. Elec. Mach. Co., multipolar.
1 12 H. P. T.-H., D 10, oil cups.
1 15 H. P. Rockford, iron clad.
1 15 H. P. Card.
1 15 H. P. Eddy.
1 15 H. P. Edison, 12 K. W.
2 20 H. P. Gen. Elec., M. P., type A.
1 20 H. P. Triumph, M. P.
1 25 H. P. Bullock, multipolar.
1 30 H. P. Triumph, M. P.
1 30 H. P. C. & C., multipolar.
1 35 H. P. Edison, 30 K. W.
1 60 H. P. Edison, 45 K. W.
1 50 H. P. Northern, M. P.
1 60 H. P. Northern, M. P.

500-550 VOLT MOTORS.

1 1 H. P. Lundell.
2 1 H. P. Detroit.
1 1 H. P. Crocker-Wheeler.
1 1 H. P. New England.
1 1 H. P. General Electric, type C. A.
1 1 H. P. Westinghouse, multipolar.
1 1½ H. P. Akron.
2 1½ H. P. Northern, M. P., series.
1 2 H. P. C. & C.
1 2 H. P. Thomson-Houston.
1 2 H. P. Wagner.
1 2 H. P. Westinghouse, M. P.
1 3 H. P. General Electric, type C. E.
1 3 H. P. New England.
2 3 H. P. Westinghouse, multipolar.
1 4 H. P. Perrett, M. P.
1 5 H. P. Detroit, oil cups.
1 5 H. P. Thomson-Houston.
1 5 H. P. Triumph, multipolar.
1 6 H. P. Mather, square top.
1 7½ H. P. Wood, new armature.
1 7½ H. P. Eddy.
1 7½ H. P. Excelsior, multipolar, Churchward type.
1 7½ H. P. General Electric, multipolar.
1 10 H. P. Eddy.
1 10 H. P. Edison.
1 10 H. P. Crocker-Wheeler, M. P.
2 10 H. P. General Electric, M. P., "C. E."

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

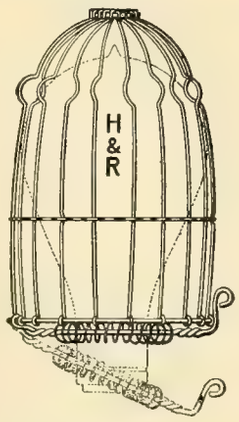
THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

No. 4.

"NEVER BREAK" ELECTRIC LIGHT GUARD.

SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely.

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

TEST INSTRUMENTS.

Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

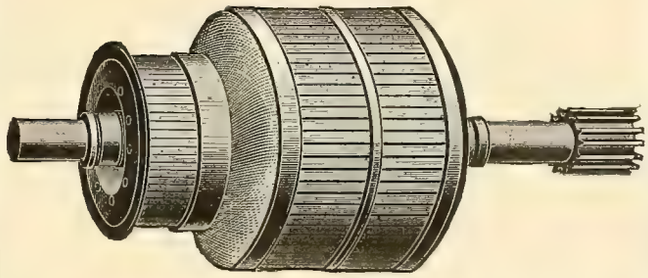
X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St.,
NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

THE VAN DORN-ELLIOTT ELECTRIC CO.

Manufacturers of



ARMATURE AND Field Coils,

COMMUTATORS, ETC.

Armatures, Transformers and Fields of all Types Rewound.

ALL OUR WORK GUARANTEED.

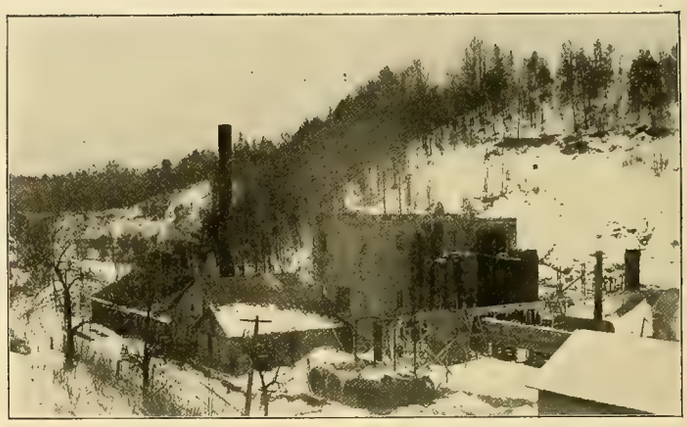
Cleveland, Ohio.

THE TAYLOR CHEMICAL CO.

PENN YAN, N. Y.

Capital Stock, - $500,000. Par Value, - -$10.00 Per Share.

Officers: Edward R. Taylor, Penn Yan, N. Y. Edward J. Hutchinson, Cincinnati, O., V.-Pres. C. A. Taylor, Penn Yan, N. Y., Sec. and Treas.



More than three million pounds of goods made by a new electrical process. Fully demonstrated and a complete success. Manufacture of many chemicals placed on an entirely new basis. Fully protected by patents. See Electrical World and Engineer of Dec. 21, 1901, page 1028; Electrical Review of Feb. 1st, 1902, pages 143-4-5, and Harpers Weekly, May 17, page 641. The U. S. Census Bulletin, No. 210, June 25th, page 58, says: "One of the most ingenious as also one of the most recent chemical applications of electricity." Good chance to get in on the ground floor of an industry that is sure to have a large future. Long established business. Present rate of production insures an 8 per cent. dividend from the start. Limited amount of stock for sale. For particulars apply to

EDWARD R. TAYLOR, Penn Yan, N. Y.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

JUST ISSUED.

MODERN ELECTRIC RAILWAY MOTORS.

BY GEO. T. HANCHETT, M. E.

FIRST PRACTICAL WORK ON RAILWAY MOTORS.

CONTENTS.—Chapter I.—Forms of Field Magnets. II.—Armature Winding Diagrams. III.—Field Coil Construction and Arrangement. IV.—Armature Construction. V.—Commutator and Brush Holder Construction. VI.—Motor Casings. VII.—Motor Suspensions. VIII.—Bearings and Gears. IX.—Lubrication. X.—General Dimensions and Data. XI.—Management and Repair. XII.—Railway Motor Design.

200 Pages. 157 Illustrations and Table. Price $2.00.

THIS is a book unique in its treatment of electric railway equipment. The first ten chapters are devoted to minute description of the details of electric railway motors that are in use to-day. Each organ of an electric railway motor is taken up in turn, described and illustrated by examples of present and past practice, and its operation explained in the light of practical experience. In short, the review of current practice is of such a nature as to bring out the reason why the electric railway motor is built as it is to-day. For example, field magnets of different types of motors are illustrated and compared, and their features of merit and faults pointed out. Armatures, armature windings, brush holders, suspensions and other details are similarly treated, each detail, however minute, being exhaustively considered. The last two chapters are devoted, one to the management and repair of electric railway motors, and the other to railway motor design, a complete design being worked out as an example. A table gives authoritative data of all types of railway motors in common use, both in America and Europe. **Sent postpaid on receipt of price.**

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**

The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**

The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1.25.**

A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.

This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.

The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.

The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.

The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

INCANDESCENT LAMPS.

WE have some bargains in Lamps.

No job lot, but a thoroughly high grade lamp that we are prepared to guarantee fully. We can make prices that will interest you. As you know, we are not in the habit of making rash statements. So write us to-day if you are in the market.

Western Electrical Supply Co.

ST. LOUIS, U. S A.

IF

There is any place on earth where a good telephone is needed it's in railroad work.

MORAL: Buy

KELLOGG

They have stood the test of the largest exchanges in the U. S.

With a private telephone system connecting your offices, car barn, repair shop, and a telephone at your right hand, you have every employe at your command. The value of this cannot be over-estimated.

In the past year over 72,380 Kellogg transmitters were put on the market, and out of that number only one purchaser expressed his dissatisfaction and asked for his money back. This speaks for the reliability of Kellogg apparatus.

No system too small for our careful consideration.

Lowest prices consistent with high qualities.

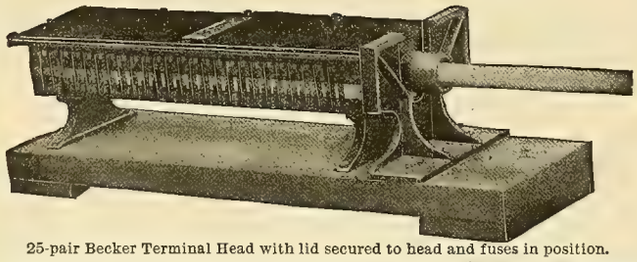
It might pay you to get our prices on CEDAR POLES. We are in a position to make prompt shipments and our prices are as low as the lowest, quality considered.

Kellogg Switchboard & Supply Co.

229 So. Green St., CHICAGO, Ill.

PROTECTION

THE BECKER TERMINAL HEAD.

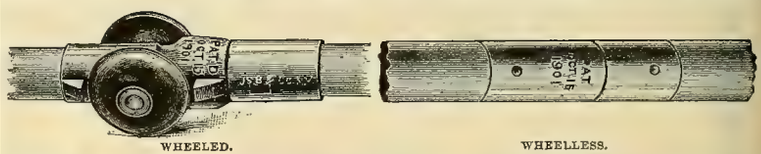


25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Chicago Office: 59 W. Jackson Boul. | Post-Glover Electric Co., Cincinnati Agents. | W. G. Nagel Electric Co., Toledo (O.) Agents.



WHEELED. WHEELESS.

Villard Automatic Wheeled and Wheelless Conduit Rods

Are Coupled and Uncoupled Instantly and with Ease.

Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed, and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa.
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

8th Edition Just Out. Price, 25c.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

AS SIMPLE AS ITS NAME.

A B C

—OF—

THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

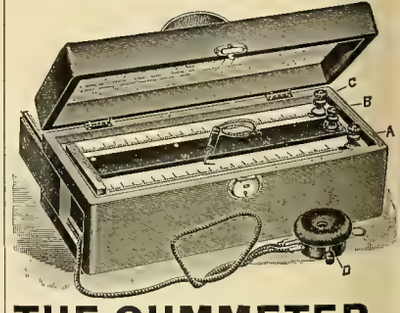
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

"YOU PRESS THE BUTTON,



THE OHMMETER DOES THE REST."

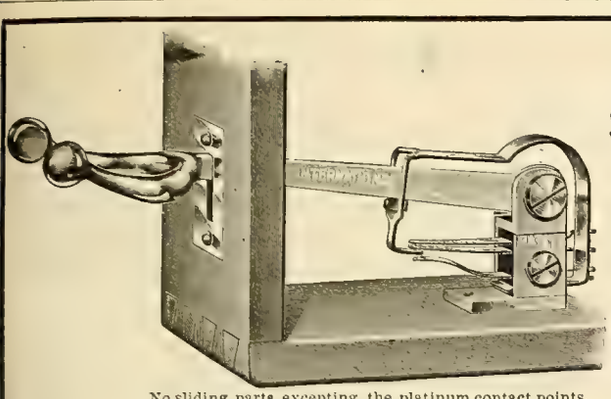
You can find your circuit troubles in a moment with our direct reading ohmmeter. Ask your supply house for it, or write for information to

ILLINOIS ELECTRIC SPECIALTY COMP'Y,
TACOMA BUILDING, CHICAGO.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

TELEPHONE AND TELEGRAPH CONSTRUCTION SPECIALTIES.

Before attachment.

PATENTED GALVANIZED STEEL CABLE HANGER.

Note Beautiful Mechanical Simplicity.

SEND FOR SAMPLE.

In place on cable.

11¼-inch "Spread," points up or down.

These Pole Brackets forged from ¾ and ⅝ round iron; punched for ⅜ bolts with forge finish.

20-inch "Spread," points up or down.

Correspond with us. We have good specialties and UP-TO-DATE. Tell us what you want.
Corner Brackets, Guy Shims and Special forgings Made to order.

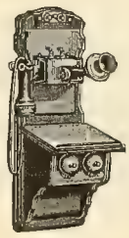
THE NORTON TOOL CO., West Park, O.

IMPROVED TELEPHONE APPARATUS.

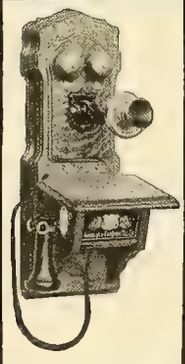
EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS



STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

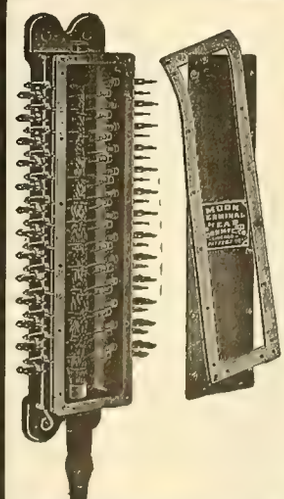
AMERICAN

CENTRAL ENERGY **TELEPHONES** GENERATOR CALL

ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.

39 JACKSON BLVD., CHICAGO



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

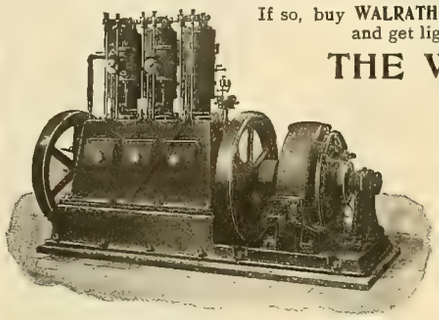
MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

DIVIDENDS

FROM SAVING REPAIR BILLS
BY USING
DEARBORN VEGETABLE BOILER COMPOUNDS
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

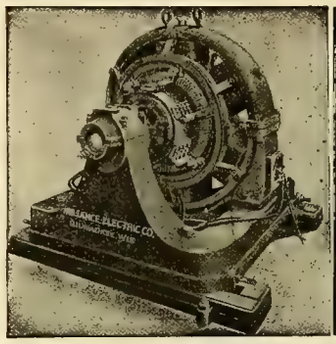
pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,
NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION MACHINERY FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.



"RELIANCE"
GENERATORS AND MOTORS.
SEND FOR BULLETIN.
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,

On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

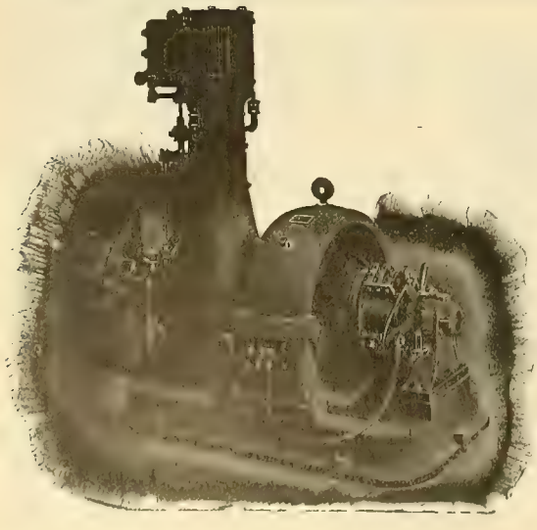
Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



HIGH-GRADE
ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

The Best of Everything

THE NORTH-WESTERN LINE

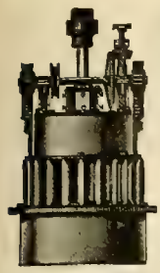
THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.

S. MORGAN SMITH CO., York, Pa.

REG. TRADE MARKS

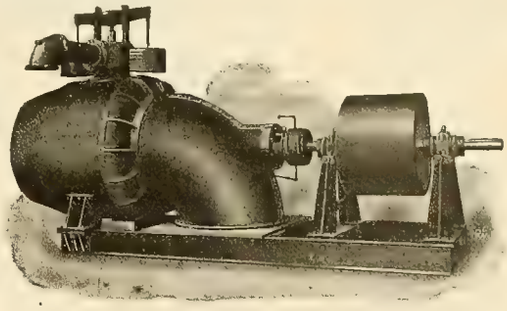
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS.
ORIGINAL AND SOLE MAKERS IN THE U.S.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



WE MAKE A SPECIALTY ALSO OF

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

IF INTERESTED ADDRESS

THE STILWELL-BIERCE & SMITH-VAILE CO.,

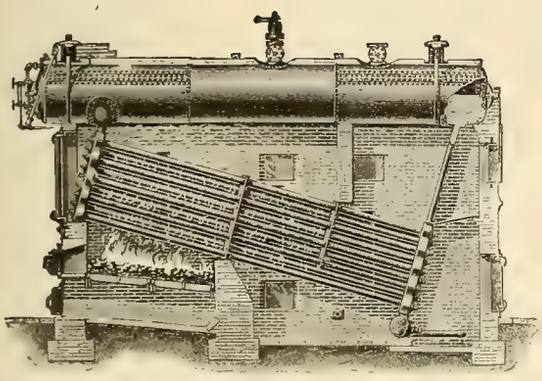
DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver St.
NEW ORLEANS, 304 Hennen Bldg.
PHILADELPHIA, 612 Arch St.
CHICAGO, 311 Dearborn St.
LONDON, E.C., 97 Queen Victoria St.
BALTIMORE, 1507 Continental Trust Bldg.
CLEVELAND, 1116 New England Bldg.

E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

ONE MILLION HORSEPOWER

—OF—



Babcock & Wilcox Boilers

ARE IN DAILY USE IN

ELECTRICAL GENERATING PLANTS.

They are used in a greater percentage of

THE WORLD'S BEST POWER PLANTS

than any other single detail of steam machinery of any one make.

SEND FOR OUR BOOK "STEAM."

BRANCH OFFICES:

BOSTON, 35 Federal Street.
PHILADELPHIA, 1110-1112 North Am. Bldg.
SAN FRANCISCO, 32 First Street.
PITTSBURGH, 1218 Frick Building.
NEW ORLEANS, 339 Carondelet Street.

The Babcock & Wilcox Co.,

85 Liberty St., NEW YORK.

BRANCH OFFICES:

CHICAGO, 1215 Marquette Bldg.
ATLANTA, GA., 817 Equitable Bldg.
CLEVELAND, 706 New England Bldg.
MEXICO CITY, 7 Avenida Juarez.
HAVANA, CUBA, 116½ Calle de la Habana.

CEDAR POLES AND TIES
WRITE FOR PRICES
E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

POLES! REDWOOD AND PINE TIES!
We make a specialty of
SAWN REDWOOD POLES.
REDWOOD TIES FOR SLEEPERS.
UNION LUMBER CO.,
CROCKER BLDG., SAN FRANCISCO, CAL.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

WESTERN CEDAR POLES
LOW PRICES.
Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

AMERICAN CREOSOTE WORKS, NEW ORLEANS LA.
ROUND AND SAWN TELEGRAPH POLES,
CROSS-ARMS, CROSS-TIES, CONDUITS.
Write for catalogue, with U. S. Agricultural Dept. reports on durability, showing life of over thirty years a certainty. The newest and most modern plant in the country.
CAPACITY, 18,000,000 FEET B. M. PER ANNUM.

DON'T FORGET US
if you need
CHESTNUT POLES
For TELEPHONE, ELECTRIC LIGHT or STREET RAILWAY Purposes.
Large Assortment.
The Medora Milling Co.,
MEDORA, IND.

READ THE BLUE ELECTRICAL PAPER.

The Telephone Hand Book,
New Dynamo Tenders' Hand Book,
Bell Hangers' Hand Book,
Incandescent Wiring Hand Book,
Electric Transmission Hand Book
Comprise the famous Western Electrician Hand Book Series.
Price, by mail, postage prepaid,
$1 A VOLUME.
Electrician Publishing Co.,
510 Marquette Building, Chicago.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

STOCK ——— BIGGEST EVER.
SHIPPING FACILITIES — NEVER BETTER.
GRADING ——— CAREFUL AS WE CAN BE.
PRICES ——— OUR STRONG POINT.

MALTBY LUMBER CO., BAY CITY, MICH.
"THE POLE AND TIE MEN."

MIXED CARS.

We Can Load Mixed Cars of

TELEPHONE POLES, CEDAR SHINGLES AND POSTS

Choice Stocks, Right Prices. Write us at once and tell us just what you require.

THE MORSE CEDAR CO., - Saginaw, Michigan.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

THE HOLCOMB-LOBB COMPANY
CEDAR POLES & POSTS
745 MARQUETTE BLDG. CHICAGO ILL.

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.
Large Stock Constantly on Hand.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES OF ALL LENGTHS AND SIZES.

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1708-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES.

HALL L. BROOKS,
TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS.

THE PORTER CEDAR CO.,
SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.

POLES

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

TIES.

CEDAR POLES STREET RY. TIES PERRIZO TOWNS DAGGETT MICH.

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

SOUTHERN White Cedar Poles

THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

The

Westinghouse

Integrating

Wattmeter

has a fine jewel movement, frictionless connecting train, and a moving element very much lighter than that of any other meter. The result is a high-grade instrument of precision, which *accurately records the lightest of loads* independent of power-factor, frequency, temperature, wave-form, etc.

FOR ILLUSTRATED BOOKLET ADDRESS NEAREST SALES OFFICE OF THE

Westinghouse Electric

and Manufacturing Co., Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

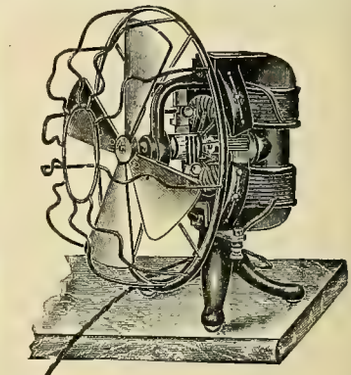
The book for those interested in telephony.

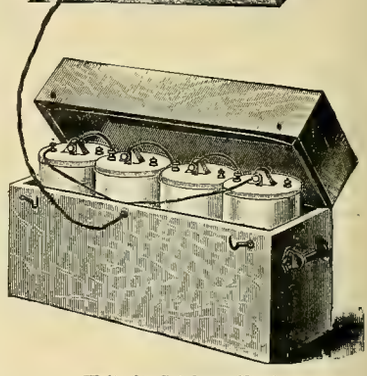
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



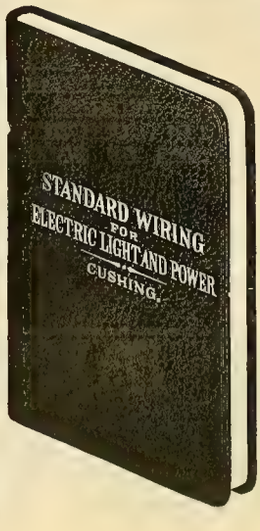


Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

"The Recognized Authority on Wiring and Construction."



The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

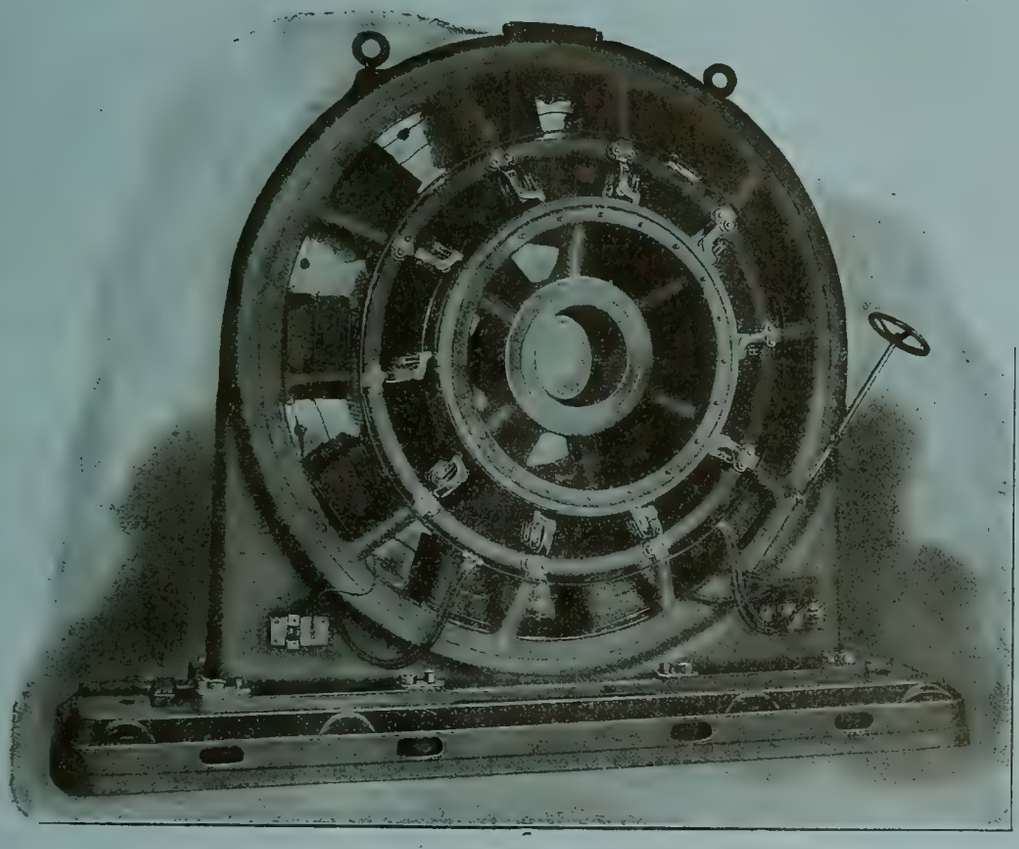
Flexible Leather Cover (pocket size), $1.00.

Sent post paid upon receipt of price, by

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO, ILL.

RAILWAY GENERATORS.

575 VOLTS.
DIRECT CONNECTED.
LAMINATED POLES.
VERTICAL SPLIT FRAME.
STANDARD SIZES. 100 to 800 K. W.



TYPE MPL 10-400-120 DIRECT CONNECTED GENERATOR—VERTICAL SPLIT FRAME.

LITERATURE.

Bulletin 1024—Type MPL Direct Connected Generators.
Bulletin 1025—Direct Current Belted Generators.

Send postal to nearest office.

Fort Wayne Electric Works,

Main Office and Factory: Fort Wayne, Indiana.

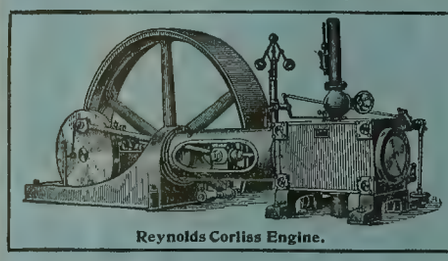
BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
New York, N. Y., 40 New St.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
Yokohama, Japan, Bagnall & Hilles.

METAL LETTERS
FOR ELECTRIC SIGNS
Durable, Fireproof, Waterproof.

20 inches high. 6 lights to height of letter
Complete electric signs for indoor or outdoor display. Write for Bulletin No. 3.
GOLTZ ENGINEERING CO.,
1502 Monadnock Block, CHICAGO.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes
SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

HELMET BRONZE WIRE

comes tempered ready for use
CHARLES H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
108-12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL. CATALOGUE

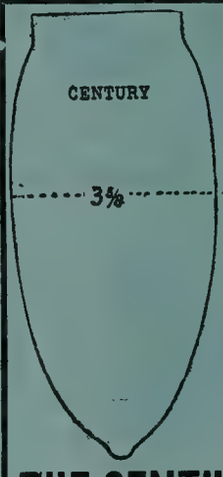
VULCANIZED FIBRE.
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

DON'T BUILD A CHIMNEY

USE MECHANICAL DRAFT
IT COSTS FAR LESS
Is independent of weather. The fan is positive in action. Responds instantly to sudden demands for more steam. Burns cheap fuel. Costs practically nothing for operation when exhaust steam is utilized
142
B. F. STURTEVANT Co BOSTON, MASS.
NEW YORK - PHILADELPHIA - CHICAGO - LONDON

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances.
Write for catalogue. 195-197 River St. DETROIT MICH

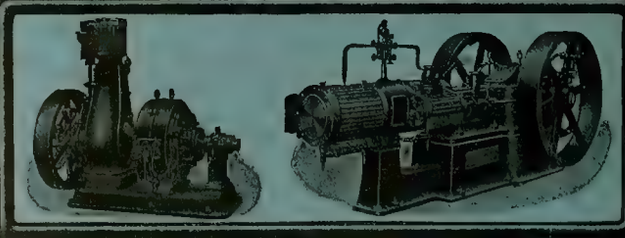


WE CAN PLEASE YOU
IN THE LINE OF
ELECTRICAL GLASSWARE
AND ARE PREPARED TO FURNISH YOU WITH GLOBES OR SHADES FOR ALL TYPES OF LAMPS.
OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.
WRITE FOR CATALOGUE.
THE CENTURY GLASS CO., BELLAIRE, OHIO.

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES
SIMPLE COMPOUND FOR ELECTRIC LIGHT AND POWER SERVICE VERTICAL HORIZONTAL
SEE NEW CATALOGUE



BUFFALO FORGE COMPANY
NEW YORK PHILADELPHIA BUFFALO, N.Y. CHICAGO PITTSBURG

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 18, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 16.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

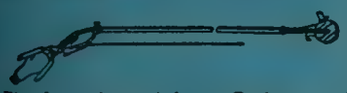
OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, / Managers. N. Durant Cheever, /
253 Broadway, New York.
Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office. 63 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

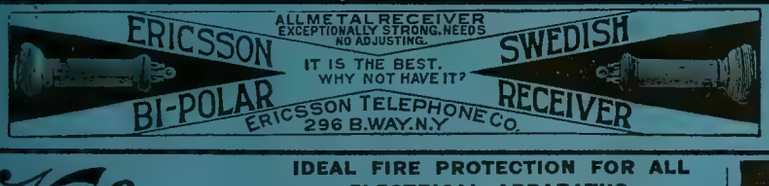

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

BARE AND INSUBATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book, "Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburgh. New York. Chicago.



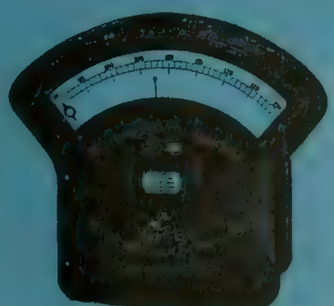
ERICSSON SWITCHBOARDS
Of all sizes. Telephones for all uses. Write for particulars and tell your needs.
ERICSSON TELEPHONE CO.,
296 Broadway, NEW YORK.

Kilfyre DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN.—European Weston Electrical Instrument Co., Ritterstrasse No. 58.


Weston Standard Illuminated Dial Potential Indicator, Style B. "Flush Type."

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON.—Elliott Bros., No. 101 St. Martins Lane.

7"
CENTURY
WESTERN ELECTRIC COMPANY
STYLE "M."
18"
WE CAN PLEASE YOU IN THE LINE OF
ELECTRICAL GLASSWARE
and are Prepared to Furnish you with Globes or Shades for all Types of Lamps.
OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.
WRITE FOR CATALOGUE.
THE CENTURY GLASS CO., BELLAIRE, OHIO.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE

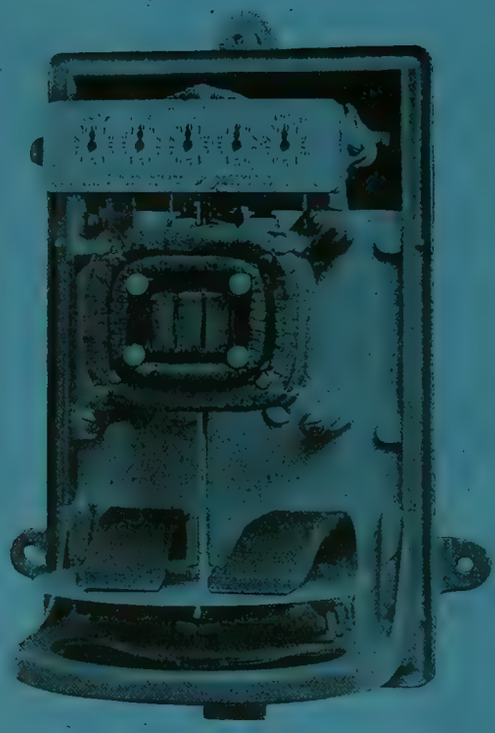
FOR DIRECT AND ALTERNATING CURRENTS

AN UP-TO-DATE METER

DESIGNED TO MEET THE REQUIREMENTS OF CENTRAL STATION PRACTICE

ACCURATE.

SENSITIVE.



DUST PROOF.

DIRECT READING.

Nonoxydizing Commutator and Brushes.
Permanent Magnets That Stay Permanent.
Armature Easily Removed for Inspection.
Spring Seated Jewel. Removable Spindle Point.
Large Dial With Circles in a Straight Line.

WRITE FOR PRICES

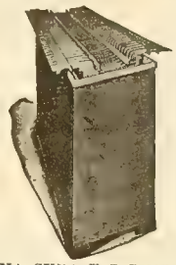
DUNCAN ELECTRIC MANUFACTURING CO.

LAFAYETTE, INDIANA, U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"



For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

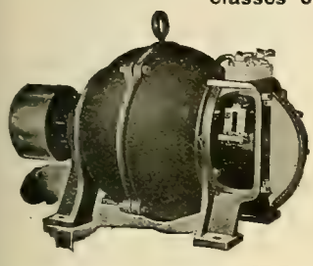
PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 84 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

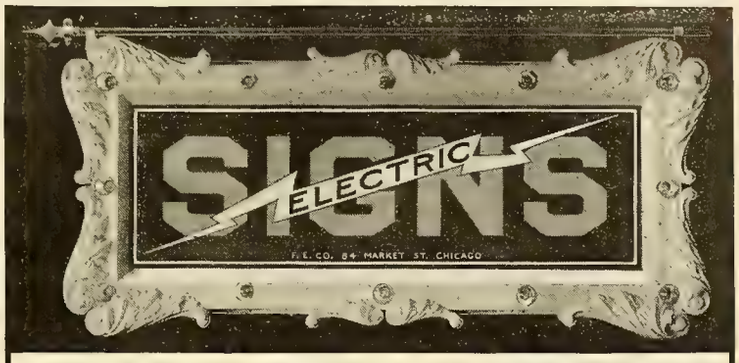
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
Allen Company, L. B.....11
Allis-Chalmers Company....20
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refl. & Lighting Co.20
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17

Baker & Company..... 3
Bario Vacuum Co.....10
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg. Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 11
Bossert El. Construction Co.. 1
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co....—
Central Telephone & El. Co..—
Century Glass Co..... 1
Chase-Shawmut Company....11
Chicago & Alton Railroad.... 8
C. & N. W. R. R.....13
Chicago Edison Company..4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago Insulated Wire Co..—
C., M. & St. P. R. R.....13
Chicago Pay Station Co.....14
Christensen Engineering. Co 9
Columbia Telephone Mfg. Co.14
Consumers Carbon Co..... 8
Continuous Rail Joint Company of America..... 8
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 4
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 8
Diamond Meter Company ...—
Dicke Tool Company.....16
Dixon Crucible Co., Joseph..16
Duncan Electric Mfg. Co.... 2

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 4
Edwards & Company..... 7
Electrical Engineer Institute. 1
Electric Appliance Company.10
Electric Storage Battery Co.. 8
Electrician Pub. Company...19
Ericsson Telephone Company 1

Faries Manufacturing Co....—
Federal Electric Company... 3
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company..... 7
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company...12

Hamblin & Russell Mfg. Co.. 7
Hartford Steam Boiler Inspection & Insurance Co...16
Hazard Manufacturing Co....20
Helios-Upton Company..... 4
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holmes Fibre Graph. Co..... 7
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electrical Mfg. Co...12
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 8
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..14

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....13

Leather Preserv. M. Corp....—
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... 13

Machado & Roller..... 4
Maley, Martin.....11
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.19
Matthews & Bros., W. N.....11
Mayer, Geo. M.....11
McLennan & Company, K....10
McNamara Brothers 11
Metropolitan Tel. & El Co...14
Mica Insulator Company.....10
Miller Anchor Company 10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 4
Munsell & Co., Eugene.....—

National India Rubber Co.... 1
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 8
Norton Tool Company, The..15

Okonite Company, The..... 1
Osburn Flexible Conduit Co —

Paragon Fan & Motor Co.....—
Parsell & Weed.....11
Perrizo & Sons.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co.....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo..... 7
Reliance Electric Company..18
Replogle Governor Works.. .16
Reynolds Electric Company.—
Roebling's Sons Co., J. A.....18
Rose Electric Company 12

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 12
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan.....16
Southern Pacific R. R.....13
Spies Electric Company..... 8
Sprague Electric Company... 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 5
Station Equipment Co.....12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co..11
Sterling Electric Company...14
Sterling Varnish Co., The....10
Sterrett Pump Company.....19
Stilwell-Bierce & Smith-Vaile Company.....13
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F....20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co.....10

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....17
Vindex Electric Company....11
Vought-Berger Company 8
Vreeland, B. F. 16
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 8
Wittenberg Cedar Co.....16
Worcester Company, C. H....17

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

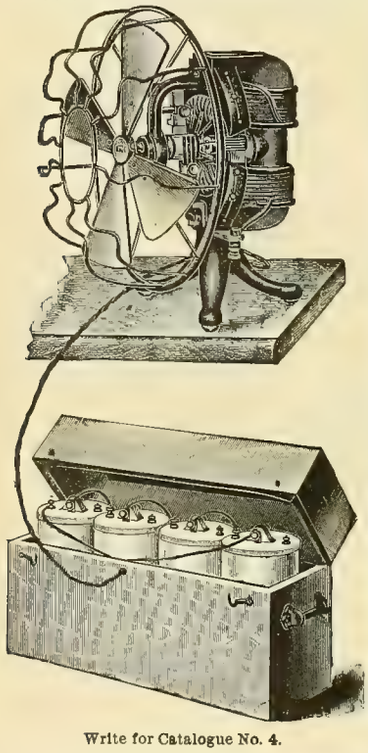
G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



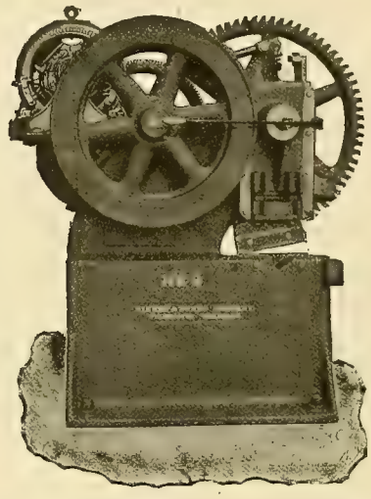
Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

CROCKER-WHEELER COMPANY,

OFFICE AND WORKS, AMPERE, N. J.



MOTOR DRIVEN MACHINES

Save on the average 40% of the power required by other methods.

AN INSTRUMENT FOR ISOLATED PLANT WORK.

Diameter of Base Flange, 7½ inches.

LIST PRICE $16.50.

This popular type of WHITNEY instrument has a polished all brass case and a permanent magnet movement giving equally divided scales and dead beat indications. The ammeters of large capacity are supplied with separate shunts.

Send for complete price list and our attractive discounts to

ELECTRIC APPLIANCE CO., Chicago, Ill.
WESTERN ELEC'L SUPPLY CO., St. Louis, Mo.
ELECTRICAL ENGINEERING CO., Minneapolis.
STANDARD ELECTRIC CO., Cincinnati, O.
OR
MACHADO & ROLLER, New York, N.Y.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

D. & W. CARTRIDGE FUSES

BEFORE BLOWING.

AFTER BLOWING.

HAVE INDICATING BULL'S EYE.

This indicator far surpasses any upon the market, as there is no wire upon the outside to cause a flash in blowing or to become broken in handling. Before blowing, the circle upon the label is clear, as you see in the accompanying cut, but when the fuse blows, the center of the circle becomes black.

A FULL SET OF BULLETINS DESCRIBING D. & W. SAFETY DEVICES SENT ON REQUEST

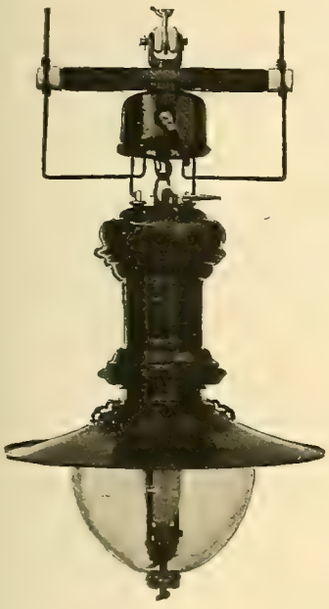
OKONITE TRADE MARK.

Central Electric Company, 264-266-268-270 Fifth Ave., CHICAGO.

GENERAL WESTERN AGENTS.

OKONITE TRADE MARK.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.

ELECTRICITY FOR ENGINEERS.

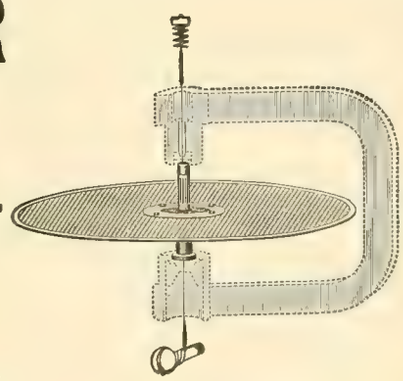
424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building, - - CHICAGO.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR **ALTERNATING CURRENT**
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.



NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

STANLEY INSTRUMENT CO., GREAT BARRINGTON, MASS., U. S. A.

SALES OFFICE,
158 BROADWAY,
NEW YORK CITY, N. Y.

PACIFIC COAST AGENTS,
JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Miller Anchor Company.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Norton Tool Company, The.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec. Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks.
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Columbia Telephone Mfg. Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Dicke Tool Company.
Klein & Son, Mathias.
Norton Tool Company, The.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Electric Company.

Wire, Bare.
American Steel & Wire Co.
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

There are no Carbons better than the "Electra" and none "just as good."

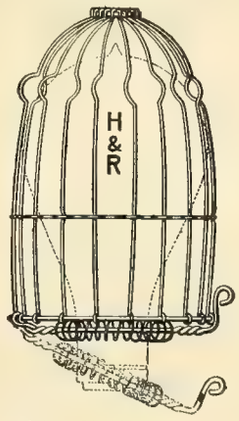
G.I.

TRADE G. I. MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely.

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

EDWARDS AND CO.

DOOR SWITCH
(The Langen).

Porcelain Insulation.
Wire Connections in Front.

Style A—Lights when door is open; out when door is closed.

Style B—Lights when door is closed; out when door is open.

THE ECO DOOR SWITCH OPERATES LIGHTS "EVERY OTHER TIME."

Approved by the National Board of Underwriters.

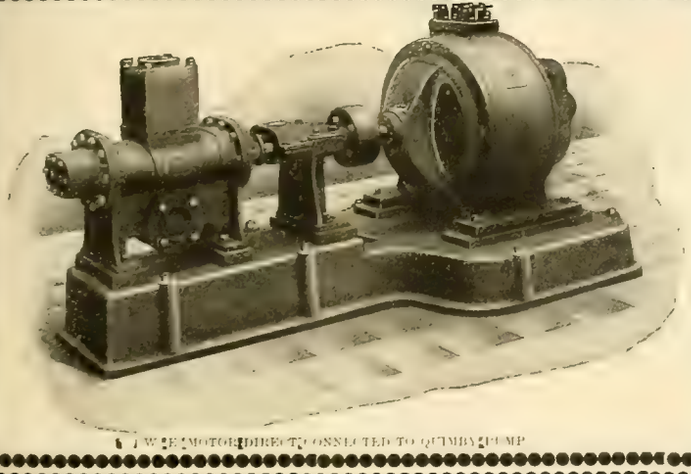
NEW YORK, N.Y.

FIBRE-GRAPHITE COMMUTATOR BRUSH
SELF-LUBRICATING NOISELESS

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.



1 KW. SE MOTOR DIRECT CONNECTED TO QUIMBY PUMP

Power Motors

ADAPTED FOR DIRECT CONNECTION
—TO—
PRINTING PRESSES, MACHINE TOOLS,
SEWING MACHINES, EXHAUST FANS, PUMPS, ETC.

Write for Power Motor Catalog.

Western Electric Company,
Chicago. Saint Louis. Philadelphia. New York.

PROTECTION

IS NECESSARY IF YOU WANT SOUND BOILERS USE

DEARBORN VEGETABLE BOILER COMPOUNDS

MADE TO SUIT THE WATER AS PER ANALYSIS, AND IS THE BEST PROTECTION KNOWN.

DEARBORN DRUG & CHEMICAL WORKS.

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

AMERICA'S MOST POPULAR RAILWAY

CHICAGO AND ALTON

PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON

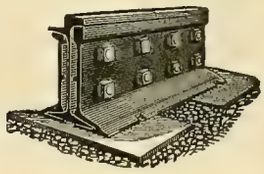
IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING,
NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



CARBONS

CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table, 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)

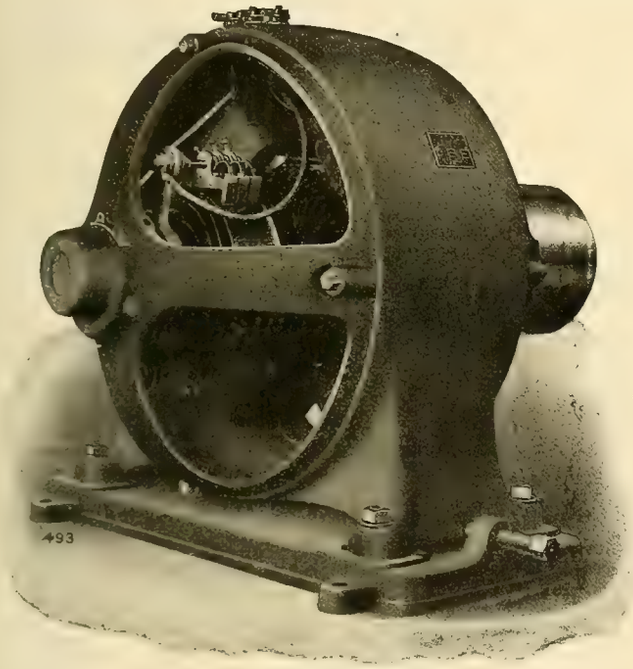
"Ceco."

Electrical Machinery.

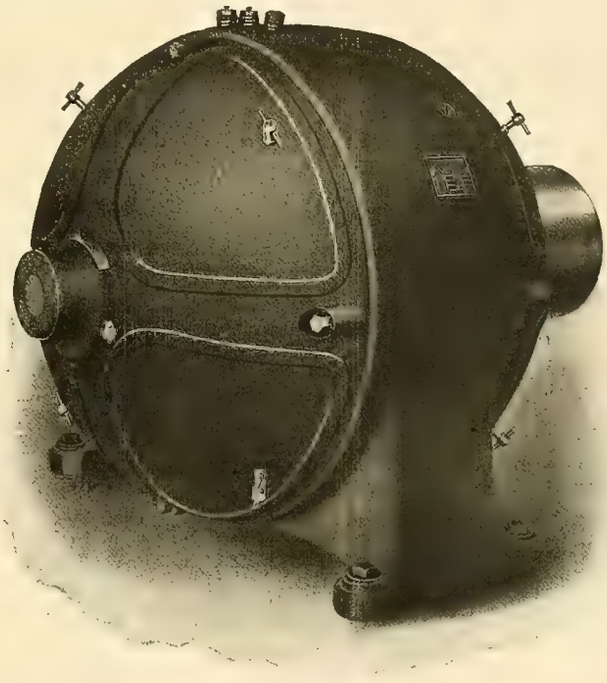
includes

Direct Current Motors and Generators, Alternating Current Generators and Transformers.

For Lighting, Power and Railway Service.



Open Style Motor.



Enclosed Style Motor.

Our experience in building electrical apparatus is indicated by the fact that we have built

More than 6,500 Motors for direct connection to our air compressors used with our air brake equipments on electric cars throughout the world.

Write for Catalogue No. 27.

Christensen Engineering Company,

MILWAUKEE.

THEY COME

EVERY mail is bringing orders for A-B. Arc Lamps—singly—in pairs—in bunches. Many are trial orders, too—from new customers. That pleases us, and would it, do you think, if we were not absolutely sure that our lamps were the best on the market and would stay sold? Have you sent your trial order?

Electric Appliance Company,
ELECTRICAL SUPPLIES
92 and 94 W. Van Buren St., CHICAGO.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICANITE CLOTH

HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.
MICA INSULATOR CO.
"ORIGINATORS."
CHICAGO. NEW YORK.

THE LIGHT THAT NEVER FAILS BECAUSE

The spools are guaranteed against burning out.
The resistance cannot sag and short-circuit.
The clutch is simple, reliable and well insulated.
Highest Awards: Philadelphia, Paris, Buffalo.

19th and Allegheny Ave., PHILADELPHIA, PA.
39 Cortlandt St., NEW YORK CITY.

G. TOERRING CO

ARE YOU CONSIDERING

An X Ray Installation?

IF SO, WRITE US FOR FULL INFORMATION.

WE MAKE all types of Adjustable Crookes Tubes; Single Focus for Coil or Static; Double Focus for A. C. Sets; Specially Protected Barium Fluoroscopes; Patented Tube Regulator; Plate-holders; Actinometers and all accessories for X Ray work.

SEND us your broken or punctured tubes for repair or re-exhaustion.

BARIO VACUUM CO.,
156 E. 23d Street, New York City.

VOLT-AMMETERS,

POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

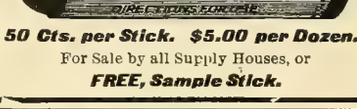
KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building.
CHICAGO.

HENRY H. HUMPHREY,
Consulting, Electrical and Mechanical Engineer.
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use



The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

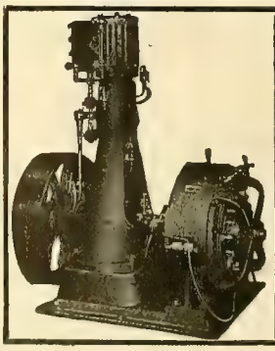
BEARDSLEE CHANDELIER M'F'G CO.

256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

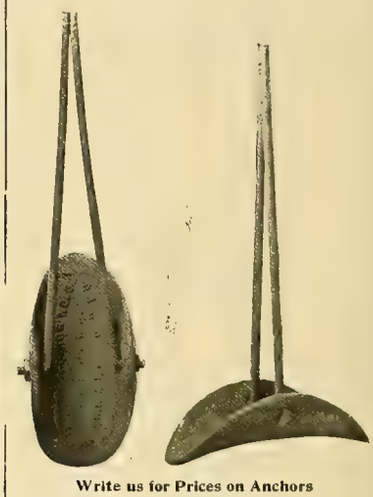
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

THE MILLER ANCHOR.



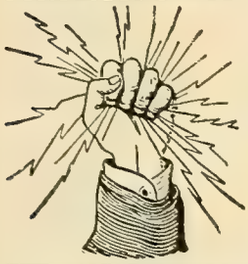
Write us for Prices on Anchors and Augers. All Sizes Made.

MILLER ANCHOR CO.
NORWALK, OHIO.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENBEIL, Treasurer. C. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

6w FRANKLIN Model Shop

The Franklin Gas Engine
One-Half Horsepower.
Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

Six Years with General Electric Company.

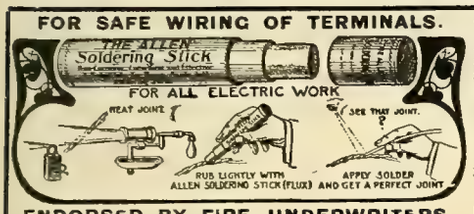
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

When you get our **STERLING** We send you lamps.

THE **Sterling Electrical Mfg. Co.** WARREN, OHIO.

We get your **STERLING** You send us coin.

FOR SAFE WIRING OF TERMINALS.



ENDORSED BY FIRE UNDERWRITERS.
Get THE ALLEN from your jobber.

THE ALLEN SOLDERING STICK.
Makes solder flow on any metal.
Is economical and safe.
Won't hurt your hands or tools

L. B. Allen

This signature on a pink label protects you from expensive, unsafe imitations.
Write us for a sample.
L. B. ALLEN CO., Inc.,
1334 Columbia Ave., Chicago.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

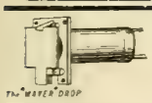
It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.



Sold by
THE MAYER ENGINEERING CO.,
Monadnock Block, CHICAGO, ILL., U. S. A
Write for Prices.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

STOMBAUGH GUYS

ARE USED EXTENSIVELY BY THESE ELECTRIC RAILWAY COMPANIES:

W. N. MATTHEWS & BRO. DISTRIBUTORS

Worm's-Eye View.

SAINT LOUIS MO. SIUTE 603 CARLETON BUILDING.

Schenectady Railway Co, Schenectady, N.Y.
Amsterdam Street Railway Co., Amsterdam, N. Y.
Athens Electric Railway Co., Athens, Ga.
South Chicago City Railway Co. Chicago, Ill.
St. Louis, Belleville and Suburban Railway Co, East St. Louis, Ill.
Louisville, Anchorage and Pewee Valley Ry. Co, Louisville, Ky.
Denver and Northwestern Railway Co, Denver, Colo.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Mechanical and electrical engineer, technical graduate of five years' experience, familiar with installation and operation of steam and electrical machinery, desires a position as superintendent of power in a central station of moderate size. References from present employer. Address BOX 124, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

A thoroughly competent man, sober and industrious, to take charge of the light and water plant at Bethany, Mo. None but good men need apply. For particulars address CITY CLERK, Bethany, Mo.

WANTED.

J. J. SPEED, Mgr. Cairo Telephone Co., Cairo, Ill., would like to hear from parties manufacturing a combined police and fire-alarm system.

POSITIONS OPEN.

	PER MONTH.
8 Draftsmen, Electrical	$100
2 Draftsmen, Structural Steel	$125
2 Draftsmen, Bridge	$75 up.
7 Armature Winders, must be gilt edge	$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

Wanted Central Station Managers

And Users of Machinery

TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger, more improved or more modern.

We have the following Quick Shipment Bargains:—

1—20x 8—½ Harrisburg Ideal Engine,
1—16x16 Erie Ball Engine,
1—15x15 " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine,
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps.

A. G. SCHOONMAKER CO.,
126 Liberty St., New York City, U. S. A.

NOTICE.

Sealed proposals will be received until November, 15, 1902, for the furnishing of one hundred arc lights to light the city of Baton Rouge. Specifications can be obtained by addressing EDWARD WAX, Secretary of the Water and Lighting Committee, Baton Rouge, La.

NOTICE.

Bids are invited until Oct. 20, on which date they will be opened at 501 Jackson Ave., Topeka, Kan., for furnishing material for the Council Grove Electric Light & Power Co. Specifications will be supplied on application. JOHN H. PACKER, Secy. and Gen. Mgr., Perry, Kan.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley Inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings), Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Forty T. H. K. 2-series open arc lamps in good condition. For particulars and price address,
Dodge Mfg. Co., Mishawaka, Ind.

FOR SALE.

Electric-light plant in good condition. Franchise, ten years to run. Good street light contract. Monthly receipts average $800. Good proposition for party understanding the business. Or will sell interest to party who is capable of taking full charge, and who has proven himself successful elsewhere. Address BOX 123, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

An electric-light plant near Chicago. County seat town, located across line in Indiana. Plant on good paying basis, good city contract. Gross receipts last year $6,500. Price $10,000 cash. Owner's reason for selling, sickness. Full statement of plant given upon application. Address J. G. POMEROY, 309 Dearborn St., Chicago.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric Light and Steam Heating Plant in thriving town of 2,500 people; 10-year contract with city at $1,900 per year, with nine years to run. One hundred patrons with 1,900 incandescent lights; five 1,200 C. P. arc and 89,32 C. P. incandescents on streets, 90,000 feet of wire on streets, 415 poles, 75 meters, 45 transformers. Plant is modern and new, two dynamos, two engines, two boilers and as complete as can be made in new isolated building. Has steam vacuum heating system using exhaust steam, 13 patrons, including hotel, and using less than one-quarter of the exhaust steam, and balance of business district anxious for extension of system to their places. All light patrons on meter basis, 15 cents per 1,000 watts. Will sell on easy terms. Further information cheerfully given by calling upon or addressing STEWARD BROTHERS, Plano, Ill.

FOR SALE.

We have for sale at very reasonable prices the following machinery, which has become too small for our business, but is in first-class working condition:

One 60 K. W. Westinghouse Alternator complete with instruments, Exciter and Rheostat, 1100 volts primary, 16000 alternations, speed 1650 r. p. m., self-oiling bearings.

One 45 K. W. Alternator, same as above, with Exciter, but less switchboard instruments, speed 2000 r. p. m.

One T. & H. Arc Machine, 60 lighter 9 6-10 amperes, speed 850 r. p. m., in good working condition.

About 60 Street Arc Lamps, T. & H., 9 6-10 amperes, only in fair condition.

About 60 Street Arc Lamp Hoods.

The above are now in use, but will be released within the next forty days.

The Delphos Electric Light and Power Co.
DELPHOS, OHIO.

FOR SALE.

Boilers—Three 200 h. p. Wickes Hor. Water Tube.
Engine—30x72 in. R. H., Geo. H. Corliss.
Engine—24x42 in. L. H., Cooper Corliss.
Engine—16x36 in. L. H., Green Corliss.
Engine—15x14 in. Ideal Automatic.
Engine—12x16 in. R. H., Russell Automatic.
Pump—14x7x10 in. Worthington Duplex.
Pump—10x6x10 in. Snow Duplex.
Pump—18x5x16 in. Hydraulic Single Cylinder.
Pump—7½x4½x12 in. Knowles Single Cylinder.
Dynamo—800 light, 100-125 volt, National.
Dynamos—Three 65-light Brush Arc.
Motor—22 h. p., 220 volt, Novelty.
Motor—10 h. p., 220 volt, Keystone.

Send for complete monthly stock list.

WICKES BROTHERS,
45th St. and A. V. R. R., Pittsburg, Pa. Saginaw, 95-97 Liberty St., New York City. Mich. 1214 Marquette Bldg., Chicago, Ill.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

WANTED.

For delivery within seven months, 2—400 to 500 K. W. Street Railway Generators, also 10—38B 45 H. P. Westinghouse Motors.

2—G. E. 120 K. W. class 14-120-1070, 133 cycles.
1—250 K. W. 3-phase, G. E. 60 cycles, 2400 volts.
1—300 K. W., G. E. 60 cycles, 2300 volts.
4—60 K. W. 133 cycles, Westinghouse.
1—60 K. W. 60 cycles, 1100 volts, Westinghouse.
1—100 K. W., G. E. 110 and 220 volts, direct connected.
1—60 K. W. 250 volts, Westinghouse, direct connected.
1—120 K. W. Eddy, M. P., 110 volts.
4—110 K. W., G. E., M. P. 4, 550 volts.
40—125 lt. Brush, 9 6 and 6. 6 arc lighters.
14x36 Hamilton-Corliss Engine.
18x48 Brown-Corliss

Automatic engines and boilers up to 500 H. P. Write us your wants, we may have what you are looking for. The Steam and Electrical Equipment Co., Pittsburg, Pa.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP, COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

REPAIRS AND SECOND-HAND MACHINERY.

STREET RAILWAY, LIGHTING AND POWER.
Write for List of Machines.
ILLINOIS ELECTRICAL MFG. CO., PEORIA, ILL.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot

TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts. Fine Condition. All Accessories.

Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 18 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

STATION EQUIPMENT COMPANY,

539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—200 K. W. 60-cycle, two-phase Stanley alternators, 2,750 or 5,500 volts.
2—150 K. W. 60-cycle, three-phase Stanley alternators, 2,750 or 5,500 volts.
1—200 K. W., W. A. L. type, Ft. Wayne wood alternator, 133-cycle, three bearing, 1,100 or 2,200 volts, compound wound, complete with exciter.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K. W. Edison bi-polar railway generators.
2—100 K. W. Edison bi-polar railway generators.
4—100 K. W. Edison bi-polar 140 volt generators.
1—45 K. W. Edison bi-polar 140 volt generator.
2—30 K. W. Edison bi-polar 140 volt generators.
1—30 K. W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.

All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, E. H. CHENEY, Manager. **204 Dearborn St., CHICAGO.**

CHICAGO EDISON COMPANY REPAIR SHOPS

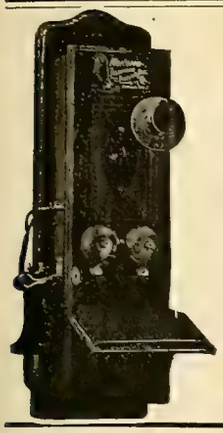
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

NOTICE.

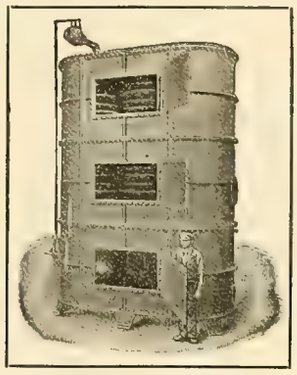
TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette Bldg., Chicago.

When You Save Steam,



You Economize in Fuel, and

ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

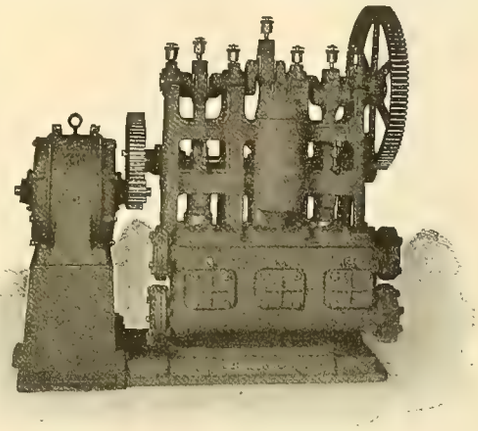
We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,

Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS



The Stilwell-Bierce & Smith-Vaile Co.,

P. O. Box 257, DAYTON, OHIO, U. S. A.

GASOLINE MOTORS

—FOR—

BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO.,

NORTH CHELMSFORD, MASS.

Western Electrician

WANT ADS

Bring Results.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

AS SIMPLE AS ITS NAME.

A B C

—OF—

THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,

510 Marquette Building, Chicago, Ill.

ARE YOU LOOKING FOR TROUBLE?

IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM

—IN—

BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

8th Edition Just Out. Price, 25c.

Electrician Publishing Co.,

510 Marquette Building, CHICAGO.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

A Prosperous State.

The whole great empire of California is rapidly developing. It was long said of this sunny and attractive region that "man cannot live upon climate," but when it was seen that Southern California had something more substantial than sunshine to offer, cities rose like exhalations, and deserts became fruitful fields. The same discovery is being made in Northern and Central California. The climate is seen to be a unit throughout the state, and industrial opportunities are seen to go with the climate, and business advantages with the winterless skies.

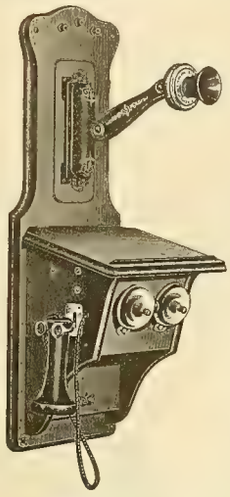
San Francisco's trade has nearly doubled in the past few years, and her foreign tonnage since 1895 has been multiplied by fifteen. Banks and savings banks show an enormous increase in commercial deposits and in the savings of the people, while a glance at the records of the building trades shows everywhere immense activity. There are no indications of a local or temporary boom. The growth of irrigation and the multiplication of farms; the discovery of oil and its widening use as fuel in mines and manufactories, and on engines and steamers; the enlarging market for California products in China, Japan, Hawaii and the Philippines, and the increasing trade with the west coast of Central and South America and with Australia, is sufficient to show that the prosperity of the state has a natural and healthful root.

Settlers' rates, based upon a $33 fare from Chicago, during September and October, are bringing in a host of home seekers. This is a daily rate, and particulars may be had at any agency of the Southern Pacific. With the best climate, from the fewest acres, with the least labor, California will yield a wider range of harvest, and pay larger profits, and more dividends in comfort, than any land in the world.

ONE YEAR'S RECORD

—IN—

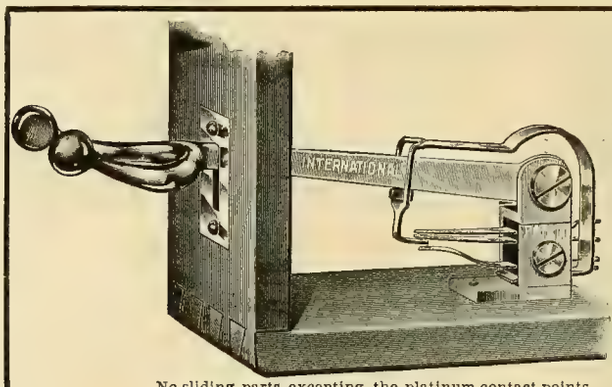
COMMON BATTERY WORK.



Toledo, Ohio	12,000 capacity
Houston, Texas	6,000 capacity
Cedar Rapids, Iowa	5,000 capacity
Clarksville, Tennessee	2,500 capacity
Davenport, Iowa	5,000 capacity
Freeport, Illinois	2,500 capacity
Galesburg, Illinois	3,000 capacity
Ironton, Ohio	2,500 capacity
Joplin, Missouri	5,000 capacity
Lima, Ohio	5,000 capacity
Lorain, Ohio	3,000 capacity
Marion, Ohio	3,000 capacity
Moline, Illinois	2,000 capacity
Newark, Ohio	3,000 capacity
Canton, Illinois	2,000 capacity
Peru, Indiana	2,500 capacity
Paris, Kentucky	2,500 capacity
Rockford, Illinois	5,000 capacity
Rock Island, Illinois	3,500 capacity
Terre Haute, Indiana	2,000 capacity
Wichita, Kansas	5,000 capacity
Ottawa, Illinois	2,000 capacity

WHY CAN'T WE ADD **YOU** TO THIS LIST?

STERLING ELECTRIC CO.,
LAFAYETTE, IND.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

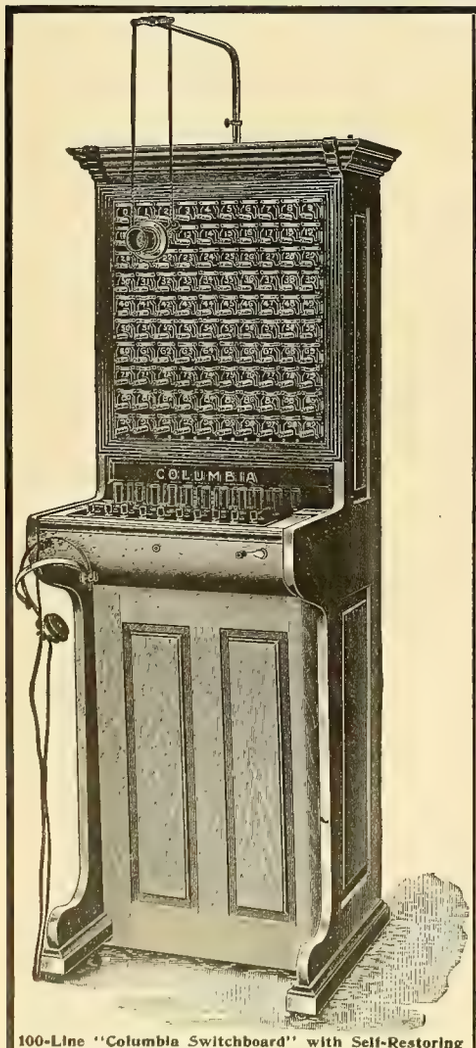
Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM
CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

CHICAGO TELEPHONE PAY STATIONS and METERS
Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.
Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.



100-Line "Columbia Switchboard" with Self-Restoring Drops. Showing Plugs in the Board and Jacks on end of Switching Cords.

ALL EXPENSE AND UNSATISFACTORY SERVICE DUE TO THE USE OF THE UNRELIABLE SPRING JACK **WIPED OUT**

Columbia Switchboards Guarantee This

Number of spring jacks necessary to operate a Columbia Switchboard **reduced from 80 to 98 per cent** of the number required to operate switchboards of other makes; the small percentage remaining being placed on the ends of switching cords, a location easy of access for inspection and repairs.

SWITCHBOARDS FOR MAGNETO, CENTRAL ENERGY, LAMP SIGNAL AND MULTIPLE SYSTEMS.

CENTRAL ENERGY LAMP SIGNAL AND MULTIPLE SWITCHBOARDS NOW BEING INSTALLED.

Waxahachie, Tex.,	Switchboard capacity,	1,200	lines and	telephones
Ennis, Tex.,	"	1,200	"	"
Norwalk, Ohio,	"	2,400	"	"
Frankfort, Mich.,	"	250	"	"
Dundee, Mich.,	"	200	"	"

COLUMBIA TELEPHONES.

FOR MAGNETO AND CENTRAL ENERGY SYSTEMS.
Equipped with superior solid back transmitters, non-packing and practically indestructible.

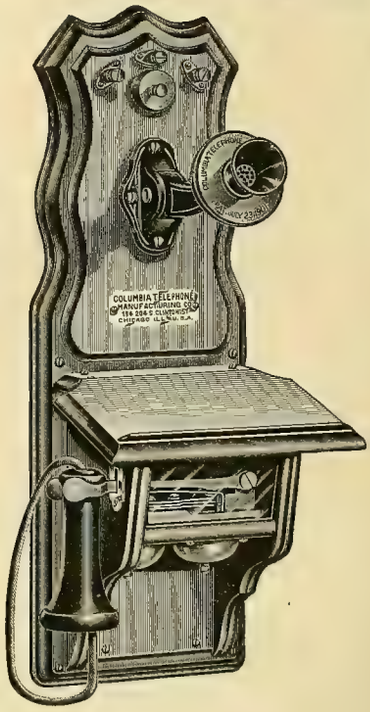
COLUMBIA CONDENSERS.

Compact and enclosed in tin case and guaranteed as to efficiency and for 250 volts. Send sample order and confirm our guarantee.

INCREASED FACILITIES ENABLE US TO FILL ALL ORDERS PROMPTLY. WRITE FOR QUOTATIONS.

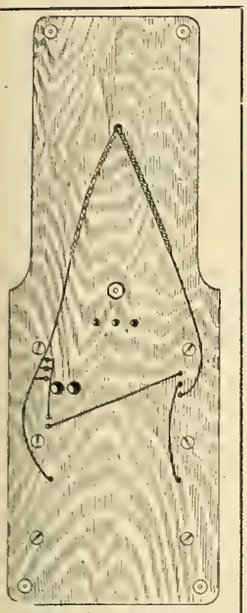
THE COLUMBIA TELEPHONE MANUFACTURING CO.,

OTTAWA, OHIO.



Central Energy Wall Set.

Right About Face!



Rear View Common Battery Telephone.

THE REAR OF A

Kellogg Common Battery Telephone

AND YOU WILL SEE THAT THE WIRING IS EMBEDDED IN SLOTS AND COVERED WITH BEESWAX.

TELEPHONE MEN CAN READILY SEE THE ADVANTAGE OF THIS METHOD OF CONSTRUCTION.

ONE OF THE SMALL DETAILS OF MANUFACTURE THAT HELPS MAKE THE NAME

Kellogg

STAND FOR EVERYTHING THAT'S GOOD IN A TELEPHONE.

RECEIVERS HAVE PURE HARD RUBBER SHELLS AND PERMANENT ADJUSTMENT.

TRANSMITTERS GUARANTEED BETTER THAN THE "BELL SOLID BACK."

Kellogg Switchboard & Supply Co., *229 So. Green Street, CHICAGO, ILL.*

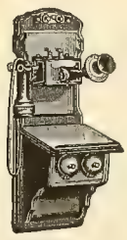
WRITE FOR GENERAL CATALOGUE.

IMPROVED TELEPHONE APPARATUS.

"CENTRAL ENERGY"

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

MULTIPLE BOARDS

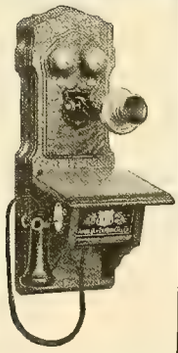


STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO

Telephone and Telegraph Construction Specialties

Patented Combination Messenger Hanger
for straight lines and corners, SOLID FORGED STEEL, Japanned or galvanized.
No. 1. Light, 1¾x ⅜in.
No. 2. Medium, 1¾x⅛ in.
No. 3. Heavy, 2x⅛ in.
Nos. 2 and 3 always in stock.

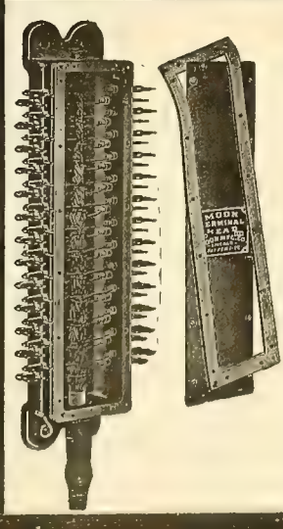
DEAD END HANGER.
Forged steel. Galvanized

In place on cable.

Patented Galvanized Steel Cable Hanger.
Note beautiful mechanical simplicity. Send for sample. Correspond with us; we have good specialties and up-to-date. Tell us what you want.
Corner Brackets, Guy Shims, and Special Forgings made to order.

3-Bolt Guy Clamp.
Solid forged steel. Japanned or galvanized. Never break, never slip. For 5-16 to ½-inch strand. 2-Bolt Clamps furn'd if desired.

THE NORTON TOOL CO., WEST PARK, OHIO.



MOON TERMINALS

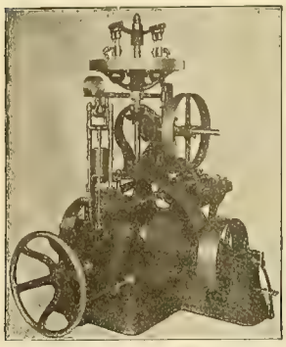
WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.



Water Wheel Governors

For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.

We are now prepared to

GUARANTEE ABSOLUTE SATISFACTION

Write for References in your Locality.

The Replogle Governor Works,

HIGH & CHESTNUT STS., AKRON, OHIO.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

GRAPHITE RESISTANCE.

Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

REG. TRADE MARKS

Phosphor Bronze

DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

NEW CATALOGUE

ELEVATING = CONVEYING — MACHINERY —
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

ELECTRICAL BOOKS.

All Kinds.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette, CHICAGO.

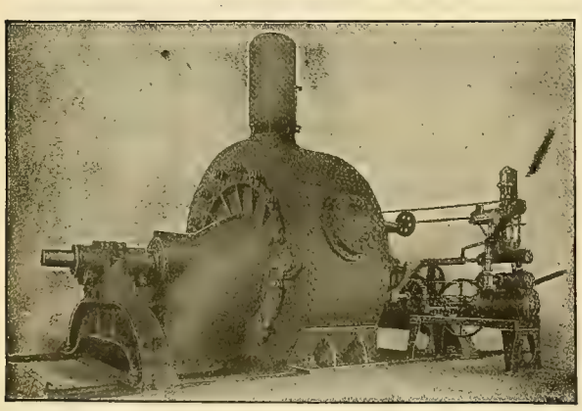
THOROUGH INSPECTIONS

AND

urance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.



SAMSON TURBINE

UNEXCELLED FOR DRIVING

ELECTRICAL MACHINERY.

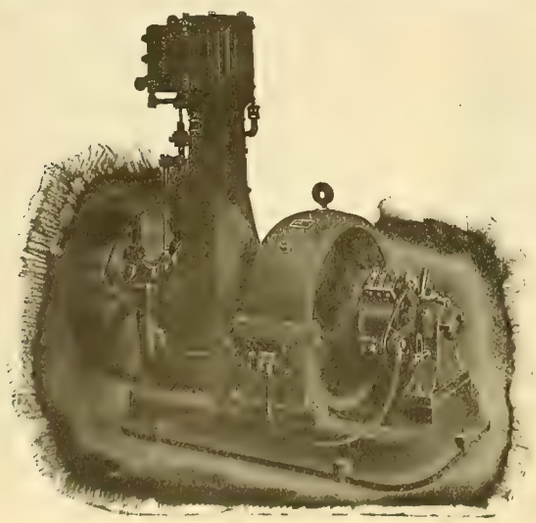
Special Features:

HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

AWARDED HIGHEST MEDAL ON TOOLS AT PARIS EXPOSITION OF 1900.

ASK FOR THIS

AWARDED HIGHEST MEDAL ON TOOLS AT PAN-AMERICAN EXPOSITION

THE DICKE TOOL COMPANY,

FACTORY: DOWNER'S GROVE, ILL.
Eastern Office: J. E. Way, Manager, 39 Cortlandt Street, New York.
Thos. C. Grier, Electrical Building, Chicago.
St. Louis Office: W. N. Matthews & Bros., 320 N. 6th Street.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

STOCK ——— BIGGEST EVER.
SHIPPING FACILITIES — NEVER BETTER.
GRADING ——— CAREFUL AS WE CAN BE.
PRICES ——— OUR STRONG POINT.

MALTBY LUMBER CO., BAY CITY, MICH.
"THE POLE AND TIE MEN."

MIXED CARS.

We Can Load Mixed Cars of

TELEPHONE POLES, CEDAR SHINGLES AND POSTS

Choice Stocks, Right Prices. Write us at once and tell us just what you require.

THE MORSE CEDAR CO., - Saginaw, Michigan.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand.

CEDAR POLES OF ALL LENGTHS AND SIZES

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1705-7 FISHER BLDG. CHICAGO.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

CEDAR POLES

LONG DISTANCE 'PHONE — WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO SOLES DAGGETT MICH.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.

Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

SOUTHERN White Cedar Poles

THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.
Electric Building, Cleveland, Ohio.
346 Broadway, New York.

CEDAR POLES

THE VALENTINE-CLARK CO.,
234 LA SALLE ST., CHICAGO.
YARDS: PINCONNING, Mich. — GREEN BAY, WIS. — NEW LONDON, WIS.

The

Westinghouse

Integrating

Wattmeter

has a fine jewel movement, frictionless connecting train, and a moving element very much lighter than that of any other meter. The result is a high-grade instrument of precision, which *accurately records the lightest of loads* independent of power-factor, frequency, temperature, wave-form, etc.

FOR ILLUSTRATED BOOKLET ADDRESS NEAREST SALES OFFICE OF THE

Westinghouse Electric

and Manufacturing Co., Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

GOOD BOOKS.

AUTHORITIES ON SUBJECTS MENTIONED.

The Pocket Electrical Dictionary. Containing all of the words and definitions in the science. A new work. Indispensable to the electrician, student and professor. Over 11,000 words and about 15,000 definitions. By *Edwin J. Houston*, A. M., Ph. D. (Princeton). 1 volume, 32mo, cloth, **$2.50**; leather, **$3.00.**

Electricity Made Easy. Profusely illustrated. A hand-book for busy people. By *Edwin J. Houston*, A. M., Ph. D., and *Arthur E. Kennelly*, Sc. D. 1 volume, 12mo, cloth, **$1.50.**

Dynamo-Electric Machinery. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. Sixth edition, revised and enlarged. Profusely illustrated with new engravings. 19 folding plates. 2 volumes, 8vo, cloth, gilt, **$6.00.**
The rapid advance of electrical science made it absolutely necessary to revise the last edition, and this is now a new work. It is indispensable to the electrical expert, professor and student of electrotechnics. Students and professors highly appreciate the publication of this extensive work in two volumes.

Polyphase Electric Currents and Alternate Current Motors. By *Silvanus P. Thompson*, D. Sc., B. A., F. R. S. 1 volume, 8vo, cloth, gilt, **$5.00.**
The most important work on the subject. A companion book to "Dynamo-Electric Machinery." One of the text-books in schools of technology and colleges. Beautifully illustrated with fine engravings. Folding plates. Invaluable to the expert electrician.

Algebra Made Easy. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. This little work is of special value to readers of Prof. Thompson's Dynamo-Electric Machinery and Polyphase Electric Currents, as the work has been written to explain in a clear and simple manner the equations contained in those works. 1 volume, 16mo, cloth, **75** cents.

The Interpretation of Mathematical Formulae. By *Edwin J. Houston*, Ph. D., and *A. E. Kennelly*, Sc. D. 1 volume, 12mo., cloth, **$1.25.**
A most valuable aid to students and electrical workers.

A B C of Electricity. Now approaching its 65th thousand. By *William H. Meadowcroft*. 1 volume, 12mo, cloth, **50** cents. Fully illustrated.
This excellent primary book has taken the first place in elementary scientific works. It has received the endorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

Scholars' A B C of Electricity. By *William H. Meadowcroft*. 1 volume, 12mo, illustrated, cloth, **50** cents.
The author of this work has designed it for the use of teachers and scholars. A large number of simple experiments have been added, with notes relative to the work. It is the primary book for school use.

The X Ray; or Photography of the Invisible and Its Value in Surgery. By *William J. Morton*, M. D. Written in collaboration with *Edwin W. Hammer*, 1 volume, 12mo, cloth and silver, **75** cents; paper, **50** cents.
The work explains in clear and simple style how these extraordinary pictures are taken through solids. Full description is given of the apparatus used, and the text is profusely illustrated with half-tone illustrations giving facsimile copies of the pictures taken from the negatives of the author. The subjects are varied.

The A B C of the X Ray. By *William H. Meadowcroft*. 1 volume, 12mo, cloth and gold, **75** cents.
The first primary work on the subject. A book for the people. The author of "A B C of Electricity" showed clearly in that work his ability to explain a technical subject for the laymen who know nothing of scientific terms. He has written this work about the X Ray in his usual clear and simple style, and a wide circulation of this useful book is assured. The text of the author is beautifully embellished with fine engravings, and nothing is omitted that will give the public a clear knowledge of this remarkable discovery of Prof. Röntgen. The public would do well to secure both these important works.

Sent Prepaid on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

Type A Insulation

STRUCK BY LIGHTNING.

Monroeville, Ind., July 14, 1902.

Fort Wayne Electric Works,
Fort Wayne, Ind.

Gentlemen:—During the severe electrical storm at this place, lightning struck the line and entered one of your 30-light Type "A" Oil Transformers, No. 40,048. The discharge blew the fuse and burst the cast-iron cover. I did not think it possible for a transformer to be good for anything after this severe discharge, but on having same tested out carefully I find that the coils are not injured in the least.

I cannot too highly recommend your Type "A" Oil Transformers to central station men.

Very truly yours,
H. W. DORRIS, Sup't Electric Light Plant.

No diagram is needed to prove that weakened insulation caused by "unequal expansion" or "hot spots" is noticeably absent in "Wood" Type A Transformers.

Fort Wayne Electric Works
Fort Wayne, Ind.

Branch Offices in Large Cities.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE
FOR
Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,
NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 160 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

A New Paper-Weight.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

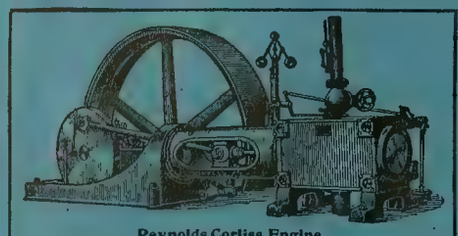
We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



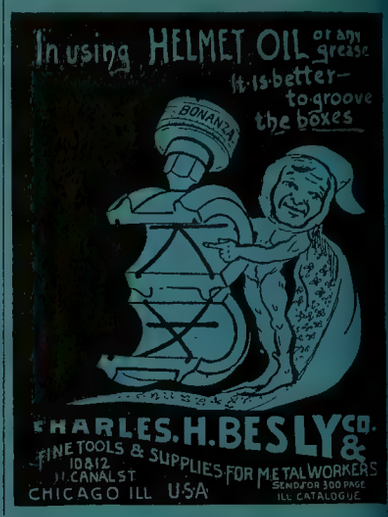
Reynolds Corliss Engine.

Sole Builders of

REYNOLDS CORLISS ENGINES

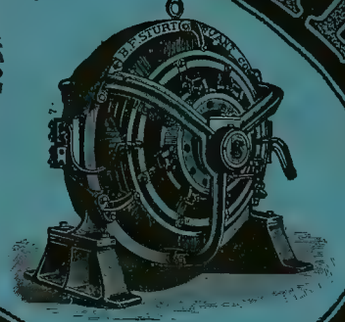
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.



THE STURTEVANT MOTORS

B. F. STURTEVANT COMPANY
BOSTON, MASS.
NEW YORK
PHILADELPHIA
CHICAGO
LONDON



255

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF **WIRES AND CABLES.**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg

PARAGON REFLECTORS

Silver-Plated Mirror Reflectors.

A deep cone, for use with any system of incandescent electric light, where it is desired to concentrate a very powerful light on a small space. Lined with silver-plated mirror-plate glass. Increases the light from twelve to fifteen times. Most valuable in show windows and over machines, work-benches, type cases, etc., etc.

Thousands of this style used in show windows. Get our Catalogue and Prices.

American Reflector & Lighting Co.,

271-273 FRANKLIN ST., CHICAGO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

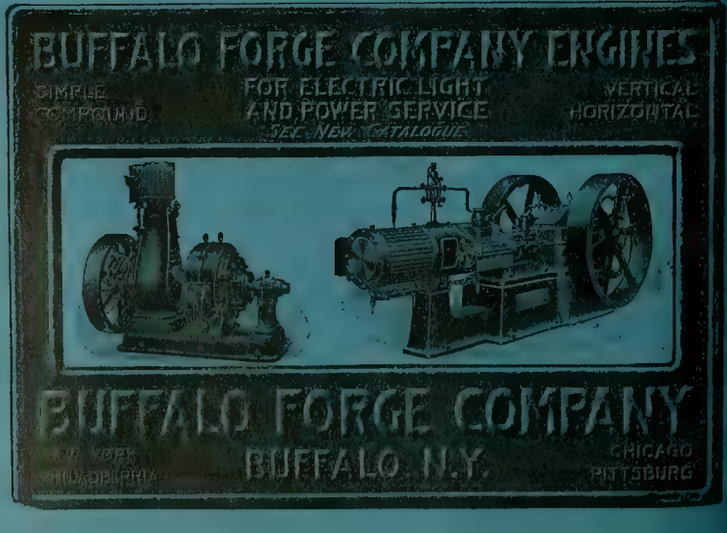
TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY

PHILADELPHIA, PA.



Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1902, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 25, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 17.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, W. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

When you get our STERLING We send you lamps.
THE Sterling Electrical Mfg. Co. WARREN, OHIO.
We get your STERLING You send us coin.

The FRANKLIN Model Shop
The Franklin Model Shop
Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawing and designs worked out from inventors' ideas. Send for circular 16.
PARSELL & WEED, 129-131 W. 31st Street, New York

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes, 2-to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.

THE ERICSSON TELEPHONE CO.
IS THE BEST TOO GOOD FOR YOU?

USED BY SIGNAL CORPS U. S. ARMY and ADOPTED AS THEIR STANDARD.
OUR TELEPHONES STAND EVERY TEST AND ARE ALWAYS SATISFACTORY. GIVE THEM A TRIAL AND BE CONVINCED. PARTICULARS FREE.
ERICSSON TELEPHONE CO., 296 BROADWAY, NEW YORK.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

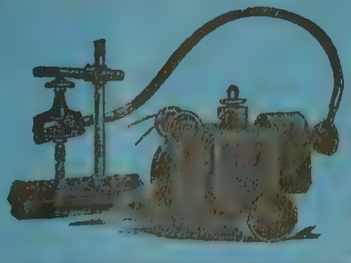
WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Voltmeter. Style B. "Flush Type."

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.

Mention the WESTERN ELECTRICIAN when writing for catalogues.

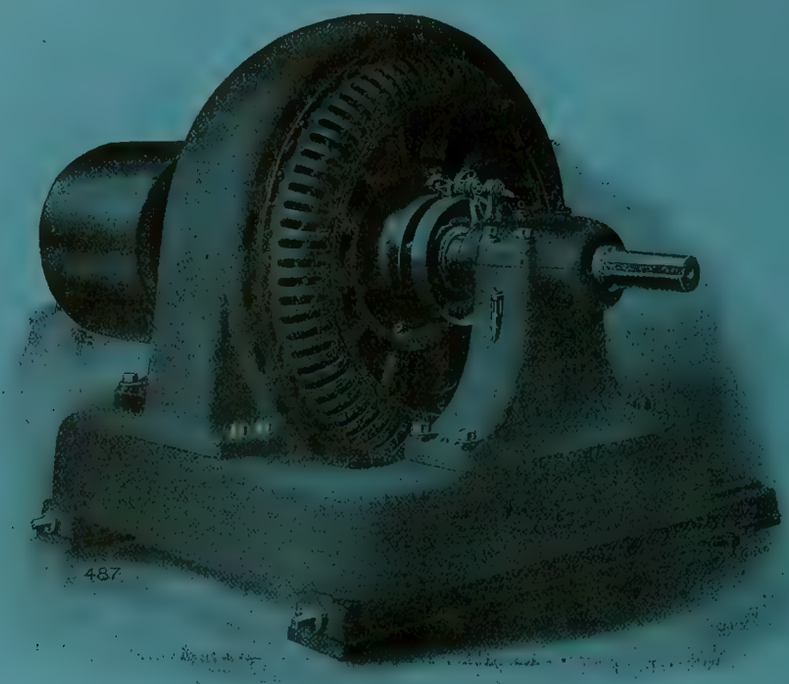

ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Can't Europeans Agents, Selby, Semmerhar & Co., 95 Queen Victoria Street, London, England.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

"Ceco."

Electrical Machinery.

Direct and Alternating Current
For Lighting, Power and Railway Service.



250 K. W. Three Phase "Ceco" Alternator.

"Ceco" apparatus is modern in design, accurate in construction and superior in performance. Our experience in manufacturing electrical apparatus is indicated by the fact that we have built

MORE THAN 6,500 MOTORS

FOR DIRECT CONNECTION TO OUR AIR COMPRESSORS USED WITH OUR AIR BRAKE EQUIPMENTS ON ELECTRIC CARS.

WRITE FOR CATALOGUE No. 27.

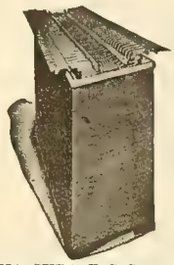
Christensen Engineering Company,

MILWAUKEE.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"



For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

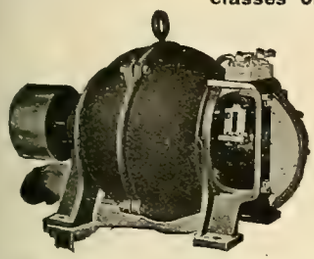
PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

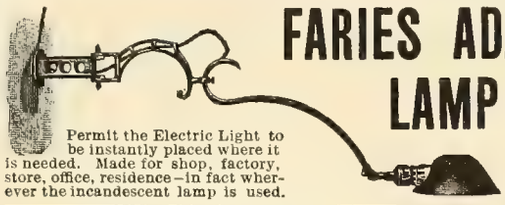
Write for Descriptive Bulletin No. 206.



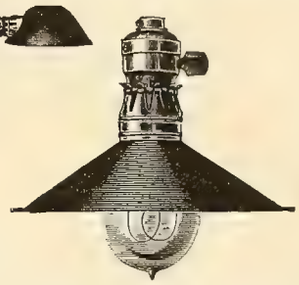
GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

FARIES ADJUSTABLE LAMP HOLDERS



Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.



WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers.

Send for Catalogue No. 10, just issued.

FARIES MFG. CO., DECATUR-ILL.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.

BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.

Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co..... 1
Allen Company, L. B..... 11
Allis-Chalmers Company....20
American Battery Co.....20
Amer. Electrical Heater Co..20
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refl. & Lighting Co.20
Amer. Steel & Wire Company 1
Anderson & Sons, W. H..... 9
Audel & Company, Theo.... 14

Baker & Company..... 3
Bario Vacuum Co..... .....—
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg. Co.—
Beardsley Gravity Dam & Construction Co..... 9
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 11
Bossert El. Construction Co..20
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20

Central Electric Co..... 5
Central Manufacturing Co...17
Central Telephone & El. Co..14
Century Glass Co.....10
Chase-Shawmut Company...11
Chicago & Alton Railroad....18
C. & N. W. R. R.....18
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....13
Chicago Pay Station Co.....14
Christensen Engineering. Co 2
Consumers Carbon Co..... 1
Continuous Rail Joint Company of America..... 9
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 4
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co.. 7
Diamond Meter Company ...13
Dixon Crucible Co., Joseph..16
Duncan Electric Mfg. Co.... 19
Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....13
Edwards & Company.....13
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 8
Electrician Pub. Company...18
Ericsson Telephone Company 1

Faries Manufacturing Co.... 3
Federal Electric Company...—
Fisher Electric Company....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company..... 4
General Incand. Lamp Co....—
Great Western Smelting & Refining Company..., ...—
Gregory Electric Company...12

Hamblin & Russell Mfg. Co.. 9
Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Helios-Upton Company..... 7
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electrical Mfg. Co...12
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..14

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....16
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller.....—
Maley, Martin.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.13
Matthews & Bros., W. N.....11
Mayer, Geo. M.....11
McLennan & Company, K....10
McNamara Brothers 11
Metropolitan Tel. & El Co...14
Mica Insulator Company.....—
Miller Anchor Company 10
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co.....—
Monon Railroad.....13
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E.....20
Munsell & Co., Eugene.....10

National India Rubber Co....—
Naugle Tie Co., E. E 16
New York Ins. Wire Co..... 7
Norton Elec'l Instrument Co. 7

Okonite Company, The..... 1
Osburn Flexible Conduit Co —

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....17
Phelps Company..... 9
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo.....—
Reliance Electric Company..13
Replogle Governor Works.. .—
Reynolds Electric Company.—
Roebling's Sons Co., J. A....18
Rooney-Westbury El. Lmp. Co.10
Rose Electric Company 12

Sargent & Lundy.....11
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....—
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan.....16
Southern Pacific R. R.....—
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co...—
Standard Varnish Works 7
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 5
Station Equipment Co.....12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co.. 1
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Sterrett Pump Company.....13
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company.....17
Triumph Electric Co.....11

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....—
Vindex Electric Company....—
Vought-Berger Company 9
Vreeland, B. F. 16
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.... 4
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co..... 8
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G..... 7
Wisconsin Central R. R..... 9
Wittenberg Cedar Co.....17
Worcester Company, C. M....17

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

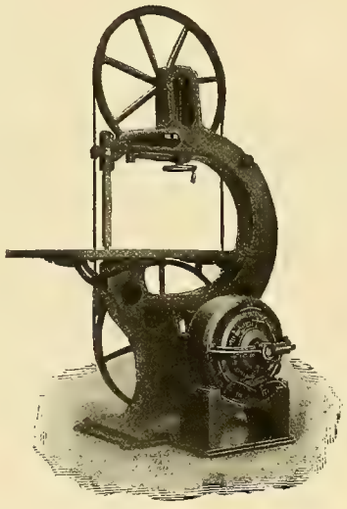
ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

CROCKER-WHEELER COMPANY,
Manufacturers and Electrical Engineers.
AMPERE, N. J.



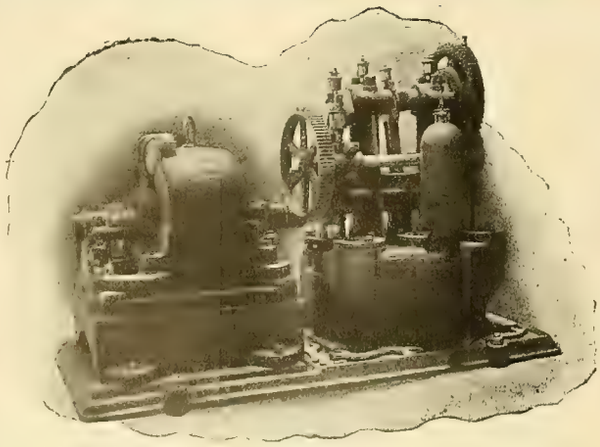
The Motor that will Increase Your Tool Output.

G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I. G.I.

TRADE **G. I.** MARK

STANDS FOR MECHANICAL AND ELECTRICAL PERFECTION

GENERAL INCANDESCENT ARC LIGHT CO.
NEW YORK, N. Y., AND ALL LARGE CITIES.



30 H. P., 60 Cycle, 208 Volt. Single Phase Motor Geared to Triplex Pump.

OUR **SINGLE PHASE MOTORS** ARE
Particularly Suited for Pump Operation.

THEY WILL **START UNDER FULL LOAD** BY
Simply Closing the Primary or Secondary Circuit at any point however distant from the motor.

ONLY ONE TRANSFORMER REQUIRED.

If interested we would be pleased to have you inform us of your requirements.

WAGNER ELECTRIC MFG. CO.
ST. LOUIS, MO., U. S. A.

OKONITE WIRES and CABLES

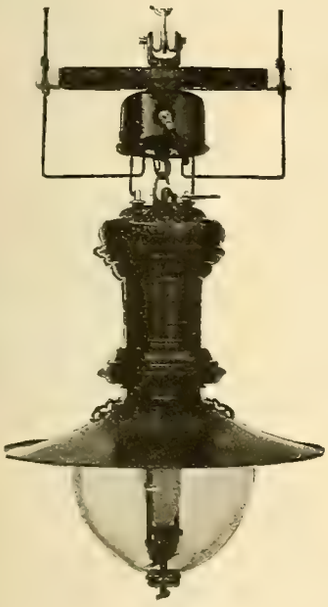
OKONITE
TRADE MARK

OKONITE TAPE and MANSON TAPE
ARE THE BEST MADE

LIKE COLUMBIA LAMPS, THEY HAVE A LONG LIFE.

Central Electric Company, 264-266-268-270 FIFTH AVENUE, CHICAGO.
GENERAL WESTERN AGENTS.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: - - SCHENECTADY, N. Y.

ELECTRICITY FOR ENGINEERS.

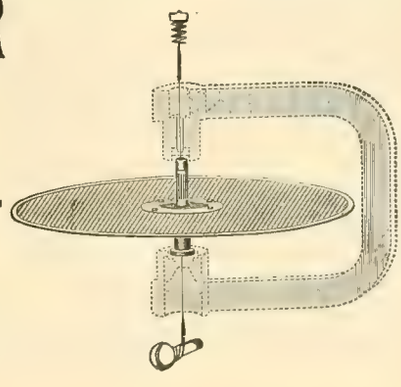
424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.
SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U.S.A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Miller Anchor Company.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutler Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
Electrical Engineer Inst.
Int. Corresbond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks.
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Ericsson Telephone Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 8.

Don't

Allow Your Boilers to be Ruined when You Can Save Them
BY USING
DEARBORN VEGETABLE BOILER COMPOUNDS.
Made to Suit the Water as per Analysis.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

TEST INSTRUMENTS.
Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.

The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.
Agents.-Kohler Bros. Chicago, Ill ; Newman-Spranley Co., New Orleans, La

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

BOOKS.

BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

Type 212 Arc Lamps

For Direct Current Constant Current Arc Circuits.
Write for Bulletin 7008.

View of the Philadelphia and Reading Terminal in Philadelphia. This depot has installed 115 Western Electric, Type 212 Long Burning Arc Lamps.

Western Electric Company

Chicago New York
Saint Louis Philadelphia

INCANDESCENT LAMPS.

WE have some bargains in Lamps.

No job lot, but a thoroughly high grade lamp that we are prepared to guarantee fully. We can make prices that will interest you. As you know, we are not in the habit of making rash statements. So write us to-day if you are in the market.

Western Electrical Supply Co.

ST. LOUIS, U. S A.

PROFITABLE TO CENTRAL STATIONS THE HYLO. IT

Teaches People To Use More Illumination—

HOW?

By Turning Lamps Down Instead of Out.

If you sell light on flat rate why don't you push the **HYLO** lamp and save current? You could afford to furnish it ***free.*** You certainly cannot afford to refuse to ***sell*** it.

If you are selling current on meter you need the **HYLO.** One baby filament may not start your meters and you may make the customer a present of nine watts now and then. But are you letting this ***one fault*** (of the meter) outshine all the advantages of the **HYLO?** A meter too slow to catch ten watts will be very likely to miss one 8 c. p. lamp or be altogether too slow if it moves at all. Therefore, it is much better to give a customer a nine-watt lamp all night, and no more, ***than to take the chance of giving him 25 or 30 watts.*** We insist that you will ***gain*** on the item of meter slip by using **HYLOs.**

Besides, we are advertising so heavily all over the world that your customers will eventually get the **HYLO** ***anyway,*** and you had better score a point and provide it for them.

PHELPS COMPANY,
50 State St., DETROIT, U. S. A.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

TO THE GREAT NORTHWEST

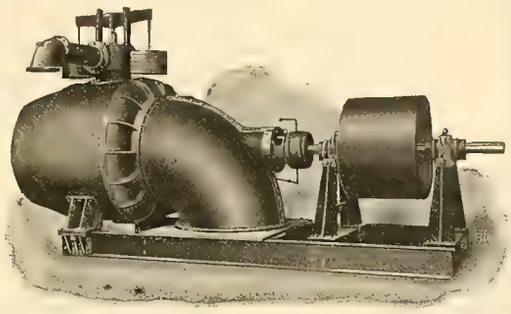
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

A SINGLE 27-INCH VICTOR TURBINE

mounted on horizontal shaft is shown by the cut herewith. The water is discharged at one end through the draft tube, and, in this case, the usual end thrust connected with single wheels is entirely provided for. The high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion are

SALIENT FEATURES OF THE VICTOR TURBINE.



WE MAKE A SPECIALTY ALSO OF

STEAM AND POWER PUMPING MACHINERY FOR ALL PURPOSES.
AIR COMPRESSORS FOR THE AIR LIFT SYSTEM AND GENERAL USE.
JET AND SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS,
STILWELL'S FEED WATER HEATERS.
OIL MILL MACHINERY AND FILTER PRESSES.

IF INTERESTED ADDRESS

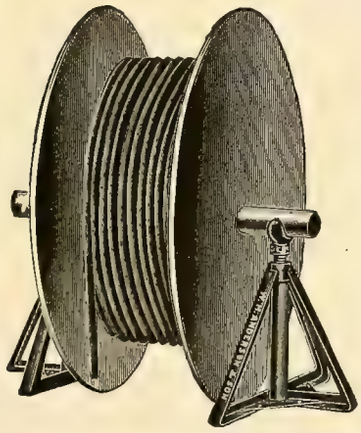
THE STILWELL-BIERCE & SMITH-VAILE CO.,

DAYTON, OHIO, U. S. A.

NEW YORK, 141 Broadway. **PHILADELPHIA, 612 Arch St.**
BOSTON, 73 Oliver St. **CHICAGO, 311 Dearborn St.**
NEW ORLEANS, 304 Hennen Bldg. **LONDON, E.C., 97 Queen Victoria St.**
BALTIMORE, 1507 Continental Trust Bldg.
CLEVELAND, 1116 New England Bldg.

E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

CABLE REEL JACK.



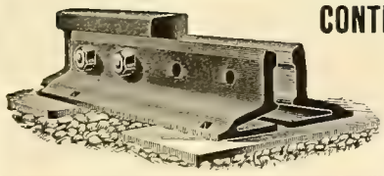
Made in Two Styles.

No. 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No. 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,
Tool Manufacturers.
Established 1871.
St. Aubin Ave., DETROIT, MICH.

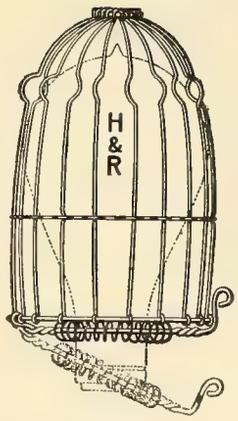


CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.

Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.
Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

EVEN IN THESE BUSY TIMES

We Receive Letters Like this:

NO. 1106.

October 4, 1902.

"Electric Appliance Co., Chicago.

Dear Sir:

Goods received, and thanks for your prompt shipment. We will have another order for you in a few days. Yours truly,

_____,,

THERE ARE MANY LINKS IN OUR CHAIN OF EVIDENCE.

ELECTRIC APPLIANCE COMPANY,
Electrical Supplies,
92 and 94 West Van Buren Street, . . . CHICAGO.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS ARC LAMPS

39 Cortlandt St.

19th & Allegheny Ave.

NO MATTER HOW FINE

the superstructure, if a house is built on a poor and weak foundation it is bound to fail. No matter how fine an arc lamp may appear if its foundation — the magnet spools — are weak. The Toerring lamp spools are guaranteed against burning out.

NEW YORK CITY **C. J. TOERRING CO** PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS

AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

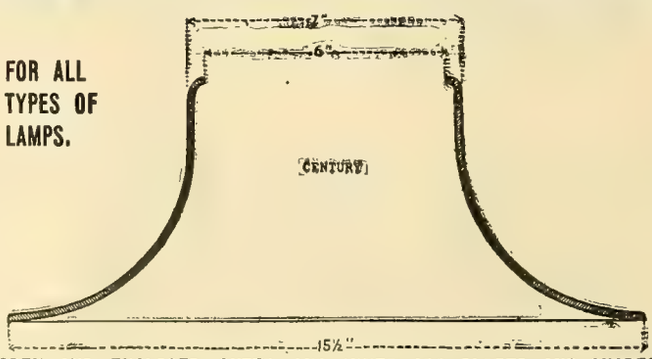
Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

COMPLETE STOCK ALWAYS ON HAND.

FOR ALL TYPES OF LAMPS.



OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES AND SHADES.
WRITE US.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

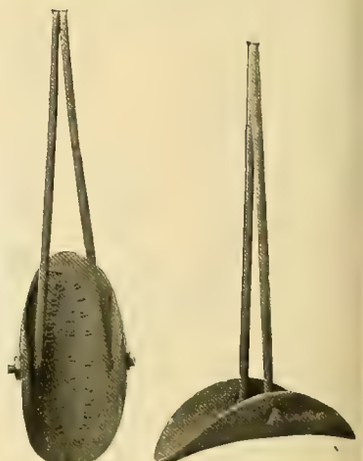
Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

THE MILLER ANCHOR.



Write us for Prices on Anchors and Augers. All Sizes Made.

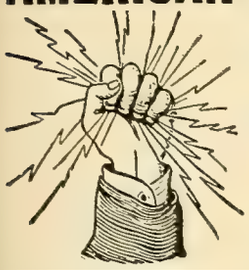
MILLER ANCHOR CO.

NORWALK, OHIO.

FRANK N. PHILLIPS, PRESIDENT. E. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, 'Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

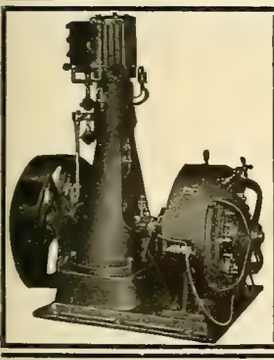
McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

This Signature L. B. Allen on the pink label
of the Allen Soldering Stick means that every ingredient, every process, every result is watched religiously.
THE ALLEN SOLDERING STICK
Does what it's intended for, makes solder flow on any metal. The top's as good as the bottom. Wide awake jobbers sell the ALLEN. Sample Free.
L. B. ALLEN CO., Inc., Sole Manufacturers,
1334 Columbia Avenue, - - CHICAGO.



TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

SARGENT & LUNDY,
Engineers,
1000, 46 E. VAN BUREN ST., CHICAGO.
FREDERICK SARGENT. A. D. LUNDY

Designs for PATENTS—WORKING DRAWINGS
FOR SPECIAL AND AUTOMATIC MACHINERY.
Developing of ELECTRICAL INVENTIONS a Specialty.
GEO. M. MAYER, M. E., MONADNOCK BLK., CHICAGO, ILL.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

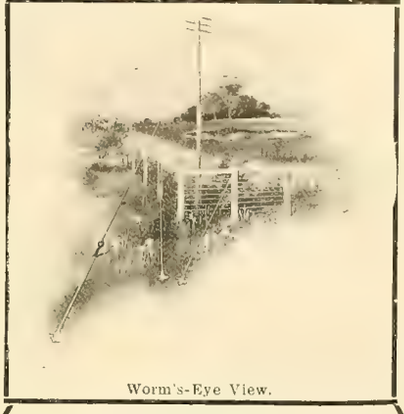
Office and Factory: PAWTUCKET, R. I.

STOMBAUGH GUYS

ARE USED EXTENSIVELY BY THESE ELECTRIC RAILWAY COMPANIES:

W. N. MATTHEWS & BRO. DISTRIBUTORS

SIUTE 603 CARLETON BUILDING SAINT LOUIS MO.



Worm's-Eye View.

Schenectady Railway Co., Schenectady, N.Y.
Amsterdam Street Railway Co., Amsterdam, N. Y.
Athens Electric Railway Co., Athens, Ga.
South Chicago City Railway Co. Chicago, Ill.
St. Louis, Belleville and Suburban Railway Co., East St. Louis, Ill.
Louisville, Anchorage and Pewee Valley Ry. Co., Louisville, Ky.
Denver and Northwestern Railway Co., Denver, Colo.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.
New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each*
POSITION WANTED *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a young man 35 years of age as superintendent and manager of an electric-light and power plant. Has 14 years' experience; strictly temperate; references. Open for an engagement after November 1st. Address BOX 125, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

In charge of an electric plant; have had 16 years' experience and am well posted on steam, water, inside lighting and street railways. Can furnish good references. Address BOX 126, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Burnt out Transformers. Westinghouse L. and P. or C. S. types. Write stating alternations, primary and secondary voltage, sizes and prices. STEWART ELECTRICAL CO., 311-313 East Fifth Street. Cincinnati, O.

WANTED.

For delivery within seven months, 2–400 to 500 K. W. Street Railway Generators, also 10—388 45 H. P. Westinghouse Motors.
2—G. E. 120 K. W. class 14-120-1070, 133 cycles.
1—250 K. W. 3-phase, G. E. 60 cycles, 2400 volts.
1—300 K. W.. G. E. 60 cycles. 2300 volts.
4—60 K. W. 133 cycles, Westinghouse.
1—60 K. W. 60 cycles, 1100 volts, Westinghouse.
1—100 K. W., G. E. 110 and 220 volts, direct connected.
1—60 K. W. 250 volts, Westinghouse, direct connected.
1—120 K. W. Eddy, M. P., 110 volts.
4—110 K. W., G. E., M. P. 4. 550 volts,
40—125 lt. Brush, 9. 6 and 6. 6 arc lighters.
14x36 Hamilton-Corliss Engine.
18x48 Brown-Corliss.
Automatic engines and boilers up to 500 H. P.
Write us your wants. we may have what you are looking for. The Steam and Electrical Equipment Co., Pittsburg, Pa.

POSITIONS OPEN.

PER MONTH.

8 Draftsmen, Electrical..... $100
2 Draftsmen, Structural Steel.....$125
2 Draftsmen, Bridge ..... $75 up.
7 Armature Winders, must be gilt edge..... .....$100

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

NOTICE.

Sealed proposals will be received until November, 15, 1902, for the furnishing of one hundred arc lights to light the city of Baton Rouge. Specifications can be obtained by addressing EDWARD WAX, Secretary of the Water and Lighting Committee, Baton Rouge, La.

FOR SALE.

Forty T. H. K. 2-series open arc lamps in good condition. For particulars and price address,
Dodge Mfg. Co., Mishawaka, Ind.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings), Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.
Large stock of direct-current machines.
Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Good telephone exchange in northern part of Indiana. Will stand inspection. Parties wanting to buy, address BOX 127, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

Electric-light plant in good condition. Franchise, ten years to run. Good street light contract Monthly receipts average $800. Good proposition for party understanding the business. Or will sell interest to party who is capable of taking full charge, and who has proven himself successful elsewhere. Address BOX 123, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 361 Washington St., Newark, N. J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.
Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette B.dg., Chicago, Ill.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

NOTICE IS HEREBY GIVEN, that the Common Council of the city of Superior, Wis., with a view to granting a franchise, has caused to be prepared and has by resolution adopted full specifications containing rules and regulations for the construction, maintenance and operation of a plant for the distribution of electric currents throughout said city, for the purpose of supplying said city and the inhabitants thereof with electricity for power, heat and lighting purposes, and for the conduct of such business.

Said specifications contain, among other things, the maximum rates which may be charged by the grantee of such franchise to patrons or consumers and for annual statements, sworn to by the manager and treasurer of the company operating under such franchise to be made to the Common Council of the gross receipts of the business carried on under such franchise. Said specifications are on file and of record in the office of the city clerk of said city.

Request is hereby made that proposals be submitted stating what percentage of the gross receipts from the business carried on under the franchise the bidder will pay annually into the treasury of said city in consideration of receiving a franchise according to said specifications.

Each person presenting a bid shall accompany such bid with a certified check of some national bank of the United States in the sum of one thousand dollars ($1,000), payable to the order of the treasurer of the city of Superior, Wis., as a guarantee of the acceptance of the franchise, if such bid is accepted and a franchise granted in accordance with the specifications and the laws of the state of Wisconsin, and for the giving of a bond in the sum of one thousand dollars ($1,000), as in said specifications provided.

Sealed bids will be received for a franchise to be granted according to said specifications, said bids to be opened at a meeting of the Common Council of said city, to be held November 18, 1902.

This advertisement is made pursuant to directions contained in a resolution of said Common Council passed at a meeting thereof held in the council chamber in the city of Superior, Wis., on October 14, 1902. Said resolution was approved by the mayor October 16, 1902.

Dated at Superior, Wis., this 18th day of October, 1902. JOHN A. HOBE,
Clerk of the City of Superior, Wis.

IMMEDIATE SHIPMENT

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-inch, 24-inch, 22-inch Double Leather Belts.

BOILERS

One Geary Water Tube Boiler, 175 horsepower for 150 pounds pressure; almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 h. p. Berryman Heater.
600 h. p Berryman Heater.
125 h. p. Berryman Heater.
500 h p Excelsior Heater.
6x4x6 and 7¼x3½x5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY CO.,
DAVENPORT, IOWA.

SECOND-HAND MACHINERY
BOUGHT AND SOLD.
Write for List.
ILLINOIS ELECTRICAL MFG. CO., PEORIA, ILL.

MOTORS WANTED.
500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

60-K. W. EDISON, 500-VOLT.
For Sale, four 60-K. W Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot
TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts. Fine Condition. All Accessories.
Located in Lindell Railway Co's Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. MOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
30 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
U.S. METAL POLISH GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

A LEADER.

500 H. P. CROSS COMPOUND CONDENSING COOPER CORLISS,

16 and 30 by 48, with heavy girder frames supported under guides. Heavy sectional band wheel, 20 feet diameter with 37-inch face.

Shaft 10½-inch diameter in bearings and 12½ inch diameter in wheel. Shaft 13 feet 9 inches long. Disc Cranks. Engine is complete with 20 by 18 C. & G. Cooper Independent Air Pump and Condenser, direct driven by 12 by 18 Cooper engine.

Photograph and general dimension and foundation blue prints on application. We can ship immediately.

Write for our stock list of dynamos, engines and boilers just issued.

STATION EQUIPMENT COMPANY, 539 MARQUETTE BLDG., - CHICAGO, ILL.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, E. H CHENEY, Manager. 204 Dearborn St., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago. Ill.

MONON TRAINS FOR
La Fayette
W. Baden Spg
Fr. Lick Spr
Louisville
Mammoth Cave
Chattanooga
New Orleans
All Southern Cities.

MONON TRAINS FOR
Indianapolis
Dayton
Cincinnati
Asheville
Atlanta
Jacksonville
St. Augustine
Tampa
Havana.

ANY TIME

You travel between
CHICAGO
LOUISVILLE
INDIANAPOLIS
AND
CINCINNATI
CO VIA

MONON ROUTE

AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W. H. McDOEL, PRES. & GEN'L MGR. FRANK J. REED, GEN. PASS. AGT. CHAS. H. ROCKWELL, TRAFF. MGR.
CHICAGO.

EDWARDS AND CO.
New York, N.Y. U.S.A.

ELECTRO-MECHANICAL GONG

Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

New Dynamo Tenders' Hand-Book.

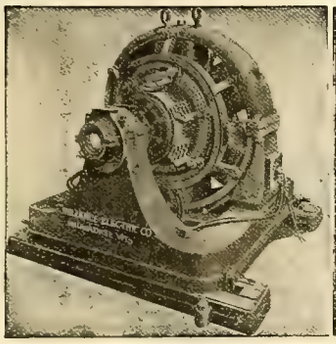
By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.

Electrician Publishing Co.,

510 Marquette Building, CHICAGO.



"RELIANCE"

GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,

MILWAUKEE, - - WIS.

AGENTS WANTED EVERYWHERE.

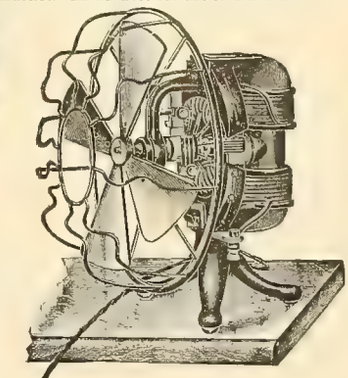
EDISON

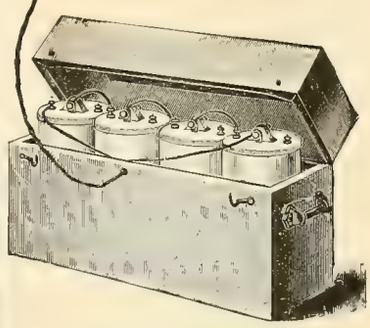
BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.





Write for Catalogue No. 4.

EDISON MFG. CO.,

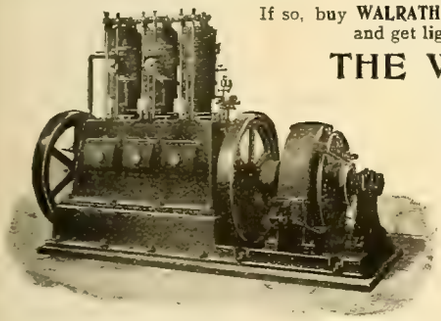
FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP

IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

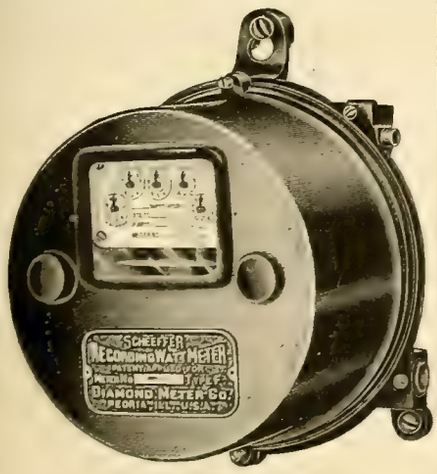
pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

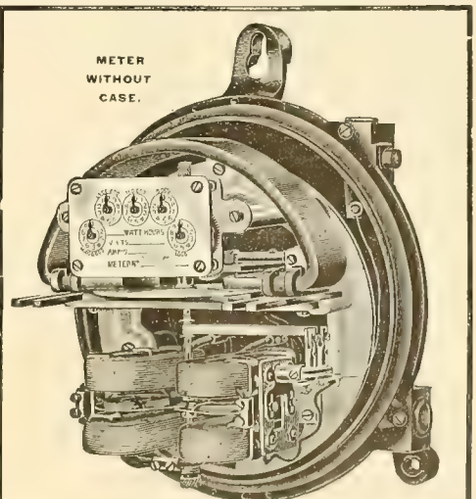
IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

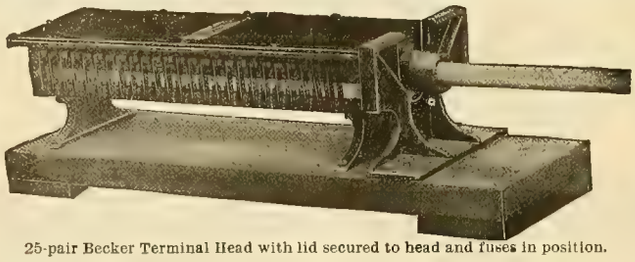
DIAMOND METER CO.,

PEORIA, ILL., U. S. A.



METER WITHOUT CASE.

PROTECTION
THE BECKER TERMINAL HEAD.

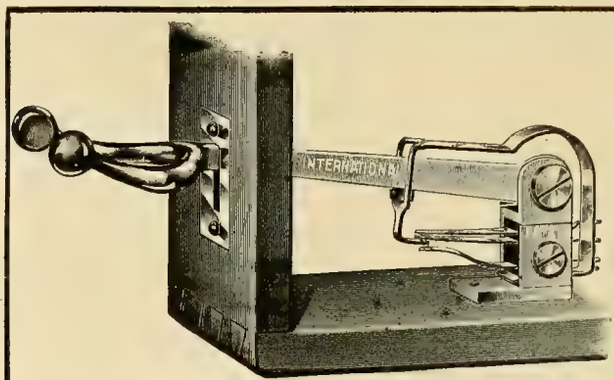


25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Chicago Office: 59 W. Jackson Boul. | Post-Glover Electric Co., Cincinnati Agents. | W. G. Nagel Electric Co., Toledo (O.) Agents.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. Co.**

KOKOMO TELEPHONES
Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

STEAM ENGINEERS' LICENSES

Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

Theo. Audel & Co., Publishers, 63 Fifth Avenue, New York City.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.

WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

New and Revised Edition JUST ISSUED.
American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

CHAPTER I.—History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V.—Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., *510 Marquette Building, CHICAGO, ILLINOIS.*

The Inspector
AND
Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

Mailed anywhere on receipt of price, **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

AS SIMPLE AS ITS NAME.

A B C
OF
THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

The Electro-Magnet

BY

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

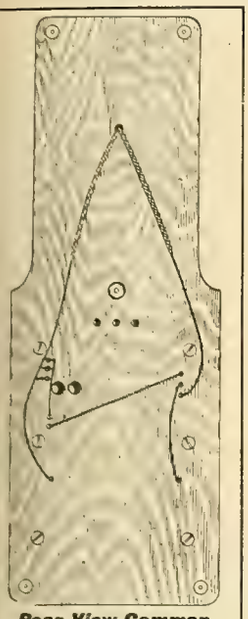
On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

FOR SALE BY

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

Right About Face!



Rear View Common Battery Telephone.

THE REAR OF A

Kellogg Common Battery Telephone

AND YOU WILL SEE THAT THE WIRING IS EMBEDDED IN SLOTS AND COVERED WITH BEESWAX.

TELEPHONE MEN CAN READILY SEE THE ADVANTAGE OF THIS METHOD OF CONSTRUCTION.

ONE OF THE SMALL DETAILS OF MANUFACTURE THAT HELPS MAKE THE NAME

Kellogg

STAND FOR EVERYTHING THAT'S GOOD IN A TELEPHONE.

RECEIVERS HAVE PURE HARD RUBBER SHELLS AND PERMANENT ADJUSTMENT.

TRANSMITTERS GUARANTEED BETTER THAN THE "BELL SOLID BACK."

Kellogg Switchboard & Supply Co., 229 So. Green Street, CHICAGO, ILL.

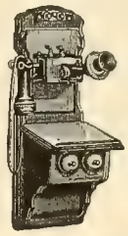
WRITE FOR GENERAL CATALOGUE.

IMPROVED TELEPHONE APPARATUS.

EVERYTHING UP-TO-DATE.
SOMETHING NEW ALL THE TIME.

"CENTRAL ENERGY"

MULTIPLE BOARDS

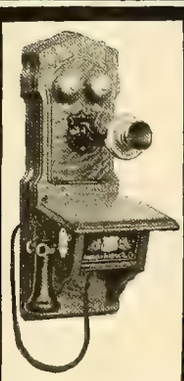


STROMBERG-CARLSON TELEPHONE MFG. CO.,
ROCHESTER, N.Y. CHICAGO, ILL.

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO

PRACTICAL FEATURES OF TELEPHONE WORK.

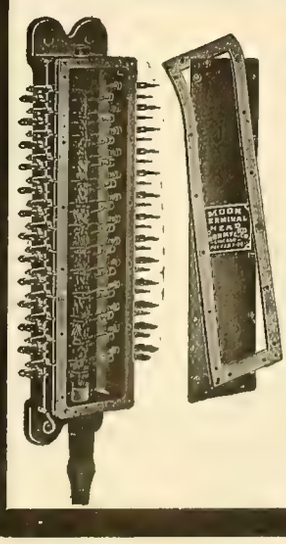
By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.



MOON TERMINALS

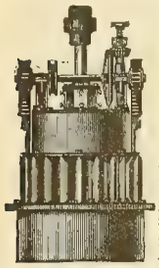
WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

REG. TRADE MARKS

"Phosphor Bronze"

DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS.
ORIGINAL AND SOLE MAKERS IN THE U.S.

GRAPHITE BRUSHES

That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

NEW CATALOGUE ELEVATING = CONVEYING — MACHINERY —
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.
135 ADAMS ST. CHICAGO.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

SAMSON TURBINE

UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING

ELECTRIC LIGHTING AND POWER PLANTS,

On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

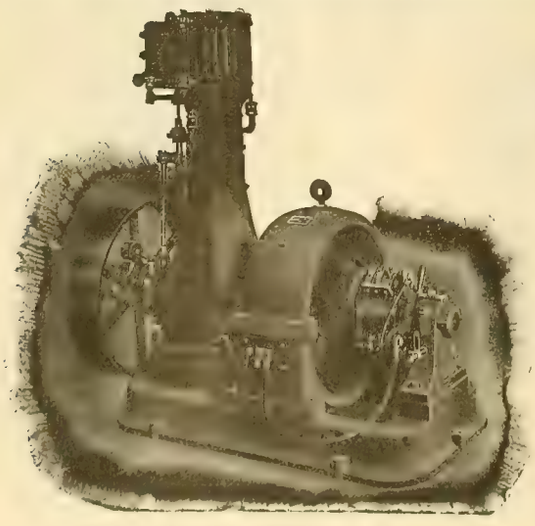
BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

146 Pages. 129 Ills. Cloth. PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BLDG., CHICAGO.



HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

STOCK ——— BIGGEST EVER.
SHIPPING FACILITIES — NEVER BETTER.
GRADING ——— CAREFUL AS WE CAN BE.
PRICES ——— OUR STRONG POINT.

MALTBY LUMBER CO., BAY CITY, MICH.
"THE POLE AND TIE MEN."

SPECIAL PRICES.

25 foot 7 inch—No. 1 Michigan Cedar Poles.
25 foot 8 inch—No. 1 Michigan Cedar Poles.
30 foot 6 inch—No. 1 Michigan Cedar Poles.
5,000 READY FOR IMMEDIATE LOADING.

If you require any of the above sizes, or any other size pole for fall construction, it will pay you to write us at once.

THE MORSE CEDAR CO., Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 57-59 W. Van Buren St. CHICAGO, ILL.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . . .
SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

CEDAR POLES STREET RY. TIES PERRIZ TOOLS DAGGETT MICH.

CEDAR POLES.
WITTENBERG CEDAR CO., Wittenberg, Wis.
A LARGE STOCK AT LOW PRICES.

Cedar Poles.
Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

The

Westinghouse

Integrating

Wattmeter

has a fine jewel movement, frictionless connecting train, and a moving element very much lighter than that of any other meter. The result is a high-grade instrument of precision, which *accurately records the lightest of loads* independent of power-factor, frequency, temperature, wave-form, etc.

FOR ILLUSTRATED BOOKLET ADDRESS NEAREST SALES OFFICE OF THE

Westinghouse Electric

and Manufacturing Co., Pittsburg, Pa.

SALES OFFICES IN ALL LARGE CITIES.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS,
CHICAGO AND PEORIA,
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

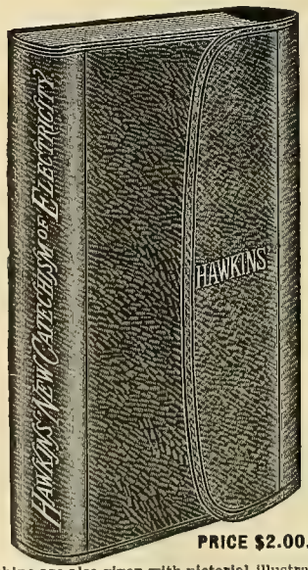
HOT SPRINGS, Ark., DENVER, Colo.,
TEXAS, FLORIDA, UTAH,
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

CROSS SECTION OF CORE AND COILS.

Efficient use is made of every inch of space and a most liberal use of copper is made possible in type A Transformers by the above construction.

TYPE A REGULATION

The shell type transformer constructed as is the "Wood" Type A, with interspersed primary and secondary windings is THEORETICALLY capable of giving closer regulation than any other standard commercial design.

Type A Transformers maintain an average regulation of two per cent. from no load to full load and preserve equal voltages on both sides of three-wire circuit with maximum unbalanced conditions.

FORT WAYNE ELECTRIC WORKS,

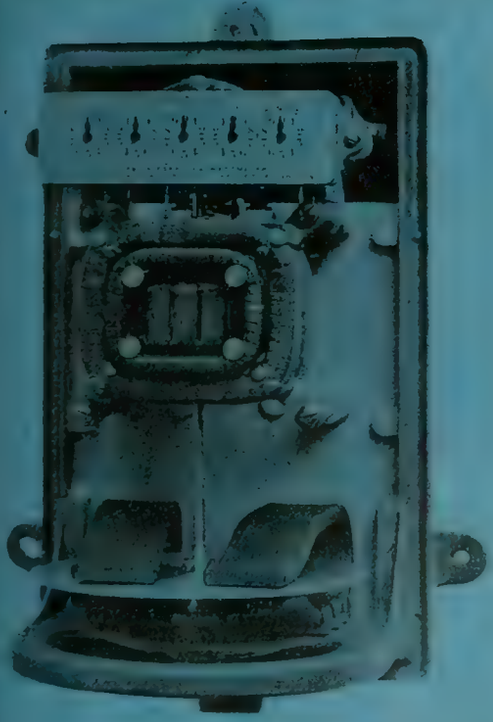
MAIN OFFICE AND FACTORY, FORT WAYNE, IND.

BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
New York, N. Y., 40 New St.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
Yokohama, Japan, Bagnall & Hilles.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS



Possesses Many Up-To-Date Features.

JUST THE METER FOR DIRECT CURRENT LIGHTING AND POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF ELECTRICITY METERS. LAFAYETTE, IND.

J. E. MOTT & CO.

CONTRACTORS

ENGINEERS

ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

We have been awarded the contract for the construction of an electric light plant at Lebanon, Penn.

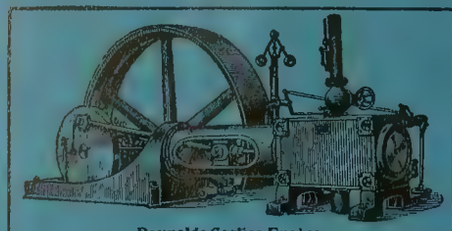
AMERICAN STORAGE CELLS

Absolutely Non-Intensing. Protection Guaranteed.

AMERICAN BATTERY CO.,

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



Reynolds Corliss Engine.

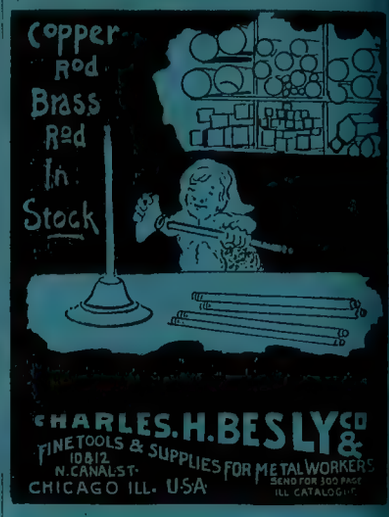
Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.

RIEDLER PUMPS AND AIR COMPRESSORS.



CHARLES. H. BESLY & CO

FINE TOOLS & SUPPLIES FOR METAL WORKERS

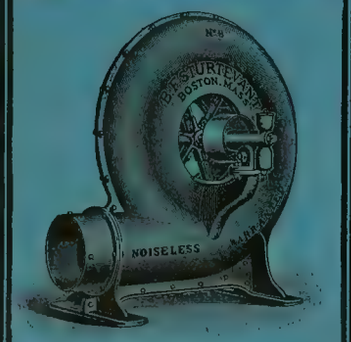
101 & 103 N. CANAL ST.

CHICAGO ILL. U.S.A.

SEND FOR 300 PAGE ILL CATALOGUE

STURTEVANT BLOWERS

of every conceivable form for every conceivable purpose. Built for endurance.



ALSO

Exhausters
Steam Fans
Electric Fans
Engines
Electric Motors
Generating Sets
Forges
Exhaust Heads
Steam Traps
Heating
Ventilating and
Drying Apparatus
Mechanical Draft

154

B. F. STURTEVANT CO. BOSTON,

NEW YORK · PHILADELPHIA · CHICAGO · LONDON

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

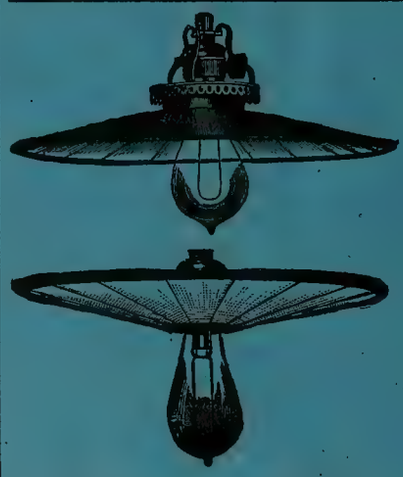
MODERN HEAT

ELECTRICITY.

AMERICAN ELECTRICAL HEATER CO.

Manufacturers Electric Heating Appliances,

Write for catalogue. 193-197 River St. DETROIT MICH



SILVER-PLATED MIRROR REFLECTORS.

A flat Reflector, for use with any system of incandescent electric light, where it is desired to spread the light considerably. Its silver-plated mirror plate lining makes it most effective and pleasing, and always as good as NEW.

Convex, reflecting slightly below the horizontal in all directions. Used in stores, etc., for general illumination.

GET OUR PRICES.

American Reflector & Lighting Co.,

271-273 FRANKLIN STREET, CHICAGO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

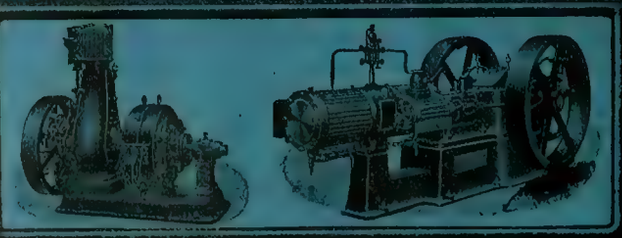
G. & H. BARNETT COMPANY

PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES

SIMPLE. COMPOUND. FOR ELECTRIC LIGHT AND POWER SERVICE. VERTICAL. HORIZONTAL.

SEE NEW CATALOGUE



BUFFALO FORGE COMPANY

BUFFALO N.Y.

NEW YORK PHILADELPHIA CHICAGO PITTSBURG

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 1, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 18.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. A. HIXSON, 1137 Monadnock Block, CHICAGO.

The Simplex Electrical Co., 78-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s

RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

STANDARD

Standard Underground Cable Co.

822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.

Electric Cables, Conduits, Wires and Accessories.

Also High Grade Rubber Covered Wires and Cables.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

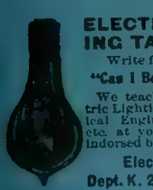
CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents. The Hobart Elec. Mfg. Co., Troy, Ohio



ELECTRICAL ENGINEERING TAUGHT BY MAIL.

Write for our free Illustrated Book, "Can I Become an Electrical Engineer."

We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.

Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

THE PHOENIX GLASS CO.

MANUFACTURERS OF

GAS AND ELECTRIC GLOBES, SHADES, Etc.

SEND FOR A COPY OF OUR NEW AND LATEST CATALOGUE.

Pittsburgh. New York. Chicago.

FIBRE-GRAPHITE COMMUTATOR BRUSH

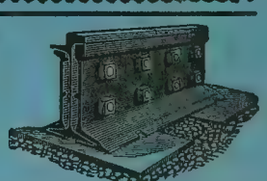
SELF-LUBRICATING NOISELESS

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO. 5155 Wakefield St., Germantown, PHILADELPHIA.

CONTINUOUS RAIL JOINT CO. OF AM.



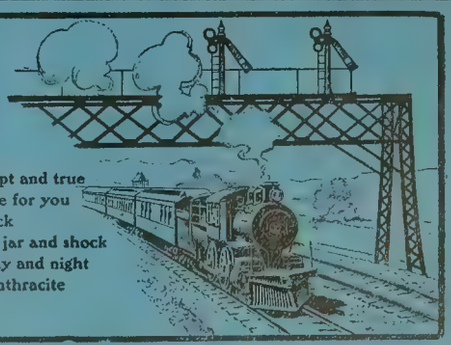
GENERAL OFFICES: CENTURY BUILDING,

NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.

Lackawanna Railroad

THIS IS THE ROAD OF ANTHRACITE.



These are the signals prompt and true
That make the journey safe for you
Over the bed of ballast rock
That keeps the trains from jar and shock
That smoothly run both day and night
On the dustless Road of Anthracite

ALL SIGNALS OPERATED EXCLUSIVELY BY

EDISON PRIMARY BATTERIES

Formerly Known as Edison-Lalande.

FULL DESCRIPTION IN BOOKLET NO. 4.

EDISON MANUFACTURING COMPANY

Factory, ORANGE, NEW JERSEY, U. S. A. New York Office, 83 CHAMBERS STREET. Chicago Office, 144 WABASH AVENUE

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

Weston Standard Illuminated Dial Station Ammeter, Style B. "Flush Type."

Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

LONDON—Elliott Bros., No. 101 St. Martins Lane

FOR HIGH GRADE

INSULATING VARNISHES

ADDRESS

STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

Mention the WESTERN ELECTRICIAN when writing for catalogues.

"Ceco."

Electrical Machinery.

includes

Direct Current Motors and Generators, Alternating Current Generators and Transformers.

For Lighting, Power and Railway Service.

Open Style Motor.

Enclosed Style Motor.

Our experience in building electrical apparatus is indicated by the fact that we have built

More than 6,500 Motors for direct connection to our air compressors used with our air brake equipments on electric cars throughout the world.

Write for Catalogue No. 27.

Christensen Engineering Company,

MILWAUKEE.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | BOSTON, 60 State Street. | BALTIMORE, Continental Trust Building. | DETROIT, Michigan Electric Company.

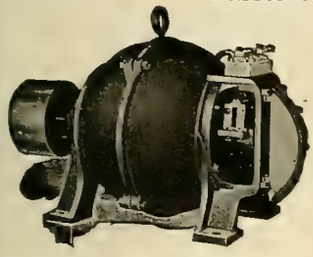
ST. LOUIS, Wainright Building. | NEW YORK, 100 Broadway. | CHICAGO, Marquette Building. | CLEVELAND, New England Building. | SAN FRANCISCO, Nevada Block. | HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

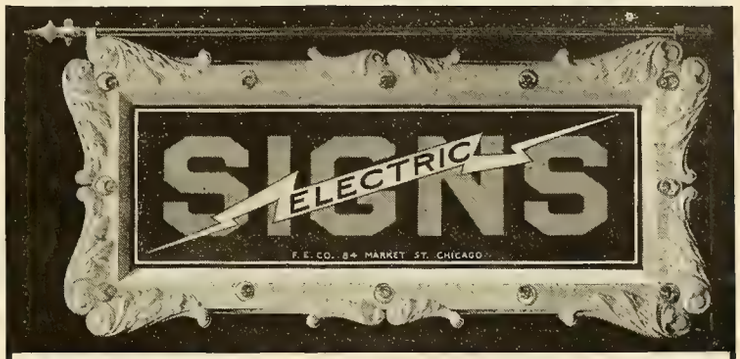
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..10
Akron Smoking Pipe Co.....—
Allen Company, L. B.....13
Allis-Chalmers Company....22
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....17
American Electrical Works..13
American Refl. & Lighting Co. 7
American School of Corresp. 7
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....19
Audel & Company, Theo.... —

Baker & Company..... 3
Bario Vacuum Co..... .....—
Barnett Company, G. & H....22
Barron & Co., J. S.....13
Bayley & Sons Co., W.....18
Beardslee Chandelier Mfg. Co.12
Beardsley Gravity Dam & Construction Co..... .....—
Berthold & Jennings.....19
Besly & Co., Charles H.....22
Bonville, Edward 11
Bossert El. Construction Co.. 1
Brooks, Hall L..... 19
Brown & Leasure..... 12
Buffalo Forge Co.....22
Camp Company, H. B..... 5
Central Electric Co..... 6
Central Manufacturing Co...—
Central Telephone & El. Co..—
Century Glass Co.....—
Chase-Shawmut Company...13
Chicago & Alton Railroad....20
& N. W. R. R.....20
Chicago Edison Company..4, 14
Chic. Fuse Wire & Mfg. Co...22
Chicago Insulated Wire Co..—
C., M. & St. P. R. R.....14
Chicago Pay Station Co.....16
Christensen Engineering. Co 2
Consumers Carbon Co..... 8
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 8
Cushing, H. C., Jr..... 9
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..18
Diamond Meter Company....—
Dixon Crucible Co., Joseph..18
Duncan Electric Mfg. Co.... 21
Edison Decorative & Miniature Lamp Department....12
Edison Mfg. Company..... 1
Edwards & Company.....15
Electrical Engineer Institute. 1
Electric Appliance Company.12
Electric Storage Battery Co.. 8
Electrician Pub. Company...20
Faries Manufacturing Co....—
Federal Electric Company... 3
Fisher Electric Company....13
"For Sale" Advertisements..14
Ft. Wayne Elec. Works., Inc.21
Fowler, John H.....19
Franklin Eng. & Elec. Co....17
Fulmer Lumber Co., D. M. ...19
General Electric Company... 4
General Incandescent Arc Light Company..... 9
General Incand. Lamp Co....—
Great Western Smelting & Refining Company.... 14
Gregory Electric Company...14

Hamblin & Russell Mfg. Co.. 8
Hartford Steam Boiler Inspection & Insurance Co...18
Hazard Manufacturing Co....22
Helios-Upton Company..... 5
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co..... 1
Hopkins & Co., A. P.....19
Huebel Company, C. J.....18
Humphrey, Henry H.....12

Illinois Electrical Mfg. Co...—
Illinois Maintenance Co.....14
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Internat'l Corres. Schools....15
International Tel. Mfg. Co. ..16

Jeffrey Manufacturing Co....18
Johnston, Thomas J.....13

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....17, 19
Klein & Son, Mathias.....19
Kohler Brothers. 12
Kokomo Tel. & El. M. Co....16
Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lindsley Brothers Company..19
Lowell Model Co..... 15

Machado & Roller..... 7
Maley, Martin..... 11
Maltby Lumber Company.. .19
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.15
Matthews & Bros., W. N.....13
Mayer, Geo. M.....16
McLennan & Company, K....12
McNamara Brothers 11
Metropolitan Tel. & El Co...16
Mica Insulator Company.....—
Miller Anchor Company 12
Miscellaneous Advs.....14
Monarch Fire Appl. Co.....17
Monon Railroad.....—
Moon Mfg. Co., The.....17
Morse Cedar Company.....19
Mott & Company, J. E.....16
Munsell & Co., Eugene.....12
Murdock Parlor Grate Co.... 8

National India Rubber Co.... 1
Naugle Tie Co., E. E 18
New York Ins. Wire Co..... 8
N. Y. Safety Steam Power Co.22
Norton Elec'l Instrument Co.—

Okonite Company, The..... 1
Osburn Flexible Conduit Co —

Paragon Fan & Motor Co.....—
Parsell & Weed.....16
Perrizo & Sons.....19
Phelps Company..... 8
Phillips, Eugene F.....13
Phillips Insulated Wire Co..13
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co.....19
Porter Cedar Company.....19

Rauscher, John .....—
Reisinger, Hugo..... 7
Reliance Electric Company..20
Replogle Governor Works.. .—
Reynolds Electric Company.—
Roebling's Sons Co., J. A.....20
Rooney-Westbury El. Lmp. Co.12
Rose Electric Company 14

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....14
Schott, W. H. 12
Schureman & Hayden.....14
Scientific Exchange.....14
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 12
Smith Co., S. Morgan.....18
Southern Pacific R. R.....16
Spies Electric Company..... 8
Sprague Electric Company... 3
Standard Pole & Tie Co.... .19
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 8
Stanley Instrument Co..... 9
Station Equipment Co.....14
Steam & Elec'l Equipment Co.14
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co.. 5
Sterling Electric Company...16
Sterling Varnish Co., The....12
Sterrett Pump Company.....15
Stilwell-Bierce & Smith-Vaile Company.....11
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 17
Sturtevant Company, B. F...22

Taylor Chemical Co.....11
Toerring Company, C. J 12
Torrey Cedar Company.....19
Triumph Electric Co.....12

U. S. Electric Mfg. Co.....17

Valentine-Clark Co., The....19
Vindex Electric Company....13
Vought-Berger Company 8
Vreeland, B. F. 18
Vulcanized Fiber Company..22

Wagner Electric Mfg. Co.....—
Wagor Mfg. Co., P. R..... 8
Walsh's Sons & Company....14
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....14
Whitmore, A. E.....19
Wickes Bros.....14
Willyoung, Elmer G.....—
Wisconsin Central R. R.....18
Wittenberg Cedar Co.....18
Worcester Company, G. H....19

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

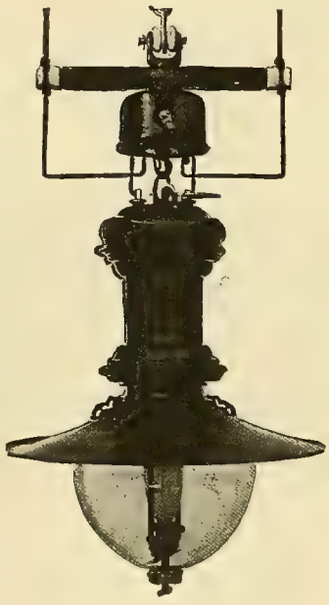
HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office, 15 Cortlandt St., New York.

(10928)

THE H. B. CAMP CO.

MANUFACTURERS OF

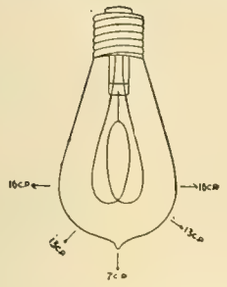
"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

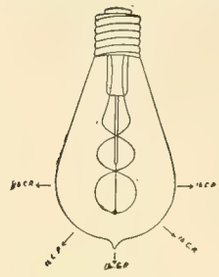
THE OTHER KIND.



Side	16 Candlepower
Angle	13 "
Tip	7 "
AVERAGE . . .	12 "

IT'S ONLY A LITTLE THING.

THE STERLING SPECIAL.



Patented February 1, 1902.

Side	16 Candlepower.
Angle	16 "
Tip	16 "
AVERAGE . . .	16 "

REGULAR TYPE LAMP 96 C. P. ÷ 12 C. P. = 8

STERLING SPECIAL LAMP 96 C. P. ÷ 16 C. P. = 6

TAKE THE AVERAGE CANDLEPOWER.

8 Regular Type Lamps 16 c. p. = 96 c. p. @ 56 Watts per Lamp = 448 Watts.
6 Sterling Special Lamps 16 c. p. = 96 c. p. @ 56 Watts per Lamp = 336 Watts.
2 Sterling Special Lamps 16 c. p. = 32 c. p. @ 56 Watts per Lamp = 112 Watts.

Do you want more light for the same current or do you want the same light for less current? It's up to you.

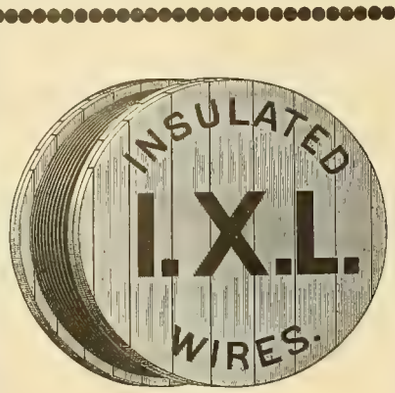
Sterling Electrical Manufacturing Company, WARREN, OHIO.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.



SEND FOR A SAMPLE

OF

I. X. L. WEATHER-PROOF WIRE

WE WANT YOUR ORDERS,

WHICH WILL BE FILLED FROM CHICAGO STOCK.

Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE :: :: :: CHICAGO.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Miller Anchor Company.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Cushing, H. C., Jr.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutler Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Compound.
Dearborn Drug & Chem. Wks.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Berthold & Jennings.
Brooks, Ifall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Wittenberg Cedar Co.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks.
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS
FOR DIRECT CURRENT
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY, NEW YORK.

There are no Carbons better than the "Electra" and none "just as good."

WITH THE KNOCK OF THE POSTMAN

comes a

TECHNICAL EDUCATION

of the Highest Quality to your very door.

Instruction by correspondence in the following subjects: **Mechanical, Electrical, Civil, Marine, Locomotive, Stationary and Sanitary Engineering, Navigation, Hydraulics, Architecture, Telegraphy, Sheet Metal Work, Mechanical and Perspective Drawing.** Also forty short special courses.

Instruction under Members of the Faculty of the Armour Institute of Technology.
Textile Course Under Foremost Authorities.

Young men not having the means to spend four years at college can begin their education in the American School of Correspondence, and later complete their courses by actual residence at the Armour Institute of Technology, as all work satisfactorily passed by students will be accepted by the Armour Institute. An exceptional opportunity to round out practical work with a course under teachers of recognized educational standing, who have at their command the equipment of a great resident technical school for testing and experimental work.

A Technical Reference Library (ten volumes) included with each full engineering course. Full particulars and a catalogue of courses may be had upon request. State subjects interested in.

AMERICAN SCHOOL OF CORRESPONDENCE
AT
ARMOUR INSTITUTE OF TECHNOLOGY.
CHICAGO, ILL.

THE POCKET VOLT AND AMMETERS

of the WHITNEY make are thoroughly accurate and reliable. They are built with powerful permanent magnets, jewel bearings, and have equally divided scales. Telephone battery and signal inspectors find them invaluable. You should not be without them.

STANDARD RANGES

VOLTMETERS.	AMMETERS.
0 to 3 Volts.	0 to 150 Milliamp.
0 to 5 Volts.	0 to 1 Ampere.
0 to 10 Volts.	0 to 2 Amperes.
0 to 15 Volts.	0 to 3 Amperes.

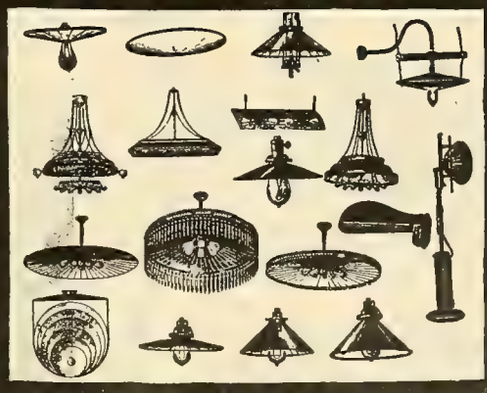
List price this range, $11.

SEND FOR CATALOGUE AND PRICE LIST.

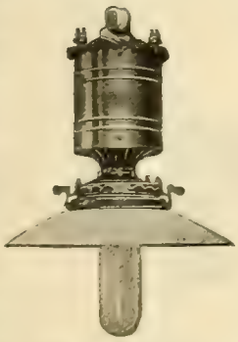
MACHADO & ROLLER,

GENERAL SELLING OFFICE OF
WHITNEY ELECTRICAL INSTRUMENT CO. 203 Broadway, New York, N. Y.

WRITE FOR ILLUSTRATED CATALOGUE



AMERICAN REFLECTOR & LIGHTING CO.
CHICAGO.



Street and Factory Lighting

Series Enclosed Arc Lamps

FOR OPERATION ON

Direct or Alternating Current

INTERCHANGEABLE PARTS—DIRECT CARBON FEED.

Western Electric Company

Chicago. Saint Louis. Philadelphia. New York.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street - - - - New York

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago Ill.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers
THE VOUGHT-BERGER COMPANY,
LA CROSSE, WIS., U. S. A.

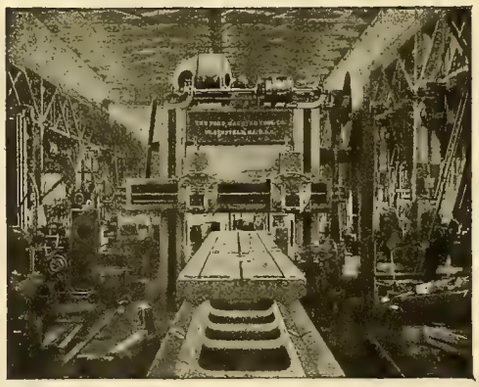
No. 4.

NAME PLATES
FOR MACHINERY.
We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.
No Plate Too Large or Too Small.
MURDOCK PARLOR GRATE CO.,
161 Boylston St., Boston, Mass, U. S. A.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

CROCKER-WHEELER COMPANY
AMPERE N.J.U.S.A

This nameplate on your Motor is the Guarantee of Excellence.

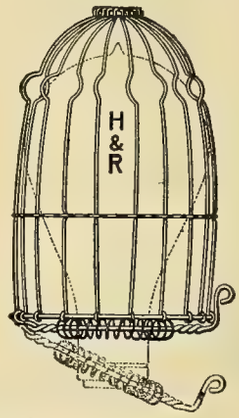


PROTECTION.

A GOOD INVESTMENT.
A Lamp Guard firmly fastened to socket protects completely.
THE P. R. WAGOR MFG. CO.,
SPRINGFIELD, MASS.

HYLO
TURN-DOWN LAMP
Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.
PHELPS CO., 50 State St., Detroit, U. S. A.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.
A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely.
Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.
HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

Grimshaw.

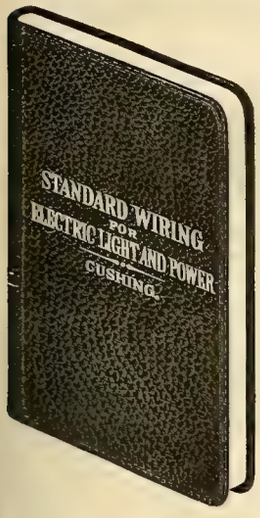
Raven White Core.

Raven Black Core.

ALL OUR WIRES pass Inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.



THE 1902 EDITION

STANDARD WIRING

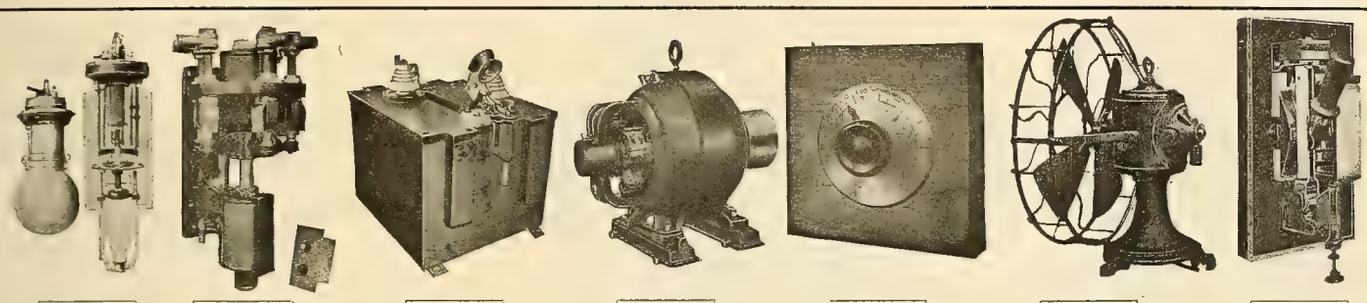
For Electric Light and Power.

ADOPTED By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 47,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

FLEXIBLE LEATHER COVER (Pocket Size) $1. Send postpaid upon receipt of price, by

H. C. CUSHING, JR., St. Paul Building, New York, N. Y.



BULLETIN No. 172 | BULLETIN No 64 | BULLETIN No. 53 | BULLETIN No. 164 | BULLETIN No. 155 | BULLETIN No. 162 | BULLETIN No. 152

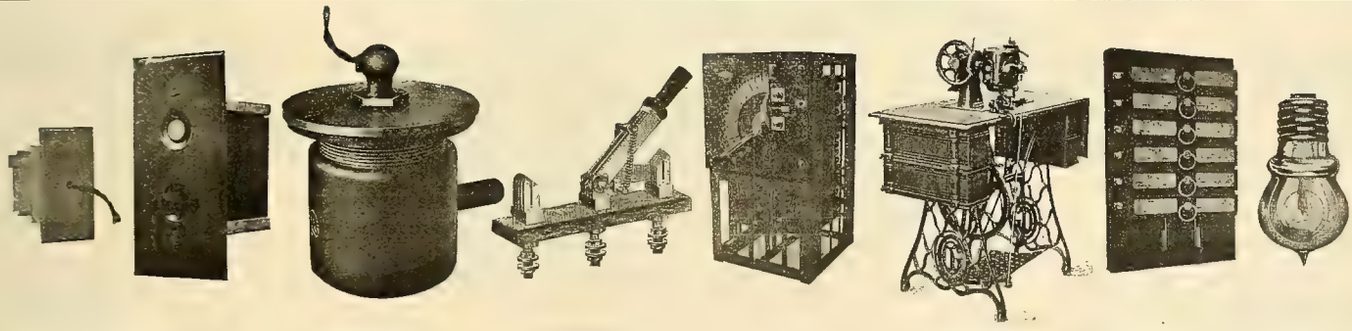
TRADE **G. I.** MARK

STANDS FOR ELECTRICAL AND MECHANICAL PERFECTION.

Bulletins, Blueprints, Photographs, Estimates, Etc., Mailed Upon Application.

GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK, N. Y.

220 Devonshire St., Boston, Mass.
48 West Jackson Blvd., Chicago, Ill.
638 Century Bldg., St. Louis, Mo.
1732 Champa St., Denver, Colo.
510 New England Bldg., Cleveland, Ohio.
319 Hayward Bldg., San Francisco, Cal.
57 Perin Bldg., Cincinnati, Ohio.
115-117 Cannon St., London, E. C. Eng.



BULLETIN No. 54 | BULLETIN No. 94 | BULLETIN No. 50 | BULLETIN No. 240 | BULLETIN No. 65 | BULLETIN No. 51 | BULLETIN No. 190

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO.

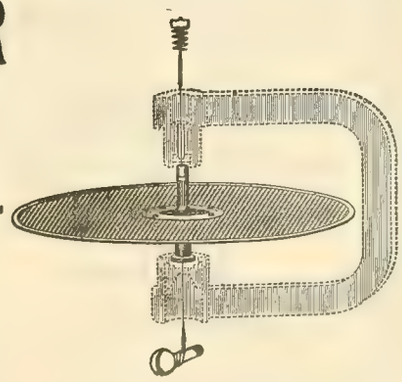
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR **ALTERNATING CURRENT**
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



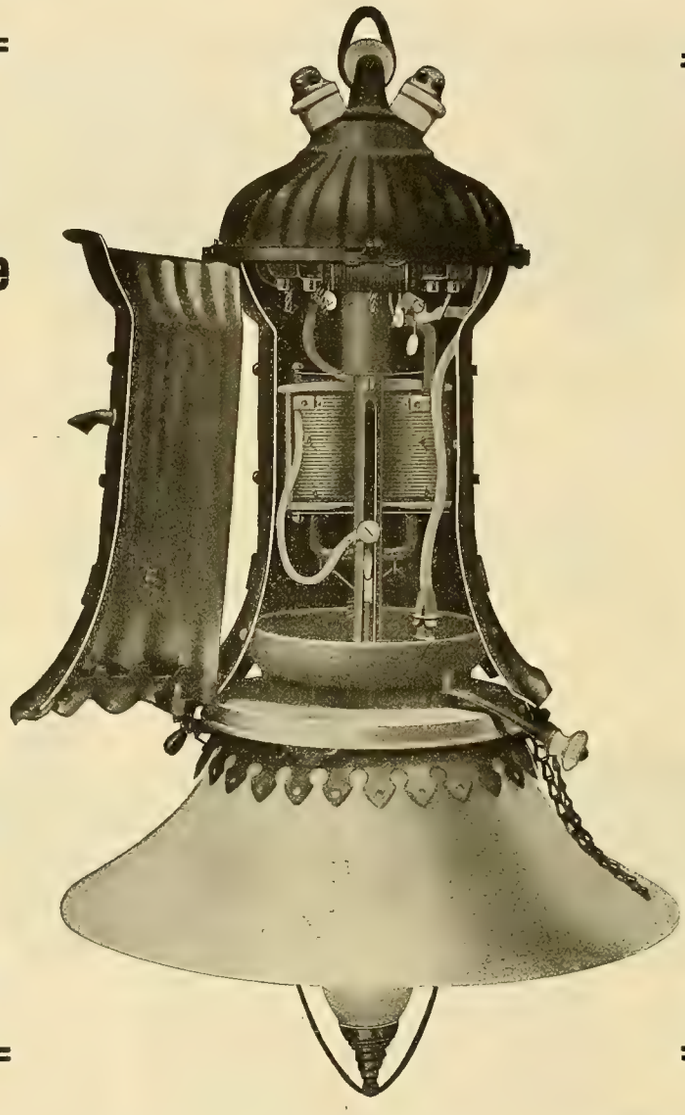
STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market. It's good to look at and built to stand the most severe service. Never has been beaten in a competitive test.



Their Efficiency and Regulation are Perfect. Easiest lamp to trim made. Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. C. POMEROY,
No. 309 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
C. A. THOMSON,
No. 136 Liberty Street.

THE BEST
VERMONT SLATE
FOR
Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY.

Suite 510 Marquette Bldg., Chicago.

When You Save Steam,

You Economize in Fuel, and

ECONOMY OF FUEL means an increased bank account. This result is secured by

Stilwell's Feed-Water Heater.

It uses EXHAUST STEAM and delivers PURE HOT WATER TO YOUR BOILERS.

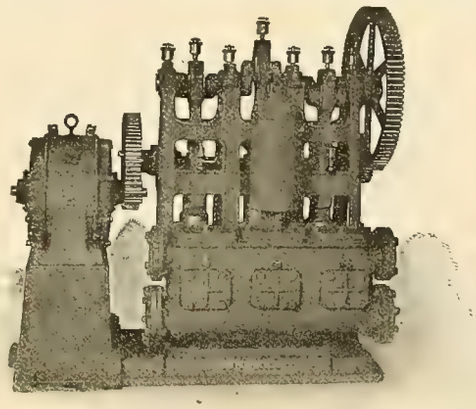
We also make STEAM POWER and ELECTRIC PUMPING MACHINERY for all purposes, including

Water Works Pumps,

Jet and Surface CONDENSERS, AIR COMPRESSORS,

Cottonseed and Linseed Oil Machinery, Filter Presses and Victor Turbines.

IF INTERESTED ADDRESS



The Stilwell-Bierce & Smith-Vaile Co.,
P. O. Box 257, DAYTON, OHIO, U. S. A.

THE
TAYLOR CHEMICAL CO.

PENN YAN, N. Y.

Capital Stock, - $500,000. Par Value, - -$10.00 Per Share.

Officers: Edward R. Taylor, Penn Yan, N. Y. Edward J. Hutchinson, Cincinnati, O., V.-Pres. C. A. Taylor, Penn Yan, N. Y., Sec. and Treas.

More than three million pounds of goods made by a new electrical process. Fully demonstrated and a complete success. Manufacture of many chemicals placed on an entirely new basis. Fully protected by patents. See Electrical World and Engineer of Dec. 21, 1901, page 1028; Electrical Review of Feb. 1st, 1902, pages 143-4-5, and Harpers Weekly, May 17, page 641. The U. S. Census Bulletin, No. 210, June 25th, page 58, says: "One of the most ingenious as also one of the most recent chemical applications of electricity." Good chance to get in on the ground floor of an industry that is sure to have a large future. Long established business. Present rate of production insures an 8 per cent. dividend from the start. Limited amount of stock for sale. For particulars apply to

EDWARD R. TAYLOR, Penn Yan, N. Y.

FOR DAMP PLACES

There is preeminently one thing to use

NEWGARD COMBINED WATERPROOF GLOBE AND RECEPTACLE.

No socket or other attachment necessary.

Strong, durable and the only article of its kind that is an absolute protection to the lamp.

Send for special circular showing three different styles.

"MAKES A WET JOB DRY."

ELECTRIC APPLIANCE COMPANY,

ELECTRICAL SUPPLIES, CHICAGO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.,

218 Water St., New York. 117 Lake St., Chicago.

MOST ANY MAN

Can Make a Dollar, but it takes

A WISE MAN

to know how to save a dollar. By using Toerring Arc Lamps you can save several dollars per annum on each lamp. We guarantee a carbon life of over 200 hours, and we guarantee you against burnt-out magnets. Correspondence invited.

PHILADELPHIA, 19th St. and Allegheny Ave.
NEW YORK, 39 Cortlandt St.

C. J. TOERRING CO.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS

AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

Cale's Commutator Compound.

The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

50c. per stick. $5.00 per dozen Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street, - CHICAGO.

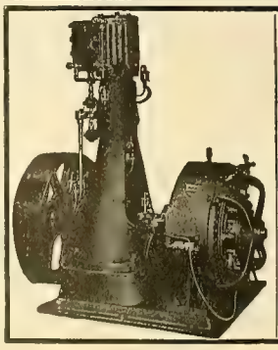
BEARDSLEE CHANDELIER MFG CO. 256 AND 257 S. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

THE MILLER ANCHOR.

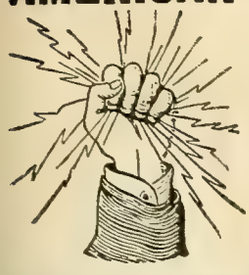
Write us for Prices on Anchors and Augers. All Sizes Made.

MILLER ANCHOR CO.
NORWALK, OHIO.

FRANK N. PHILLIPS, PRESIDENT. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. H. WAGENSEIL, TREASURER. G. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, "Eugene F. Phillips' Electrical Works
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

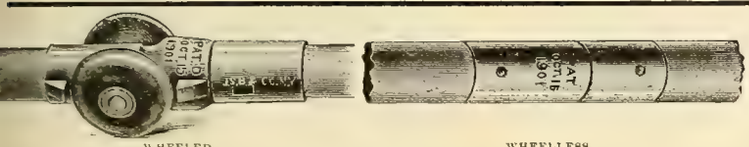
Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

NEVER TOO LATE TO MEND
faulty wiring with the
ALLEN SOLDERING STICK!
Makes solder flow ON ANY METAL.
SAMPLE STICK FREE.

L. B. ALLEN COMPANY, Inc.
Sole Manufacturers
1334 Columbia Avenue, CHICAGO.

L B Allen
This signature on a pink label protects you from expensive, unsafe imitations.



WHEELED. WHEELLESS.

Villard Automatic Wheeled and Wheelless Conduit Rods
Are Coupled and Uncoupled Instantly and with Ease.

Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.

TRANSFORMERS.
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

BOOKS.
BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

We are offering a few "used" Outriggers, illustrated herewith, together with Eddy self-locking windlass and one break arm shown midway on the pole between the windlass and the arm, at very attractive figures.

W. N. MATTHEWS & BRO.,
603 Carleton Building, - - ST. LOUIS.

TO CONTRACTORS
USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion, additional words 2c each*

POSITION WANTED.

Cable splicing, aerial underground and submarine high tension telephone and telegraph. Address OTIS ROOKER, care Stark Co. Telephone Co., Canton, O.

SITUATION WANTED.

By graduate of mechanical drafting course, to get working experience in shop practice and chance for advancement. Top wages not expected at first. Address BOX 130, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By an electric-light engineer. Wishes position in country plant. All around workman; 15 years' practical experience; understands installing and repairs. Good references. Address with particulars, BOX 128, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

Immediately by reliable, energetic man, 24, with telephone company as all around man. Am willing to start down provided given chance of promotion. Have charge of plant of 175. Reasons for change good. Six years' practical as well as theoretical experience. Can furnish references. Address CENTRAL OFFICE, Raphine, Virginia.

WANTED.

Electrical salesman to handle a new and superior arc cut-out as a side line. Address BOX 129, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A second-hand 45-lt. 1,200 C. P., T-H arc dynamo, all complete and in good operative condition with wall controller and ammeter, **but without armature.** RAPID CITY ELECTRIC & GAS LIGHT CO., Rapid City, So. Dak.

POSITIONS OPEN.

	PER MONTH.
1 Electrical Superintendent	$100
7 Draftsmen, Electrical, East	$100
4 Draftsmen, Structural Steel	$125
4 Draftsmen, Bridge	$75 up.
2 Armature Winders, must be gilt edge	$100
2 Surveyors.	

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.
SEE NEXT ISSUE.

FOR SALE.

Forty T. H. K. 2-series open arc lamps in good condition. For particulars and price address,
Dodge Mfg. Co., Mishawaka, Ind.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450
ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley Inductor, with exciter.
2—20 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2—90 K. W. General Electric type A. S. 90.
1—90 K. W. Westinghouse.
4—75 K. W. Wood.
6—60 K. W. General Electric A. 60.
2—60 K. W. Westinghouse.

Large stock of direct-current machines.
Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain WALSH'S SONS & CO. 261 Washington St. Newark, N. J.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.
WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN.
140 S. Clinton St., Chicago.

Wanted Central Station Managers
And Users of Machinery
TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger, more improved or more modern.

We have the following Quick Shipment Bargains:—
1—200 8—½ Harrisburg Ideal Engine,
1—16x16 Erie Ball Engine,
1—15x15 " " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine.
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps.

A. G. SCHOONMAKER CO.,
126 Liberty St., New York City, U. S. A.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

FOR SALE.

1—300 K. W., G. E. M. P. 8 St. Ry. generator to Corliss engine.
1—200 K. W., St Ry. plant, G. E. generators, Corliss engines.
1—216 K. W., Stanley 2 phase 133-cy. generator.
1—180 " " " " " " "
1—100 K. W., G. E. generator, 110 or 220 volts to St. Line engine.
1—80 K. W. Eddy to 13x18 Russell, 110 volts.
1—55 K. W., M. P. Churchward, 125 volts.
1—22½ " " " " " "

CORLISS ENGINES.

1—24x42 Wright Corliss.
1—20x30x42 Allis Cross Compound.
1—18x48 C. H. Brown.
1—14x36 Reynolds.

AUTOMATIC ENGINES.

1—18x24 Noye Mfg. Co., 300 H. P.
1—16 x16 Erie Ball, 200 H. P.
7—13x22x13 Westinghouse Cpd., 125 H. P.

Write for complete list.
Steam and Electrical Equipment Co., Pittsburg, Pa.

NOTICE.

Sealed proposals will be received until November, 15, 1902, for the furnishing of one hundred arc lights to light the city of Baton Rouge. Specifications can be obtained by addressing EDWARD WAX, Secretary of the Water and Lighting Committee, Baton Rouge, La.

IT'S UP TO YOU.

We pay highest market prices for
SCRAP COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.
WRITE US.
We Manufacture Copper Hard Babbitt
the best on earth for electrical work. Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.
GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Allis Heavy Duty Automatic.
11¼x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

One Geary Water Tube Boiler, 175 H.P. for 150 pounds pressure, almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 H. P. Berryman Heater.
600 H. P. Berryman Heater.
125 H. P. Berryman Heater.
500 H. P. Excelsior Heater.
6 x 4 x 6 and 5¼ x 3½ x 5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD.

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE.
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

STATION EQUIPMENT COMPANY,

539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—200 K. W. 60-cycle, two-phase Stanley alternators, 2,750 or 5,500 volts.
2—150 K. W. 60-cycle, three-phase Stanley alternators, 2,750 or 5,500 volts.
1—200 K. W., W. A. L. type, Ft. Wayne wood alternator, 133-cycle, three bearing, 1,100 or 2,200 volts, compound wound, complete with exciter.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K.W. Edison bi-polar railway generators.
2—100 K.W. Edison bi-polar railway generators.
4—100 K.W. Edison bi-polar 140 volt generators.
1—45 K.W. Edison bi-polar 140 volt generator.
2—30 K.W. Edison bi-polar 140 volt generators.
1—30 K.W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.

All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety.
1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, E. H. CHENEY, Manager.
204 Dearborn St., CHICAGO.

Preserve Your Copies OF THE WESTERN ELECTRICIAN.

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, ... CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP
IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

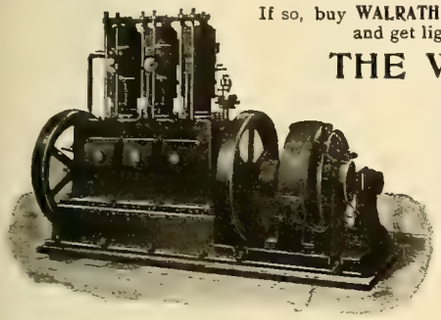
Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original All Modern Machinery fully described and explained Technical Points made Clear by Word and Drawing Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,

510 Marquette Bldg, Chicago.

From Electrician to Chief Engineer.

The correspondence method is the only method for the man with little spare time to improve his prospects, and of correspondence methods, the I. C. S. is the best. At the time of enrolling I was employed as electrician at the Indiana State Prison; but, as a result of my I. C. S. training, I have been promoted to the position of chief engineer, my salary has been increased 68%, and my hours of work shortened. R. E. CROCKETT, Michigan City, Ind.

We have hundreds of indorsements just as strong and convincing as the foregoing. You owe it to yourself to find out just what we can do for ***you.*** Our advice has put many a man on the road to progress and prosperity. You should ask it at once.

Fill Out and Send in the Coupon TODAY!

International Correspondence Schools,
Box 1002, Scranton, Pa.

Please explain how I can qualify for position marked X below

Electrical Engineer	Mechanical Draftsman	Textile Designer
Elec. Machine Designer	Refrigeration Engineer	Sanitary Engineer
Electrician	Steam Engineer	Contractor and Builder
Electric Lighting Supt.	Marine Engineer	Arch. Draftsman
Electric Railway Supt.	Civil Engineer	Sign Painter
Telephone Engineer	Hydraulic Engineer	Chemist
Telegraph Engineer	Municipal Engineer	Sheet-Metal Draftsman
Wireman	Bridge Engineer	Bookkeeper
Dynamo Tender	Railroad Engineer	Stenographer
Motorman	Architect	To Speak French
Mechanical Engineer	Cotton Mill Supt.	To Speak German
Machine Designer	Woolen Mill Supt.	To Speak Spanish

*Name*_____ *St. and No.* _____

*City*_____ *State* _____

NOTICE IS HEREBY GIVEN, that the Common Council of the city of Superior, Wis., with a view to granting a franchise, has caused to be prepared and has by resolution adopted full specifications containing rules and regulations for the construction, maintenance and operation of a plant for the distribution of electric currents throughout said city, for the purpose of supplying said city and the inhabitants thereof with electricity for power, heat and lighting purposes, and for the conduct of such business.

Said specifications contain, among other things, the maximum rates which may be charged by the grantee of such franchise to patrons or consumers and for annual statements, sworn to by the manager and treasurer of the company operating under such franchise to be made to the Common Council of the gross receipts of the business carried on under such franchise. Said specifications are on file and of record in the office of the city clerk of said city.

Request is hereby made that proposals be submitted stating what percentage of the gross receipts from the business carried on under the franchise the bidder will pay annually into the treasury of said city in consideration of receiving a franchise according to said specifications.

Each person presenting a bid shall accompany such bid with a certified check of some national bank of the United States in the sum of one thousand dollars ($1,000), payable to the order of the treasurer of the city of Superior, Wis., as a guarantee of the acceptance of the franchise, if such bid is accepted and a franchise granted in accordance with the specifications and the laws of the state of Wisconsin, and for the giving of a bond in the sum of one thousand dollars ($1,000), as in said specifications provided.

Sealed bids will be received for a franchise to be granted according to said specifications, said bids to be opened at a meeting of the Common Council of said city, to be held November 18, 1902.

This advertisement is made pursuant to directions contained in a resolution of said Common Council passed at a meeting thereof held in the council chamber in the city of Superior, Wis., on October 14, 1902. Said resolution was approved by the mayor October 16, 1902.

Dated at Superior, Wis., this 18th day of October, 1902. JOHN A. HOBE,
Clerk of the City of Superior, Wis.

GASOLINE MOTORS

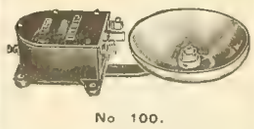
—FOR—
BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

EDWARDS AND CO.

THE "RECTI" BELL

FOR AUTOMOBILES AND ELECTROMOBILES.



No 100.

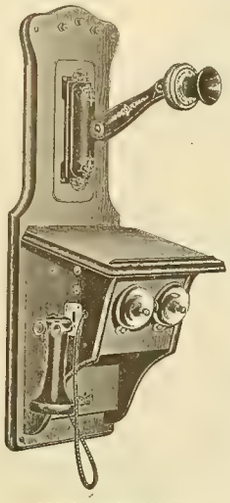
This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.

NEW YORK, N.Y.

ONE YEAR'S RECORD

—IN—

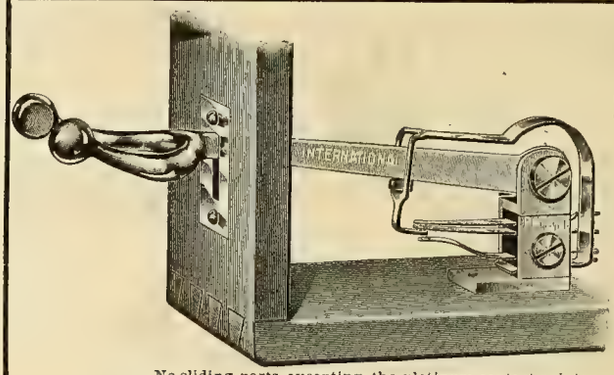
COMMON BATTERY WORK.



Toledo, Ohio	12,000 capacity
Houston, Texas	6,000 capacity
Cedar Rapids, Iowa	5,000 capacity
Clarksville, Tennessee	2,500 capacity
Davenport, Iowa	5,000 capacity
Freeport, Illinois	2,500 capacity
Galesburg, Illinois	3,000 capacity
Ironton, Ohio	2,500 capacity
Joplin, Missouri	5,000 capacity
Lima, Ohio	5,000 capacity
Lorain, Ohio	3,000 capacity
Marion, Ohio	3,000 capacity
Moline, Illinois	2,000 capacity
Newark, Ohio	3,000 capacity
Canton, Illinois	2,000 capacity
Peru, Indiana	2,500 capacity
Paris, Kentucky	2,500 capacity
Rockford, Illinois	5,000 capacity
Rock Island, Illinois	3,500 capacity
Terre Haute, Indiana	2,000 capacity
Wichita, Kansas	5,000 capacity
Ottawa, Illinois	2,000 capacity

WHY CAN'T WE ADD **YOU** TO THIS LIST?

STERLING ELECTRIC CO.,
LAFAYETTE, IND.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

—Sold by—
THE MAYER ENGINEERING CO.
Monadnock Block,
Chicago, Ill., U. S. A.
WRITE FOR PRICES.

CHICAGO TELEPHONE PAY STATIONS and METERS

Have unique patented features giving them exceptional value.
WRITE FOR CIRCULAR.

Chicago Pay Station Co.,
130 LA SALLE AVE.,
CHICAGO.

A Prosperous State.

The whole great empire of California is rapidly developing. It was long said of this sunny and attractive region that "man cannot live upon climate," but when it was seen that Southern California had something more substantial than sunshine to offer, cities rose like exhalations, and deserts became fruitful fields. The same discovery is being made in Northern and Central California. The climate is seen to be a unit throughout the state, and industrial opportunities are seen to go with the climate, and business advantages with the winterless skies.

San Francisco's trade has nearly doubled in the past few years, and her foreign tonnage since 1895 has been multiplied by fifteen. Banks and savings banks show an enormous increase in commercial deposits and in the savings of the people, while a glance at the records of the building trades shows everywhere immense activity. There are no indications of a local or temporary boom. The growth of irrigation and the multiplication of farms; the discovery of oil and its widening use as fuel in mines and manufactories, and on engines and steamers; the enlarging markets for California products in China, Japan, Hawaii and the Philippines, and the increasing trade with the west coast of Central and South America and with Australia, is sufficient to show that the prosperity of the state has a natural and healthful root.

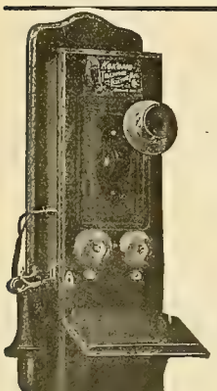
Settlers' rates, based upon a $33 fare from Chicago, during September and October, are bringing in a host of home-seekers. This is a daily rate, and particulars may be had at any agency of the Southern Pacific. With the best climate, from the fewest acres, with the least labor, California will yield a wider range of harvest, and pay larger profits, and more dividends in comfort, than any land in the world.

The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.

3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 8 candle-power lamps. Parts $3 50, 86, 88.50. Complete $12.50. Write for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.

CONTRACTORS

CONSULTING, MECHANICAL AND ELECTRICAL

ENGINEERS

ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

Do You Think?

A COMPANY THAT HAS THE REPUTATION OF MAKING THE HIGHEST GRADE OF TELEPHONE AND SWITCHBOARD APPARATUS WOULD MAKE THIS STATEMENT IF THEY WERE NOT DEAD SURE THEY COULD BACK IT UP.

KELLOGG TRANSMITTERS Guaranteed

BETTER than the "BELL SOLID BACK."

WE STAND READY TO PROVE THIS STATEMENT.

Write for new booklet -- "The Express and some of it's stopping places."

Kellogg Switchboard & Supply Co.
229 South Green Street, CHICAGO.

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

Kilfyre
DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

It's No Secret...

That the proper illustration in an **Ad.** pays for itself and the entire space of the ad.

WE MAKE THE PROPER KIND ...
TRY THEM AND SEE

Real order fetchers
Full of force...

Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

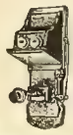
This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

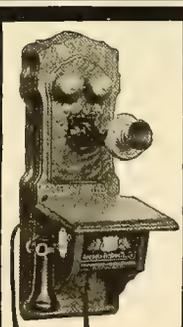
"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

STROMBERG-CARLSON TELEPHONE MFG. CO.



ROCHESTER, N. Y. **CHICAGO, ILL.**

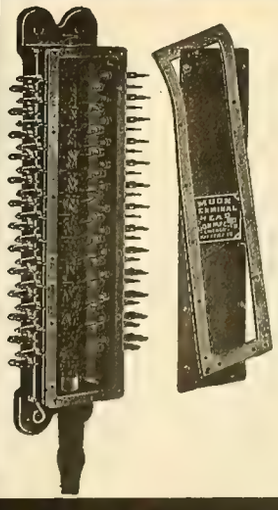


LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



MOON TERMINALS

WITH

METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

80 PER CENT OF THE TUBES YOU ARE LOSING CAN BE SAVED BY USING **DEARBORN BOILER COMPOUNDS** MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

GRAPHITE RESISTANCE.

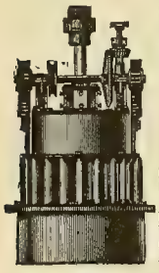
Graphite resistance in rods, tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

REG. TRADE MARKS

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

NEW CATALOGUE ELEVATING = CONVEYING — MACHINERY — NOW READY SEND FOR COPY JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

CEDAR POLES.

WITTENBERG CEDAR CO., Wittenberg, Wis.

A LARGE STOCK AT LOW PRICES.

CEDAR POLES AND TIES

WRITE FOR PRICES

E. E. NAUGLE TIE CO.

135 ADAMS ST. CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

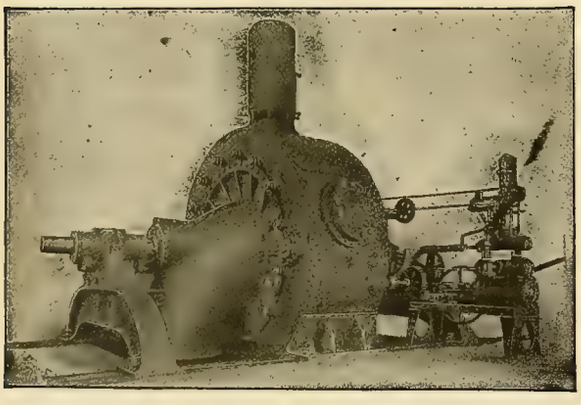
C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.



SAMSON TURBINE

UNEXCELLED FOR DRIVING

ELECTRICAL MACHINERY.

Special Features:

HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.

WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

HIGH-GRADE

ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS

AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer,
L. F. MIDDLEBROOK, Asst. Secretary.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

PRICES:—OUR STRONG POINT.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

SPECIAL PRICES.

25 foot 7 inch—No. 1 Michigan Cedar Poles.
25 foot 8 inch—No. 1 Michigan Cedar Poles.
30 foot 6 inch—No. 1 Michigan Cedar Poles.

5,000 READY FOR IMMEDIATE LOADING.

If you require any of the above sizes, or any other size pole for fall construction, it will pay you to write us at once.

THE MORSE CEDAR CO., Saginaw, Mich.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1705-7 FISHER BLDG. CHICAGO.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

M. KLEIN & SON.

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

CEDAR POLES

LONG DISTANCE PHONE WRITE US

A. P. HOPKINS & CO. ESCANABA, MICH.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

CEDAR POLES OF ALL LENGTHS AND SIZES.....

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO SOAKS DAGGETT MICH.

POLES. W. C. STERLING & SON, MONROE, MICH. TIES.

Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

SOUTHERN White Cedar Poles

THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.

Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.

STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

Send your Book Orders to

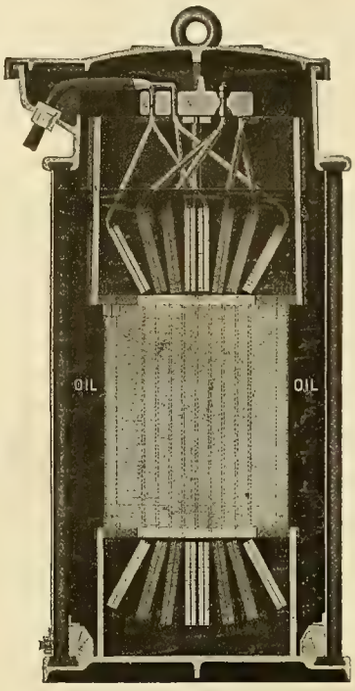
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

CEDAR POLES

THE VALENTINE-CLARK CO.,

234 LA SALLE ST, CHICAGO

YARDS: PINCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.



Are you operating for 50 or 100-volt lamps?

May you not want to introduce a 220-volt service?

The

Westinghouse

Type N

Transformer

gives all three voltages

PRIMARY	SECONDARY	
	Class 200	Class 400
1050	52½-105-210	105-210-420
	58 116-232	116-232 464
2100	52½-105-210	105-210 420
	55-110-220	110-220-440
	58-116-232	116-232-464

With 1,000 and 2,000 volt primaries, the secondary voltages are proportional.

FOR TRANSFORMER BOOKLET ADDRESS NEAREST SALES OFFICE OF THE

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Sales Offices in All Large Cities.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

AMERICA'S MOST POPULAR RAILWAY
CHICAGO AND ALTON
PERFECT PASSENGER SERVICE

BETWEEN

CHICAGO AND KANSAS CITY,
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

THROUGH PULLMAN SERVICE BETWEEN CHICAGO AND

HOT SPRINGS, Ark., DENVER, Colo.,
TEXAS. FLORIDA. UTAH.
CALIFORNIA AND OREGON.

IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE CHICAGO & ALTON, IT WILL PAY YOU TO WRITE TO THE UNDERSIGNED FOR RATES, MAPS, TIME-TABLES, ETC.

GEO. J. CHAMLTON,
GENERAL PASSENGER AGENT,
CHICAGO, ILL.

NOW

IS THE TIME TO

SUBSCRIBE

TO THE

Western Electrician

WRITE FOR PARTICULARS.

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

CROSS SECTION OF CORE AND COILS.

Efficient use is made of every inch of space and a most liberal use of copper is made possible in type A Transformers by the above construction.

TYPE A REGULATION

The shell type transformer constructed as is the "Wood" Type A, with interspersed primary and secondary windings is THEORETICALLY capable of giving closer regulation than any other standard commercial design.

Type A Transformers maintain an average regulation of two per cent. from no load to full load and preserve equal voltages on both sides of three-wire circuit with maximum unbalanced conditions.

FORT WAYNE ELECTRIC WORKS.

MAIN OFFICE AND FACTORY, FORT WAYNE, IND.

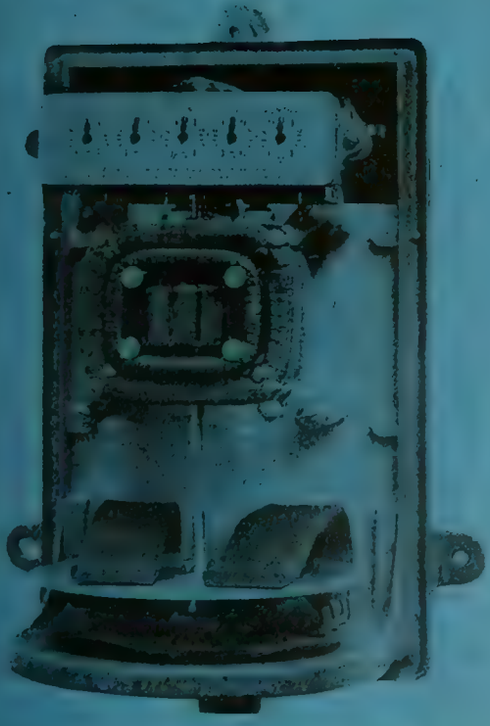
BRANCH OFFICES:

Boston, Mass., 518 Exchange Bldg.
Syracuse, N. Y., 717 Dillaye Bldg.
Chicago, Ill., 623 Marquette Bldg.
New York, N. Y., 40 New St.
Philadelphia, Pa., 1100 Penn Sq. Bldg.
St. Louis, Mo., 818 Lincoln Trust Bldg.
St. Paul, Minn., 615 Germania Life Bldg.
Grand Rapids, Mich., 222 Houseman Bldg.
Pittsburg, Pa., 902 Fifth Ave.
Cincinnati, O., 402 Neave Bldg.
Atlanta, Ga., 8 South Broad St.
Yokohama, Japan, Bagnall & Hilles.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS

Possesses Many Up-To-Date Features.



JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF ELECTRICITY METERS. LAFAYETTE, IND.

A NEW PAPER-WEIGHT.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

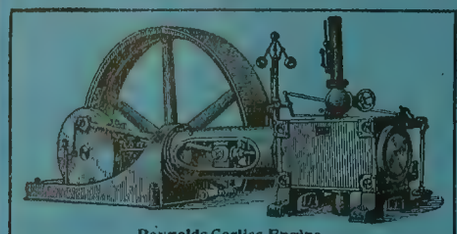
We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



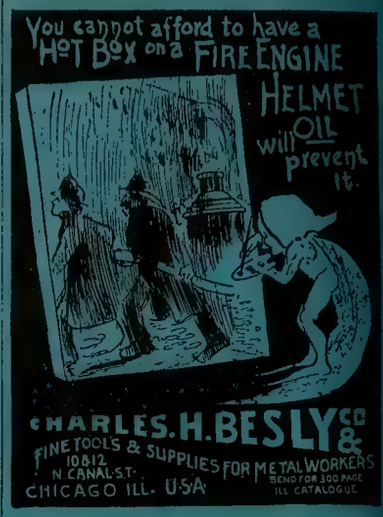
Reynolds Corliss Engine.

Sole Builders of

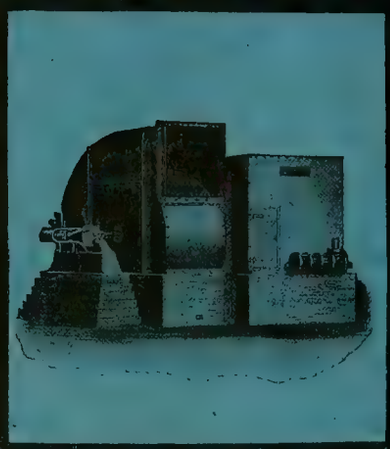
REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.



STURTEVANT SYSTEM OF HEATING & VENTILATION



Centralized plant.
No scattered steam piping.
Utilizes exhaust steam.
Send for Catalogue No. 84

B. F. STURTEVANT Co. BOSTON,
NEW YORK · PHILADELPHIA · CHICAGO · LONDON ·

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER COVERED, WEATHERPROOF **WIRES AND CABLES.**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 90 Pine St. CHICAGO OFFICE, 1201-2 Marquette Bldg

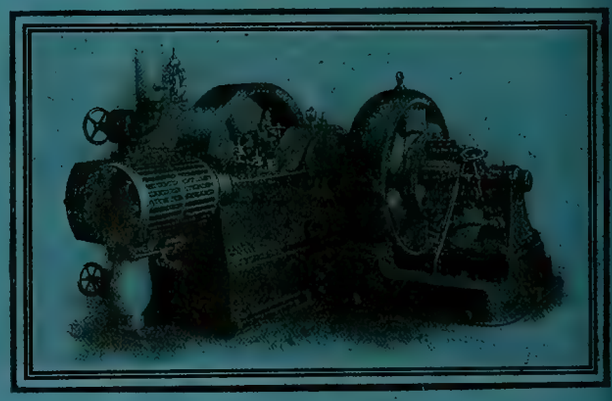
AUTOMATIC ENGINES

—VERTICAL OR HORIZONTAL—

PISTON VALVES

SELF OILING

CONTROLLED BY NICHOLS GOVERNOR FOR HEAVY DUTY BELTED OR D. C.



Boston, New York, Philadelphia, San Francisco. N. Y. SAFETY STEAM POWER CO., 60 S. CANAL ST., CHICAGO ILL.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

C. & H. BARNETT COMPANY

PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES

SIMPLE COMPOUND FOR ELECTRIC LIGHT AND POWER SERVICE VERTICAL HORIZONTAL

SEE NEW CATALOGUE

BUFFALO FORGE COMPANY

BUFFALO, N.Y.

NEW YORK PHILADELPHIA CHICAGO PITTSBURG

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 8, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 19.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 76-81 Cornhill, BOSTON, MASS.

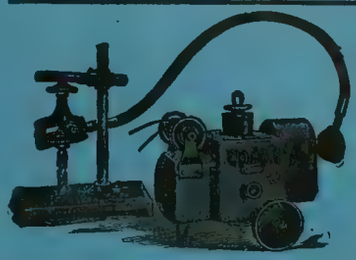
AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co. 151 Lake St.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, M. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.


ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.

2,000 IN USE.
Bipolar and Multipolar Motors from ⅓ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg Co. Troy, Ohio

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

The Franklin Gas Engine
One-Half Horsepower.
Worth $100 complete. We sell all necessary castings, materials and detail drawings for $15.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

J. E. MOTT & CO.
HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.
Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Galveston, Texas.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Millivoltmeter.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
Mention the WESTERN ELECTRICIAN when writing for catalogues.
LONDON—Elliott Bros., No. 101 St. Martins Lane.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

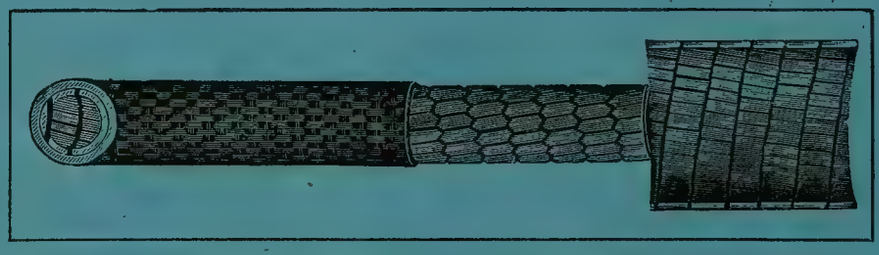
STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

FLEXDUCT

For Interior Wiring
The Superior Product

The interior of "Flexduct" remains intact under all circumstances because it is an inseparable part of the conduit.



Here are some of the advantages of "Flexduct."

The interior cannot be ripped out, because it is an inseparable part of the conduit—no possibility of ripping out the inside when installing wires too large for the conduit or when fishing wires through it.

With part of the interior of a conduit gone, and the insulating properties seriously impaired, the installation cannot possibly meet the requirements of first-class work.

When "Flexduct" is used, every foot is absolutely intact and uninjured.

"Flexduct" is positively moisture-proof—made so by closely weaving together a special fibre with a special warp and by treating the conduit with a special compound to fill up the pores.

Send for booklet—also a sample of "Flexduct," and carefully examine its smooth interior; its longitudinal interweaving; test its strength, and satisfy yourself that "Flexduct" is the best flexible conduit that has ever been manufactured for interior wiring.

Osburn Flexible Conduit Co.,

General Sales Offices, 21 Park Row, New York City.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | BOSTON, 60 State Street. | BALTIMORE, Continental Trust Building. | DETROIT, Michigan Electric Company.

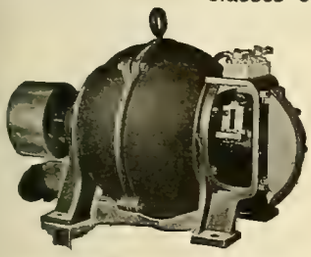
ST. LOUIS, Wainright Building. | NEW YORK, 100 Broadway. | CHICAGO, Marquette Building. | CLEVELAND, New England Building. | SAN FRANCISCO, Nevada Block. | HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

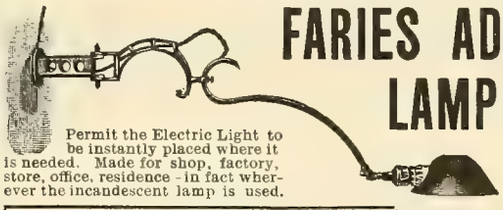
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

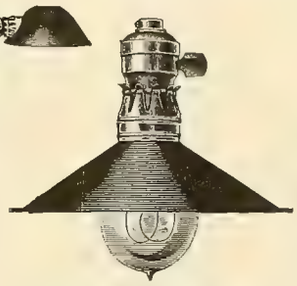


FARIES ADJUSTABLE LAMP HOLDERS

Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.

WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers. *Send for Catalogue No. 10, just issued.*



FARIES MFG. CO., DECATUR-ILL.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

BAKER & CO.,

MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.—
Akron Smoking Pipe Co. 8
Allen Company, L. B. 13
Allis-Chalmers Company 22
American Battery Co. 16
Amer. Electrical Heater Co. 22
Amer. El. Telephone Co. 17
American Electrical Works. 13
American Refl. & Lighting Co. 22
American School of Corresp. —
Amer. Steel & Wire Company 1
Anderson & Sons, W. H. 19
Audel & Company, Theo. 9
Baker & Company 3
Bario Vacuum Co. —
Barnett Company, G. & H. 22
Barron & Co., J. S. —
Bayley & Sons Co., W. 18
Beardslee Chandelier Mfg. Co. —
Beardsley Gravity Dam & Construction Co. 9
Berthold & Jennings. 19
Besly & Co., Charles H. 22
Bonville, Edward 13
Bossert El. Construction Co. 1
Brooks, Hall L. 19
Brown & Leasure 12
Buffalo Forge Co. 22
Camp Company, H. B. 7
Central Electric Co. 5
Central Manufacturing Co. 19
Central Telephone & El. Co. 16
Century Glass Co. —
Chase-Shawmut Company 13
Chicago & Alton Railroad 8
C. & N. W. R. R. 8
Chicago Edison Company 4, 14
Chic. Fuse Wire & Mfg. Co. —
Chicago House Wrecking Co. 15
Chicago Insulated Wire Co. 1
C., M. & St. P. R. R. 8
Chicago Pay Station Co. 16
Christensen Engineering Co. 11
Consumers Carbon Co. 8
Continuous Rail Joint Company of America. 3
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company 8
Cutler-Hammer Mfg. Co. 3
Cutter Elec. & Mfg. Company 1
D. & W. Fuse Company —
Dearborn Drug & Chem. Co. 18
Diamond Meter Company 4
Dixon Crucible Co., Joseph. 18
Duncan Electric Mfg. Co. 21
Edison Decorative & Miniature Lamp Department 12
Edison Mfg. Company 7
Edwards & Company 9
Electrical Engineer Institute. —
Electric Appliance Company. 12
Electric Storage Battery Co. 3
Electrician Pub. Company 18
Faries Manufacturing Co. 3
Federal Electric Company —
Fisher Electric Company 13
"For Sale" Advertisements. 14
Ft. Wayne Elec. Works., Inc. 21
Fowler, John H. 19
Franklin Eng. & Elec. Co. —
Fulmer Lumber Co., D. M. 19
General Electric Company 4
General Incandescent Arc Light Company 5
General Incand. Lamp Co. —
Gould Storage Battery Co. 6
Great Western Smelting & Refining Company —
Gregory Electric Company 14
Hamblin & Russell Mfg. Co. 12
Hartford Steam Boiler Inspection & Insurance Co. —
Hazard Manufacturing Co. —
Helios-Upton Company 9
Hobart Elec. Mfg. Company. 1
Hoffman, G. W. 14
Holmes Fibre-Graph. Co. —
Hopkins & Co., A. P. 19
Huebel Company, C. J. 19
Humphrey, Henry H. 12
Illinois Electrical Mfg. Co 14
Illinois Maintenance Co. 14
Incandescent Electric Light Manipulator Company —
Indiana Rub. & Ins. W. Co. 1
India Rubber & Gutta Percha Insulating Company —
Inland Printer Co. 16
Internat'l Corres. Schools —
International Tel. Mfg. Co. 16
Jeffrey Manufacturing Co. 18
Johnston, Thomas J. 13
Kartavert Manufacturing Co. —
Kellogg Switchboard & Supply Company 17, 19
Klein & Son, Mathias 19
Kohler Brothers. 12
Kokomo Tel. & El. M. Co. 16
Leather Preserv. M. Corp. 14
Leffel & Co., James 18
Lindsley Brothers Company. 19
Lowell Model Co. —
Machado & Roller —
Maley, Martin —
Maltby Lumber Company. 19
Manhattan Elec. Supply Co. —
Marinette Iron Wks. Mfg. Co. 15
Marshall-Sanders Co. 8
Matthews & Bros., W. N. 13
Mayer, Geo M. 13
McLennan & Company, K. 12
McNamara Brothers 13
Metropolitan Tel. & El Co. 16
Mica Insulator Company —
Miscellaneous Advs. 14
Monarch Fire Appl. Co. —
Monon Railroad 14
Moon Mfg. Co., The 17
Morse Cedar Company 19
Mott & Company, J. E. 1
Munsell & Co., Eugene 12
Murdock Parlor Grate Co. —
National India Rubber Co. —
Naugle Tie Co., E. E —
Nernst Lamp Co. 20
New York Ins. Wire Co. 9
N. Y. Safety Steam Power Co. 22
Norton Elec'l Instrument Co. —
Okonite Company, The 1
Osburn Flexible Conduit Co 1
Paragon Fan & Motor Co. —
Parsell & Weed 1
Perrizo & Sons 19
Phelps Company 13
Phillips, Eugene F. 13
Phillips Insulated Wire Co. 13
Phœnix Glass Company. —
Phosphor-Bronze S. Co. 18
Pignolet, L. M. 12
Pittsburg & L. S. Iron Co. 19
Porter Cedar Company 19
Rauscher, John —
Reisinger, Hugo —
Reliance Electric Company 9
Replogle Governor Works. —
Reynolds Electric Company. —
Roebling's Sons Co., J. A. 12
Rooney-Westbury El. Lmp. Co. 12
Rose Electric Company 14
Sargent & Lundy —
Sawyer-Man Elec. Company. —
Schoonmaker Co., A. G —
Schott, W. H. 12
Schureman & Hayden. 14
Scientific Exchange 14
Shelby Electric Company 1
Simplex Electrical Co., The. 1
Simplex Elec. Heating Co. 12
Smith Co., S. Morgan. 18
Southern Pacific R. R. —
Spies Electric Company 1
Sprague Electric Company. 3
Standard Pole & Tie Co. 19
Standard Underg. Cable Co. —
Standard Varnish Works 8
Standard Vitrified Cond. Co. 8
Stanley Instrument Co. 9
Station Equipment Co. 14
Steam & Elec'l Equipment Co. 14
Sterling & Son, W. C. 19
Sterling Electrical Mfg. Co. 22
Sterling Electric Company. —
Sterling Varnish Co., The 1
Sterrett Pump Company 15
Stilwell-Bierce & Smith-Vaile Company 15
Stow Mfg. Company 1
Stromberg-Carlson Tel. Mfg. Company 17
Sturtevant Company, B. F. 22
Taylor Chemical Co. 11
Toerring Company, C. J 12
Torrey Cedar Company 19
Triumph Electric Co. 1
U. S. Electric Mfg. Co. 17
Valentine-Clark Co., The. —
Vindex Electric Company. —
Vought-Berger Company 7
Vreeland, B. F. 19
Vulcanized Fiber Company. 22
Wagner Electric Mfg. Co.
Wagor Mfg. Co., P. R. —
Walsh's Sons & Company 14
Western Electric Company. 7
Western El. Supply Co. 10
Westinghouse Electric & Manufacturing Company 20
Weston Electrical Inst. Co. 1
Whitehead Machinery Co. 14
Whitmore, A. E. 19
Wickes Bros. 14
Willyoung, Elmer G. 13
Wisconsin Central R. R. 18
Worcester Company, C. H. 19

For Classified Index of Advertisements See Page 6.

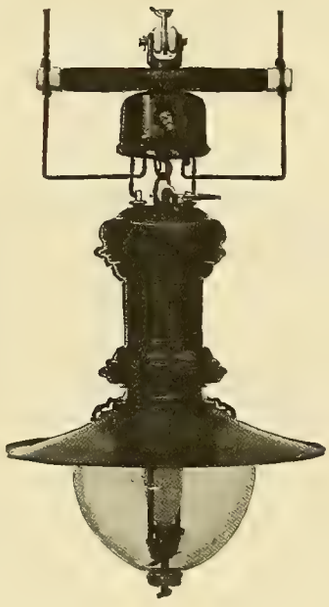
Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY
G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

THE GENERAL ELECTRIC COMPANY'S

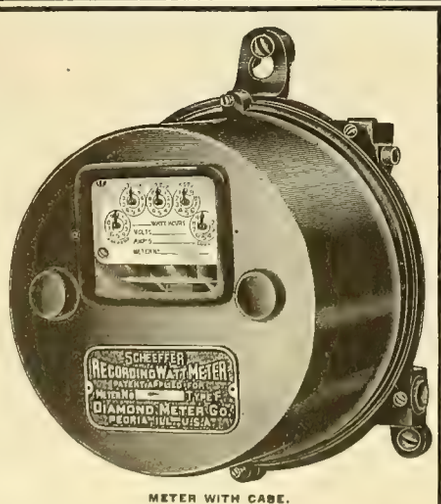


Series Enclosed Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.



METER WITH CASE.

SCHEEFFER
INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

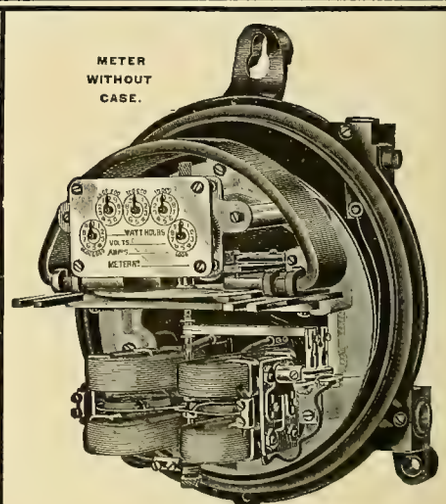
IMPROVED CONSTRUCTION.

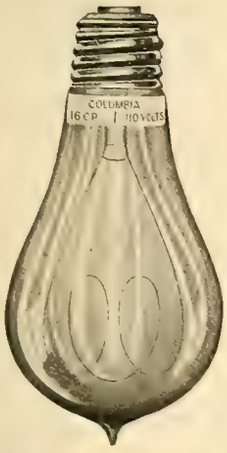
Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,
PEORIA, ILL., U. S. A.

METER WITHOUT CASE.





COLUMBIA LAMPS

ARE GUARANTEED

Uniform Candle Power, High Efficiency, Long Life.

No Need to Wait. Lamps Shipped From Chicago Stock.

OKONITE IT NEVER DISAPPOINTS

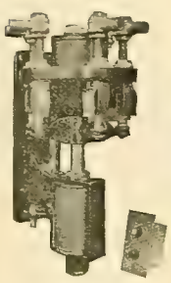
Central Electric Company,

GENERAL AGENTS.

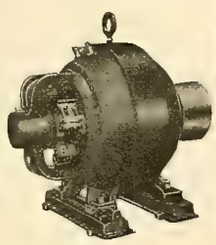
264-266-268-270 FIFTH AVENUE, CHICAGO.

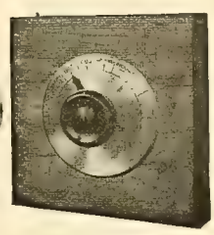
OKONITE IT NEVER DISAPPOINTS

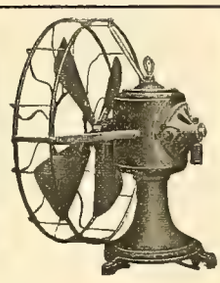
BULLETIN No. 172


BULLETIN No. 54

BULLETIN No. 53


BULLETIN No. 164


BULLETIN No. 155


BULLETIN No. 162

BULLETIN No. 152

TRADE **G. I.** MARK

STANDS FOR ELECTRICAL AND MECHANICAL PERFECTION.

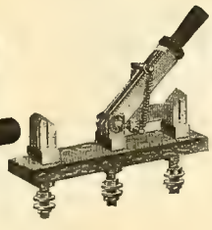
Bulletins, Blueprints, Photographs, Estimates, Etc., Mailed Upon Application.

GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK, N. Y.

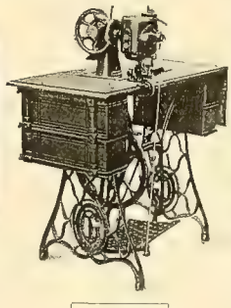
220 Devonshire St., Boston, Mass.
48 West Jackson Blvd., Chicago, Ill.
638 Century Bldg., St. Louis, Mo.
1732 Champa St., Denver, Colo.
510 New England Bldg., Cleveland, Ohio.
319 Hayward Bldg., San Francisco, Cal.
57 Perin Bldg., Cincinnati, Ohio.
115-117 Cannon St., London, E. C. Eng.

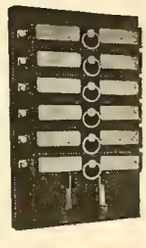
BULLETIN No. 54

BULLETIN No. 94

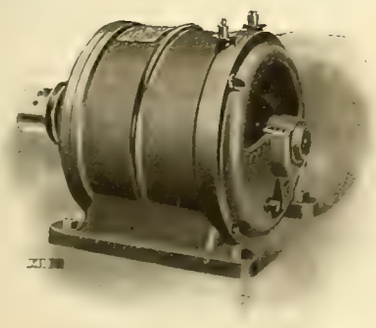

BULLETIN No. 50

BULLETIN No. 240


BULLETIN No. 65


BULLETIN No. 51

BULLETIN No. 190



TYPE "B" MOTOR CAN BE MOUNTED ON SIDEWALL OR HUNG INVERTED FROM CEILING.

REMEMBER

that by encouraging the use of our

Single Phase Self Starting A.C. Motors

on your circuits, you can materially increase your day load and consequently make your investment earn you

INCREASED DIVIDENDS.

If you are not acquainted with their many salient features, write us, *we will be pleased to point them out.*

WAGNER ELECTRIC MANUFACTURING COMPANY

ST. LOUIS, MO., U. S. A.

TRADE MARK.

STORAGE BATTERY INSTALLATIONS

FOR

RAILROAD REGULATING, LIGHTING, POWER AND ISOLATED PLANTS.

GOULD C, E-M-F BOOSTER SYSTEMS.

GOULD STORAGE BATTERY CO.

SALES OFFICES:

Boston, 53 State Street, Chicago, Rookery Building, New York, 25 West 33rd Street,
Century Electric Company, San Francisco, Cal. Pittsburg Engineering Company, Pittsburg, Pa.

WORKS: DEPEW, N. Y.

Bulletin No. 2, describing "GOULD BOOSTER SYSTEMS," on application.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Clips.
Barron & Co., Jas. S.
Chase-Shawmut Company.

Cables. (See Insulated Wires.)

Cables, Electric (See Insulated Wires) **Copper, Sheet and Bar.**
American Elec. Works.
American Steel & Wire Co.
Central Electric Co.
General Electric Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
McLennan & Co., K.
Allen Co., L. B.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Corresond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Company, W. W.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
St. Louis Elec. Supply Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Elect. Supply Co.
Western Electric Company.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors)

Name Plates.
Murdock Parlor Grate Co.

Nernst Lamps.
Nernst Lamp Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.
Gt. West. Sm. and Refining Co.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors.
American Refl. & Lighting Co.
Faries Manufacturing Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Chicago House Wrecking Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Steel Boxes.
Bossert Elec. Const. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Tapes, Insulating.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Western Electric Co.
Western Elec. Supply Co.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Transformers.
Central Electric Company.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

Practical Running of Dynamos.

A little booklet on the care and the locating and remedying of troubles in dynamos and motors.

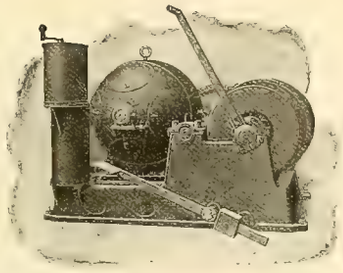
Price, 10 Cents.

Catalogue of mechanical and electrical books free.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

CROCKER-WHEELER COMPANY AMPERE N.J. U.S.A.

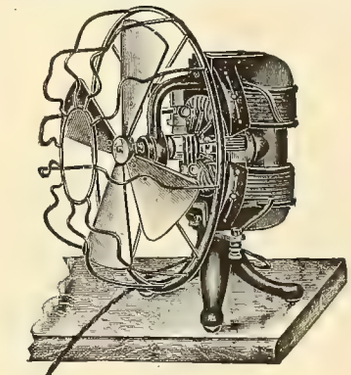
The economy in using our motors rests in their endurance under hard service.

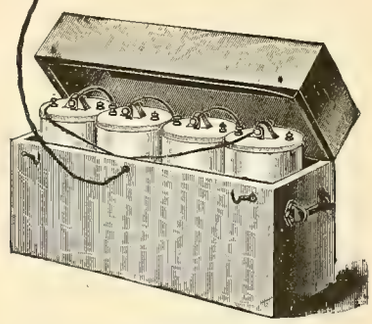


EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.





Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

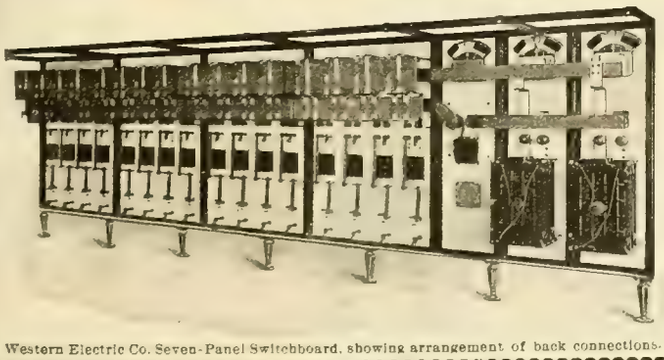
NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

Chicago.
Saint Louis.

Western Electric Company

New York.
Philadelphia.



Western Electric Co. Seven-Panel Switchboard, showing arrangement of back connections.

Motors and Generators, Arc Lamps, Switchboards and Circuit Breakers. Electrical Supplies.

Bulletins and Catalogues Sent on Request.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

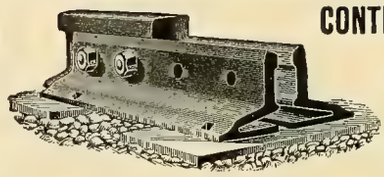
General Office, 39 and 41 Cortlandt Street = = = = New York

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER TEN THOUSAND (10,000) MILES IN USE.

Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR

Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,

THE AKRON SMOKING PIPE CO.,

MOGADORE, OHIO

FOR HIGH GRADE

INSULATING VARNISHES

ADDRESS

STANDARD VARNISH WORKS

CHICAGO NEW YORK LONDON

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette Bldg., Chicago.

THE ST. PAUL CALENDAR

FOR 1903,

six sheets 10x15 inches, of beautiful reproductions, in colors, of pastel drawings by Bryson, is now ready for distribution and will be mailed on receipt of twenty five (25) cents—coin or stamps.

Address

F. A. MILLER,

General Passenger Agent, Chicago.

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

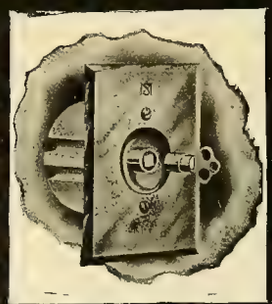
146 Pages. 129 Ills. Cloth. PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BLDG., CHICAGO.

"A little nonsense now and then, Is relished by the wisest men."



The Flush Switch has no reference to my lady's false locks. It is always the same color—black top (handle), and white bottom. It has more snap than a black cat on a cold night—and more lives.

Used face to face with salesmen of "other" switches, breaks currents of "hot air" instantaneously. double its rated capacity.

Contacts guaranteed 18 Kt.. soft brass, and bronze that costs more than it should.

The plate is straight front, edges cut on the bias. In place it sticks closer than a miser to money, but comes off when desired, like water from a duck's back.

Please Mention Western Electrician.

MARSHALL-SANDERS CO.

BOSTON, MASS.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. MCCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,
Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

EDWARDS AND CO.

The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.

All springs made of Phosphor Bronze and so formed that there is least possible strain.

Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.

Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.

The hammer entirely concealed by gong and cannot be tampered with.

It is especially adapted for use on street cars, as in addition to the advantages mentioned, it is dust, insect and moisture proof.

NEW YORK N.Y

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

STEAM ENGINEERS' LICENSES

Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

Theo. Audel & Co., Publishers, 63 Fifth Avenue, New York City.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

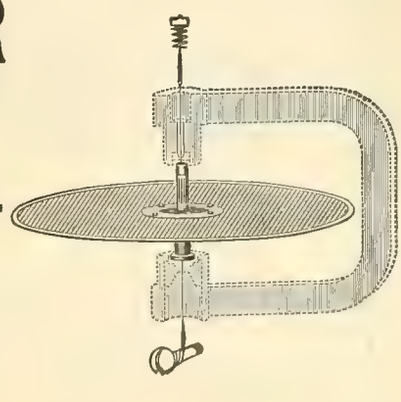
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."

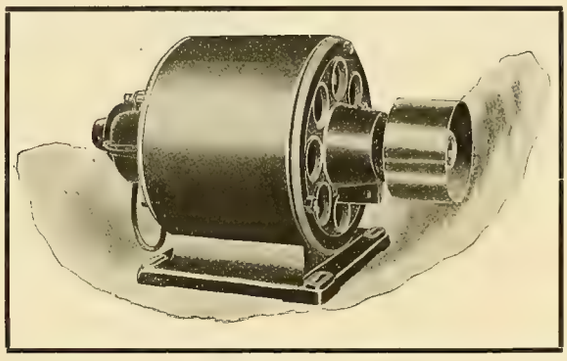


STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

Western Electrical Supply Co.

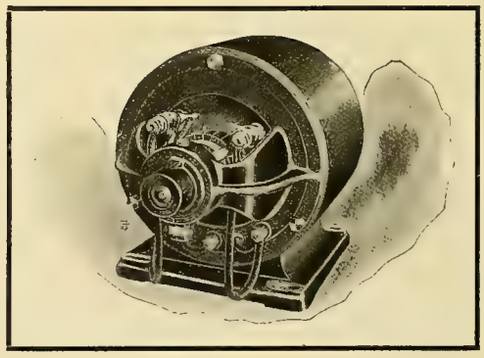
GENERAL SALES AGENTS



Sterling Direct-Current MOTORS and DYNAMOS

These motors embody some new and advanced ideas in motor building. Our factory makes nothing but small motors in large quantities which enables us to quote extremely low prices.

Guaranteed for one year against electrical and mechanical defects.



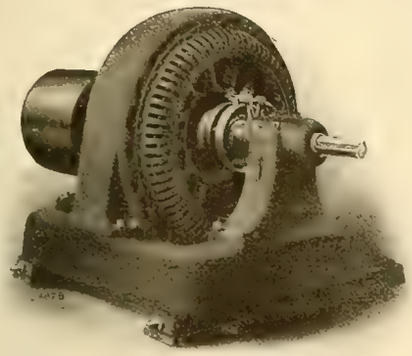
WE CAN INTEREST YOU IF YOU ARE IN THE MARKET.

WESTERN ELECTRICAL SUPPLY CO.

ST. LOUIS, U. S. A.

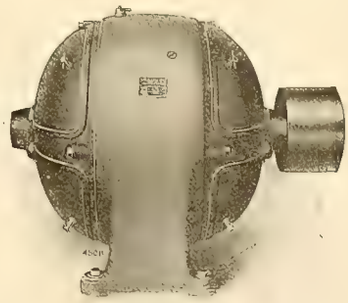
WRITE TO-DAY FOR PRICES AND DESCRIPTIVE MATTER.

"Ceco." Electrical Machinery.



250 K. W. 3 Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.



Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

THE TAYLOR CHEMICAL CO.

PENN YAN, N. Y.

Capital Stock, - $500,000. Par Value, - -$10.00 Per Share.

Officers: Edward R. Taylor, Penn Yan, N. Y. Edward J. Hutchinson, Cincinnati, O., V.-Pres. C. A. Taylor, Penn Yan, N. Y., Sec. and Treas.

More than three million pounds of goods made by a new electrical process. Fully demonstrated and a complete success. Manufacture of many chemicals placed on an entirely new basis. Fully protected by patents. See Electrical World and Engineer of Dec. 21, 1901, page 1028; Electrical Review of Feb. 1st, 1902, pages 143-4-5, and Harpers Weekly, May 17, page 641. The U. S. Census Bulletin, No. 210, June 25th, page 58, says: "One of the most ingenious as also one of the most recent chemical applications of electricity." Good chance to get in on the ground floor of an industry that is sure to have a large future. Long established business. Present rate of production insures an 8 per cent. dividend from the start. Limited amount of stock for sale. For particulars apply to

EDWARD R. TAYLOR, Penn Yan, N. Y.

NO KICK-BACKS

A WELL LIGHTED STORE

is it's own best advertisement. Light attracts trade—sells goods. Arc lamps are the cheapest, most perfect and satisfactory light for that purpose.

NOW IS THE TIME

to sell arc lamps to merchants. Why not sell the best and save trouble for yourself and your customer? There are no **KICK-BACKS** in the sale of A. B. lamps. They always satisfy.

ELECTRIC APPLIANCE COMPANY,
ELECTRICAL SUPPLIES. CHICAGO.

EDISON MINIATURE LAMPS

Dry Battery Lamps

For use in portable lighting devices--electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

All types supplied—
Accurately rated—
Carefully selected.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
Chicago Office: Monadnock Block. Sales Office all large cities.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

YOU WILL ADMIT

that an arc lamp should not be a box of tricks. On the contrary it should be built like the Toerring Arc Lamp—simple and easily accessible—so that any and all repairs may be made without taking the lamp off the hook, and it should burn over 200 hours.
We Guarantee This.

PHILADELPHIA, 19th St. and Allegheny Ave.
NEW YORK, 39 Cortlandt St

C. J. TOERRING CO.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS
AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804 · 1806 · 1808 · 1810 · 1812 Fisher Building.
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg.. CHICAGO, ILL.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. **LAMP CORD.**

POWER CABLES.
TELEPHONE CABLES. **OFFICE WIRE.**

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

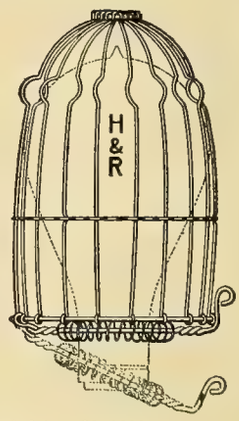
Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

L. B. ALLEN COMPANY, Inc.
Sole Manufacturers
1334 Columbia Avenue, CHICAGO.

NEVER TOO LATE TO MEND
faulty wiring with the
ALLEN SOLDERING STICK!
Makes solder flow ON ANY METAL.
SAMPLE STICK FREE.
L. B. Allen
This signature on a pink label protects you from expensive, unsafe imitations.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

HYLO
TURN-DOWN LAMP
Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.
PHELPS CO., 50 State St., Detroit, U. S. A.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

TEST INSTRUMENTS.
Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

Designs for **PATENTS—WORKING DRAWINGS**
FOR SPECIAL AND AUTOMATIC MACHINERY.
Developing of **ELECTRICAL INVENTIONS** a Specialty.
GEO. M. MAYER, M. E., MONADNOCK BLK., CHICAGO, ILL.

NATIONAL CODE STANDARD

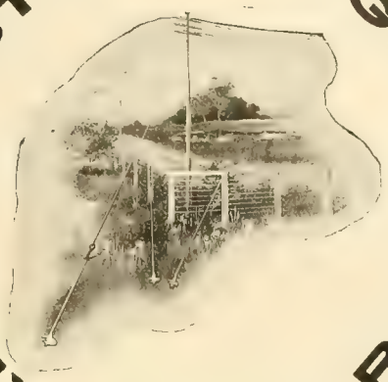
WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

INDELIBLY Stamped as Standard. **STOMBAUGH** INDESTRUCTIBLE By Weather or Fire.



Worm's-Eye View.

GUY ANCHORS.
Cork-Screw-Like in INSTALLATION.
In First and Last Cost INEXPENSIVE.

W. N. MATTHEWS & BRO.,
DISTRIBUTORS.
603 Carleton Building, - - ST. LOUIS.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, Intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.
New York Representative: WM. S. BROWN, 39 Cortlandt St., New York City.
Western Representative: THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

Electrical salesman thoroughly acquainted with electrical supply business, Ohio territory. Address BOX 131, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Forty T. H. K. 2-series open arc lamps in good condition. For particulars and price address,

Dodge Mfg. Co., Mishawaka, Ind.

FOR SALE.

My 50 K. W. electric-light plant, as I wish to avail myself of a splendid business opportunity elsewhere. Plant is new and growing rapidly. Wood system, furnished by the Ft. Wayne Electric Works, Ft. Wayne, Ind. Absolutely free power from water. Solid rock dam. A splendid opening. Particulars furnished intending purchasers on application. F. D. RODOLF, Balmoral, Wis.

FOR SALE.

One 1,000 K. W., direct-connected, vertical, cross-compound, side crank McIntosh & Seymour engine now completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26-100. This engine was ordered previous to our purchase of the Citizens Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at the McIntosh & Seymour Factory, Auburn, N. Y. Address, Electrical Department, ROCHESTER GAS & ELECTRIC COMPANY, Rochester, N. Y.

SACRIFICE SALE.

Best bidder gets electric-light plant here in new growing town of 1,000, in richest part of Iowa. Perpetual franchise, perfect water, plant near center of distribution for this and for nearby towns. Business doubles every two years. Must be sold before January 1. Mortgage $5,000 cash. Balance time or trade or best offer. Investigate at once, before it goes. Has always been held at $10,000. F. S. BOONE, Buffalo Center, Ia.

POSITIONS OPEN.

PER MONTH.

1 Electrical Superintendent.....$100
7 Draftsmen, Electrical, East.... $100
4 Draftsmen, Structural Steel.....$125
4 Draftsmen, Bridge..... $75 up.
2 Armature Winders, must be gilt edge..... .....$100
2 Surveyors.

Draftsmen, Surveyors, Engineers and Specialists will do well to register with us.

THE SCIENTIFIC EXCHANGE,
Room 418, 134 Van Buren St., CHICAGO, ILL.

SEE NEXT ISSUE.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings), Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

One hundred tons soft sheet steel for small armatures, at a bargain. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

FOR SALE.

1—300 K. W., G. E. M. P. 8 St. Ry. generator to Corliss engine.
1—200 K. W., St Ry. plant, G. E. generators, Corliss engines.
1—216 K. W., Stanley 2 phase 133-cy. generator.
1—180 " " " " " " "
1—100 K. W., G. E. generator, 110 or 220 volts to St. Line engine.
1—80 K. W. Eddy to 13x18 Russell, 110 volts.
1—55 K. W., M. P. Churchward, 125 volts,
1—22½ " " " " "

CORLISS ENGINES.

1—24x42 Wright Corliss.
1—20x30x42 Allis Cross Compound.
1—18x48 C. H. Brown.
1—14x36 Reynolds.

AUTOMATIC ENGINES.

1—18x24 Noye Mfg. Co., 300 H. P.
1—16 x16 Erie Ball, 200 H. P.
7—13x22x13 Westinghouse Cpd., 125 H. P.
Write for complete list.

Steam and Electrical Equipment Co., Pittsburg. Pa.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,

140 S. Clinton St., Chicago.

NOTICE IS HEREBY GIVEN, that the Common Council of the city of Superior, Wis., with a view to granting a franchise, has caused to be prepared and has by resolution adopted full specifications containing rules and regulations for the construction, maintenance and operation of a plant for the distribution of electric currents throughout said city, for the purpose of supplying said city and the inhabitants thereof with electricity for power, heat and lighting purposes, and for the conduct of such business.

Said specifications contain, among other things, the maximum rates which may be charged by the grantee of such franchise to patrons or consumers and for annual statements, sworn to by the manager and treasurer of the company operating under such franchise to be made to the Common Council of the gross receipts of the business carried on under such franchise. Said specifications are on file and of record in the office of the city clerk of said city.

Request is hereby made that proposals be submitted stating what percentage of the gross receipts from the business carried on under the franchise the bidder will pay annually into the treasury of said city in consideration of receiving a franchise according to said specifications.

Each person presenting a bid shall accompany such bid with a certified check of some national bank of the United States in the sum of one thousand dollars ($1,000), payable to the order of the treasurer of the city of Superior, Wis., as a guarantee of the acceptance of the franchise, if such bid is accepted and a franchise granted in accordance with the specifications and the laws of the state of Wisconsin, and for the giving of a bond in the sum of one thousand dollars ($1,000), as in said specifications provided.

Sealed bids will be received for a franchise to be granted according to said specifications, said bids to be opened at a meeting of the Common Council of said city, to be held November 18, 1902.

This advertisement is made pursuant to directions contained in a resolution of said Common Council passed at a meeting thereof held in the council chamber in the city of Superior, Wis., on October 14, 1902. Said resolution was approved by the mayor October 16, 1902.

Dated at Superior, Wis., this 18th day of October, 1902. JOHN A. HOBE,
Clerk of the City of Superior, Wis.

Electrical Machinery Bought, Sold and Exchanged. **REPAIRS** **Switchboards Built to meet specifications.**

ILLINOIS ELECTRICAL MFG. CO.,

Lowest Prices. PEORIA, ILL. Write Us.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Allis Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

One Geary Water Tube Boiler, 175 H.P. for 150 pounds pressure, almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 H. P. Berryman Heater.
600 H. P. Berryman Heater.
125 H. P. Berryman Heater.
500 H. P. Excelsior Heater.
6 x 4 x 6 and 5¼ x 3½ x 5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

STATION EQUIPMENT COMPANY,

539 Marquette Bldg., CHICAGO, ILL.

500 H. P. Corliss engine, 16 and 30x48 Cross-compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
1—16x42 Twin Cooper Condensing Corliss.
1—250 H. P. 16 and 27x16 Westinghouse engine.
150 K. W. 60-cycle Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—200 K. W. 60-cycle, two-phase Stanley alternators, 2,750 or 5,500 volts.
2—150 K. W. 60-cycle, three-phase Stanley alternators, 2,750 or 5,500 volts.
1—200 K. W., W. A. L. type, Ft. Wayne wood alternator, 133-cycle, three bearing, 1,100 or 2,200 volts, compound wound, complete with exciter.
2—120 K. W. General Electric, 133 cycle, 1,100 volt alternators.
2—175 K.W. Edison bi-polar railway generators.
2—100 K.W. Edison bi-polar railway generators.
4—100 K.W. Edison bi-polar 140 volt generators.
1—45 K.W. Edison bi-polar 140 volt generator.
2—30 K.W. Edison bi-polar 140 volt generators.
1—30 K.W. Westinghouse 110 volt direct-connected unit with engine.
2—72x16 tubular boilers, 120 lbs. Hartford.

All accessories for complete station equipments. Write us your requirements.

AUTOMATIC ENGINES.

1 90 H. P. 9x12 New York Safety. 1 75 H. P. 12x18 Taylor, side crank
1 50 H. P. 9x9 New York Safety.

110-VOLT GENERATORS.

2 1100 light, 65 K. W. Jenny.
2 1000 light, 60 K. W. Thompson-Ryan, 10 pole.
1 1000 light, 60 K. W. Siemens & Halske.
1 1000 light, 50 K. W. T. & H.
1 600 light, 35 K. W. T. & H.
1 500 light, 25 K. W. Western Electric.

133-CYCLE ALTERNATORS.

1 200 K. W. Wood, three bearing, 2200 volt.
1 150 K. W. Wood, 1100 volt.
1 120 K. W. Slattery, 1100 volt.
1 100 K. W. Slattery, 1100 volt.
1 100 K. W. Westinghouse, 1100 volt.
1 70 K. W. T. & H. 1100 volt.
1 60 K. W. General Electric, 1100 volt.
1 50 K. W. T. & H., 1100 volt.
1 50 K. W. National, 1100 volt.

Above are ready to ship. Write us your wants. We have others coming.

ILLINOIS MAINTENANCE COMPANY, **E. H CHENEY, Manager. 204 Dearborn St., CHICAGO.**

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St. and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE VICTOR TURBINE WATER WHEEL.

PARTICULARLY ADAPTED FOR DRIVING ELECTRIC PLANTS.

Its high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion will particularly commend it to all contemplating developing plants of this kind.

OUR OTHER SPECIALTIES ARE:

STEAM and POWER PUMPING MACHINERY for all purposes, AIR COMPRESSORS for the Air Lift system and general use, JET and SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS, STILWELL'S FEED WATER HEATERS, FILTER PRESSES and OIL MILL MACHINERY.

IF INTERESTED, WRITE

The STILWELL-BIERCE & SMITH-VAILE CO.

DAYTON, OHIO.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver Street.
NEW ORLEANS, 304 Hennen Building.
BALTIMORE, 1507 Continental Trust Building.
PHILADELPHIA, 612 Arch Street.
CHICAGO, 311 Dearborn Street.
LONDON, 97 Queen Victoria Street.
CLEVELAND, 1116 New England Building.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

INCANDESCENT LAMPS.

A BARGAIN PROPOSITION.

We bought at sale 150,000 new, perfect incandescent lamps of standard make. They are clean, regular goods, put up in barrels each containing 250 lamps. Our stock consists as follows:

Candle Power: 8, 10, 16, 20, 24, 25.

Voltage: 100, 102, 104, 105, 106, 107, 108, 110, 115, 120.

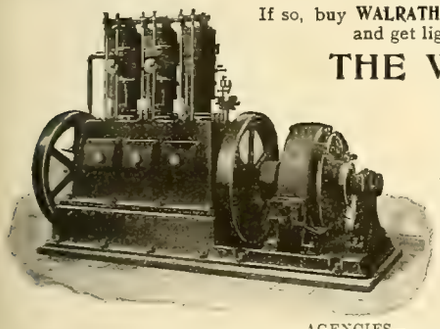
Bases: Edison, T. H. and Westinghouse.

Note Our Prices: In lots less than a barrel, 15 cents; in lots of 250, 13 cents; in lots of 1,000, 12 cents; in lots of 5,000 or over, 10 cents.

The above prices are for any candlepower or voltage, and for Edison or Westinghouse bases. Extra for lamps with T. H. base, each 3-4 cent. We handle electrical apparatus of any kind, also machinery of any description. Write for Catalogue 156.

CHICAGO HOUSE-WRECKING CO., W. 35th and Iron Sts., CHICAGO.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

ANNOUNCEMENT

"THE STERRETT" OIL PUMP

IS NOW READY FOR THE MARKET.

In making this announcement we believe that we are calling the attention of the entire engineering field, and all places where oils of any degree are handled and transferred from barrel to tank and for general use, to an article that every engineer has long looked for and regularly called upon his oil dealer to supply, particularly so when cold weather has made the handling of his valve oils difficult and almost impossible with the pumps heretofore at his command.

"THE STERRETT"

pump is guaranteed to pump any article that is in a liquid form, and handles heavy valve oils as easily as ordinary pumps will kerosene. It is made of seamless brass tubing and durable in every part. There is no leakage of oil, which makes it the cleanest pump to use ever placed on the market.

Ask your dealer for it or send direct to us. Money refunded if not satisfactory after 30 days' trial. Descriptive circulars on request. **PRICE, $3.50.**

Manufactured by

STERRETT PUMP COMPANY,

NO. 69 EAST SIXTH ST., ST. PAUL, MINN.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.

This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 580 illustrations. Price $3.00.

This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.

A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.

Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.

In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.

A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.

This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

TELEPHONING OF GREAT CITIES. By Bennett. Paper. Price 35 cents.

MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Everyday Use. By Hughes. 80 pp. 23 illustrations. Price $1.00.

ELECTRICAL TRANSMISSION OF INTELLIGENCE AND OTHER ADVANCED PRIMERS OF ELECTRICITY, treating on the telegraph, telephone, etc. By E. J. Houston. 330 pp. 88 illustrations. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

THE

Chicago Pay Station

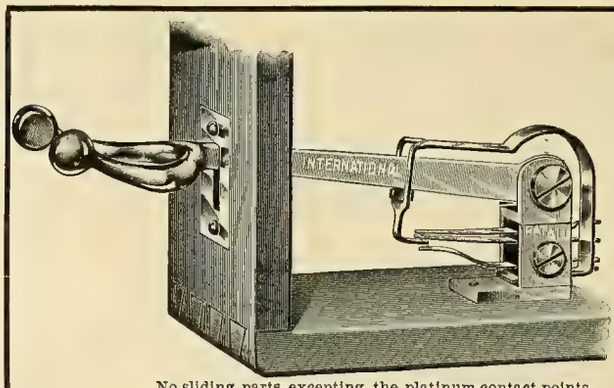
Meets the requirements of Telephone Companies for a strictly high-class

COIN COLLECTOR.

You can satisfy yourself as to RESULTS obtainable by allowing us to forward one on approval

CHICAGO PAY STATION CO.

130 La Salle Avenue,
CHICAGO, ILL.



A SWITCH ON THE RIGHT LINE.

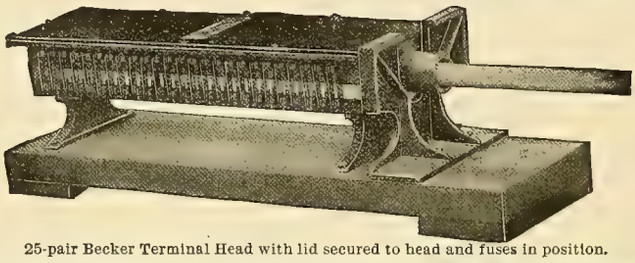
No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

PROTECTION

THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Chicago Office: 59 W. Jackson Boul. | Post-Glover Electric Co., Cincinnati Agents. | W. G. Nagel Electric Co., Toledo (O.) Agents.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

The Inspector and Trouble Man.

A dialogue between the telephone trouble man and his assistant, showing how to overcome difficulties which arise in conducting a telephone exchange. A valuable and instructive book, 106 pages, $1.

THE INLAND PRINTER CO.,
214 MONROE ST., - - - - CHICAGO.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing.
Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

PRACTICAL FEATURES OF TELEPHONE WORK.

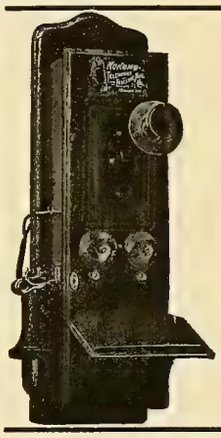
By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

"TELEPHONE TROUBLES ...AND... HOW TO FIND THEM,"

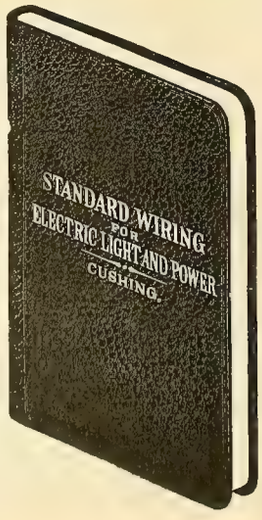
By W. H. HYDE and J. A. McMANMAN,
FORMERLY
HASKINS' TELEPHONE TROUBLES.

This little book is strictly up-to-date on all matters pertaining to telephone troubles and their remedies.

Sent Postpaid for 25c.

New (seventh) edition just out, 70 pages. Many diagrams showing connections. A complete hand-book for telephone inspectors.
Telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.



"The Recognized Authority on Wiring and Construction."

The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover (pocket size), $1.00.

Sent post paid upon receipt of price, by

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO, ILL.

AS SIMPLE AS ITS NAME.

A B C —OF— THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

Do You Think?

A COMPANY THAT HAS THE REPUTATION OF MAKING THE HIGHEST GRADE OF TELEPHONE AND SWITCHBOARD APPARATUS WOULD MAKE THIS STATEMENT IF THEY WERE NOT DEAD SURE THEY COULD BACK IT UP.

KELLOGG TRANSMITTERS Guaranteed

BETTER than the "BELL SOLID BACK."

WE STAND READY TO PROVE THIS STATEMENT.

Write for new booklet — "The Express and some of it's stopping places."

Kellogg Switchboard & Supply Co.
229 South Green Street, CHICAGO.

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

New and Revised Edition JUST ISSUED.

American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

CHAPTER I.—History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V.—Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., *510 Marquette Building, CHICAGO, ILLINOIS.*

"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

STROMBERG-CARLSON TELEPHONE MFG. CO.

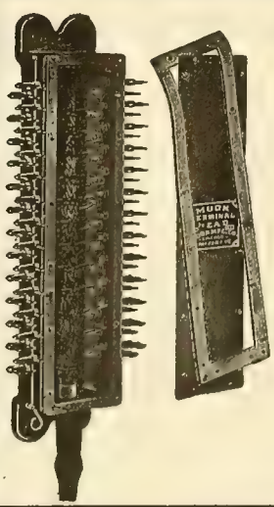
ROCHESTER, N. Y. **CHICAGO, ILL.**

LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



MOON TERMINALS
WITH
METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

POWER INCREASED

AND BOILERS PROTECTED BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

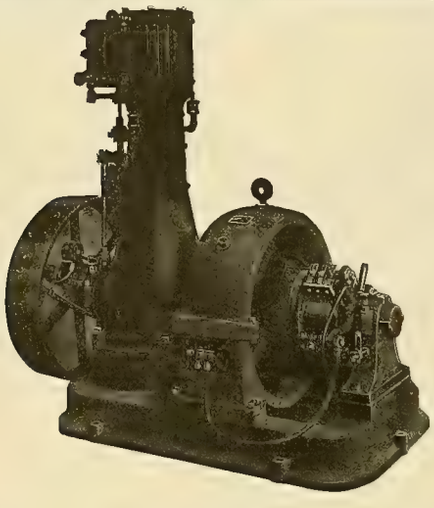
SAMSON TURBINE
UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

Only 10 Cents Each
Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

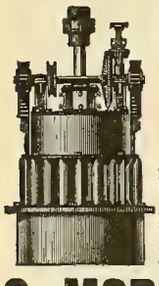
These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
510 Marquette Building, CHICAGO.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

# NEW CATALOGUE
ELEVATING = CONVEYING MACHINERY
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

GRAPHITE BRUSHES
That have been fully tested and proved superior to any in the market. We shall be pleased to send sample.

JOSEPH DIXON CRUCIBLE CO., - JERSEY CITY, N. J.

ELECTRICITY MADE SIMPLE.
233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text book for schools and colleges.

FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

The business of the Western Electrician for the year 1901 was the largest in its history of fifteen years.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

PRICES:—OUR STRONG POINT.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice.
WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.

Large Stock Constantly on Hand

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St. CHICAGO, ILL.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .
SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1703-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO TSOLS DAGGETT MICH.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

WESTERN CEDAR POLES—Low Prices.
Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

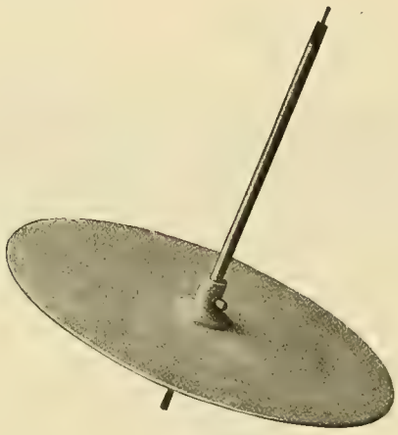
The

Revolving Element

of the

Westinghouse

Integrating Wattmeter



Has the lightest weight, insuring minimum wear on jewel support, and with high torque per unit of moving weight, assures permanency on light loads.

FOR ILLUSTRATED WATTMETER BOOKLET ADDRESS THE NEAREST SALES OFFICE OF THE ::

Westinghouse Electric
and Mfg. Co., Pittsburg, Pa.

New York, Atlanta, Dallas, Boston, Baltimore, Buffalo, Chicago, Cincinnati, Los Angeles, Cleveland, Detroit, Minneapolis, Philadelphia, Pittsburg, St. Louis, San Francisco, Salt Lake City, Syracuse, Seattle, Denver, Mountain Electric Co. Canada: Ahern & Soper, Limited, Ottawa. Mexico: G. & O. Braniff & Co., City of Mexico.

Nernst Lamps

cost one-half to run as compared with incandescents.

Cast no shadow.
Do not flicker.

Write for illustrated Booklet

Nernst Lamp Co.

Pittsburg, Pa.

ANOTHER STRIKE

LOWER AMHERST ROLLER MILLS.
B. E. DWINELL & CO., PROPRIETORS
MANUFACTURERS OF Wheat, Rye and Buckwheat Flours.

AND THE RESULT.

AMHERST, WIS., Sept. 27, 1902

Fort Wayne Electric Works,
Fort Wayne, Ind.

Gentlemen:-

Replying to your favor regarding our recent experience with your Type A transformers, would say on the night of July 13th, one sixty light transformer was struck by a lightning discharge and the cover broken in two parts, one part falling to the ground. On discovering this we thought the transformer was destroyed and did not attempt to replace the blown fuses. On taking it down the following day, we were surprised on examining the coils that they did not seem burned or damaged in any way, and after a test in the station which showed O.K. we replaced the broken cover and this transformer has been in constant service ever since. Enclosed find photograph which we had taken at the request of your Chicago representative, we remain,

Yours truly
B. E. Dwinell & Co.

FORT WAYNE ELECTRIC WORKS,

FORT WAYNE, IND.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS

Possesses Many Up-To-Date Features.

JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.,

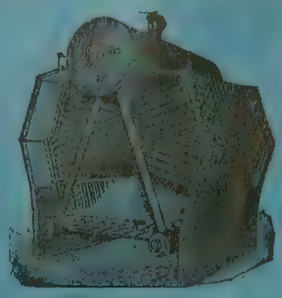
MANUFACTURERS OF ELECTRICITY METERS. LAFAYETTE, IND.

THE WORTHINGTON
Water - Tube Sectional BOILER

Units, 20 to 360 Horse-power

End or Side Fired.

SEND FOR OUR BOOK.

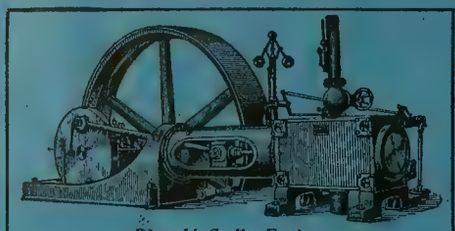


Compact, Economical, Durable, High Pressures, with Safety.

NO BRICK-WORK Bent Tubes, Screwed Joints, Gaskets or Leaks.

NEW YORK SAFETY STEAM POWER CO.,
60 S. Canal St., Chicago, Ill.
New York. Boston. Philadelphia. San Francisco.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

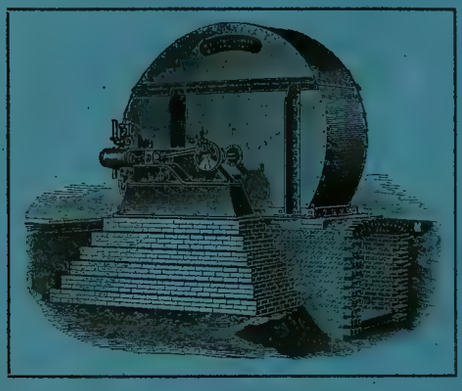
BRASS WIRE
Soft half hard Spring in stock

CHARLES H. BESLY & CO
FINE TOOLS & SUPPLIES FOR METAL WORKERS
10812 N. CANAL ST
CHICAGO ILL. U.S.A.
SEND FOR 100 PAGE ILL CATALOGUE

Sturtevant Steam Fans

WITH

DIRECT CONNECTED ENGINES



STURTEVANT STEEL PLATE STEAM FANS

in countless variety are built for purposes of Ventilation, Mechanical Draft, etc. The engines are specially designed for direct connection and make it possible to operate the fan at any time independently of other machinery. We can meet any requirements as to volume, air pressure, type of fan, etc.

B. F. STURTEVANT CO.
109 BOSTON, MASS.
New York Philadelphia Chicago London

VULCANIZED FIBRE.

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

When you get our **STERLING** We send you lamps.

THE **Sterling Electrical Mfg. Co.** WARREN, OHIO.

We get your **STERLING** You send us coin.

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances,
Write for catalogue. 193-197 River St. DETROIT MICH

REFLECTORS!

SILVER-PLATED MIRROR REFLECTORS FOR INCANDESCENT CLUSTERS.

Made in many sizes and styles. Trimmed with prisms if desired.

We also manufacture
Silver and Opal Glass Inverted Double Cone Reflectors, Chandeliers and Sun Burners
For lighting and ventilating
Churches, Theatres, Halls and Public Buildings.

Street and Ornamental Sign Lamps of Every Kind for Oil, Gas or Gasoline. Border Lights, Bunch Lights, Foot Lights and Gas Stands for Theatres.

SEND FOR CATALOG.

AMERICAN REFLECTOR & LIGHTING COMPANY,
271-273 FRANKLIN STREET, CHICAGO, ILL., U. S. A.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO DOWN DRAFT FORGES
NO SMOKE - NO OVERHEAD PIPES - NO REPAIRS
TYPES FOR ALL WORK - 50 SIZES - SEE NEW CATALOGUE

BUFFALO FORGE COMPANY
PHILADELPHIA BUFFALO, N.Y. CHICAGO PITTSBURG

Western Electrician

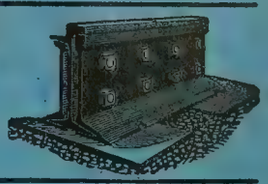
Vol. XXXI. $3.00 Per Annum. Copyright 1901, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 15, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 20.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 70-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, / N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

CONTINUOUS RAIL JOINT CO. OF AM.
General Offices: Century Building,
NEWARK, N. J.
Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.


PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

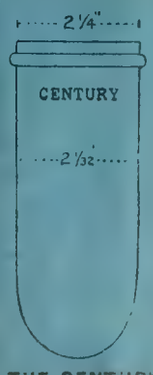
2,000 IN USE.
Bipolar and Multipolar Motors from ¼ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg Co. Troy, Ohio

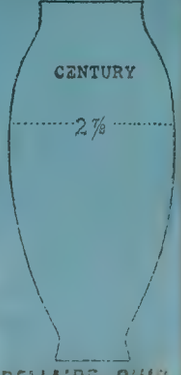
ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book, "Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburg. New York. Chicago.

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5156 Wakefield St., Germantown, PHILADELPHIA.

Kilfyre DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

THE ONLY HOUSE
IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.


WE CARRY GLOBES AND SHADES FOR ALL KINDS AND TYPES OF LAMPS.
OPEN AND ENCLOSED OUTER AND INNER ARC GLOBES.
SEND FOR OUR ILLUSTRATED CATALOGUE


THE CENTURY GLASS COMPANY, : : : BELLAIRE, OHIO.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN.—European Weston Electrical Instrument Co., Ritterstrasse No. 83.

Weston Standard Illuminated Dial Potential Indicator, Style B.

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters, Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
London.—Elliott Bros., No. 101 St. Martins Lane

INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK

Mention the Western Electrician when writing for catalogues

"Ceco." Electrical Machinery.

250 K. W 3 Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.

Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

THE TAYLOR CHEMICAL CO.

PENN YAN, N. Y.

Capital Stock, - $500,000. Par Value, - -$10.00 Per Share.

Officers: Edward R. Taylor, Penn Yan, N. Y. Edward J. Hutchinson, Cincinnati, O., V.-Pres. C. A. Taylor, Penn Yan, N. Y., Sec. and Treas.

More than three million pounds of goods made by a new electrical process. Fully demonstrated and a complete success. Manufacture of many chemicals placed on an entirely new basis. Fully protected by patents. See Electrical World and Engineer of Dec. 21, 1901, page 1028; Electrical Review of Feb. 1st, 1902, pages 143-4-5, and Harpers Weekly, May 17, page 641. The U. S. Census Bulletin, No. 210, June 25th, page 58, says: "One of the most ingenious as also one of the most recent chemical applications of electricity." Good chance to get in on the ground floor of an industry that is sure to have a large future. Long established business. Present rate of production insures an 8 per cent. dividend from the start. Limited amount of stock for sale. For particulars apply to

EDWARD R. TAYLOR, Penn Yan, N. Y.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

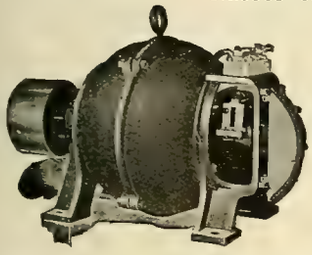
ST. LOUIS, Wainright Building. PHILADELPHIA, Allegheny Ave. and 19th St. NEW YORK, 100 Broadway. BOSTON, 60 State Street. CHICAGO, Marquette Building. BALTIMORE, Continental Trust Building. CLEVELAND, New England Building. DETROIT, Michigan Electric Company. SAN FRANCISCO, Nevada Block. HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

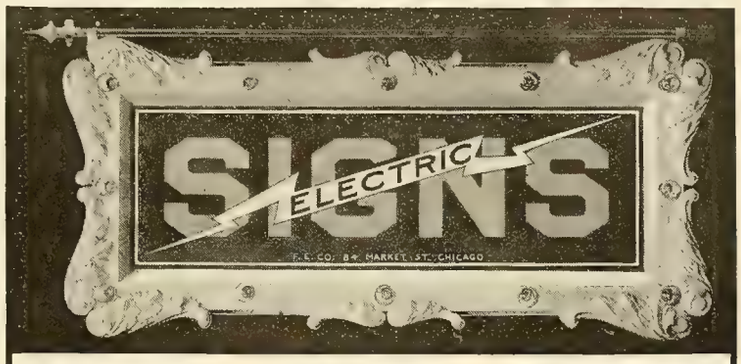
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES: 527 W. 34th St., New York.

CHICAGO OFFICE: Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS: STURTEVANT ENGINEERING CO., LONDON, ENG. KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE. BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
Allen Company, L. B..... 11
Allis-Chalmers Company....20
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refl. & Lighting Co.20
American School of Corresp. 7
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17
Audel & Company, Theo.... —

Baker & Company..... 3
Barlo Vacuum Co..... .....
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg. Co.10
Beardsley Gravity Dam & Construction Co..... .....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 11
Bossert El. Construction Co.. 9
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20
Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co..—
Century Glass Co..... 1
Chase-Shawmut Company...11
Chicago & Alton Railroad....12
C. & N. W. R. R..... 8
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago House Wrecking Co.13
Chicago Insulated Wire Co..—
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....14
Christensen Engineering. Co. 2
Consumers Carbon Co..... 8
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 5
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..16
Diamond Meter Company ....—
Dixon Crucible Co., Joseph..16
Duncan Electric Mfg. Co.... 19

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company..... 7
Edwards & Company.....11
Electrical Engineer Institute. 1
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company...13
Faries Manufacturing Co....—
Federal Electric Company... 3
Fisher Electric Company....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....17
General Electric Company... 4
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company...12

Hamblin & Russell Mfg. Co..10
Hartford Steam Boiler Inspection & Insurance Co... 8
Hazard Manufacturing Co....20
Helios-Upton Company..... 5
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co..... 1
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electrical Mfg. Co...—
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 4
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14
Leather Preserv. M. Corp....—
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... 8

Machado & Roller..... 9
Maley, Martin..... 11
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co...—
Marinette Iron Wks. Mfg. Co.13
Marshall-Sanders Co. 8
Matthews & Bros., W. N.....11
Mayer, Geo. M.....14
McLennan & Company, K....10
McNamara Brothers 11
Mechanical Appliance Co.... 9
Metropolitan Tel. & El Co...15
Mica Insulator Company.....—
Miscellaneous Advs..... ..12
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 8
Munsell & Co., Eugene.....10
Murdock Parlor Grate Co.... 8

National India Rubber Co.... 1
Naugle Tie Co., E. E .....—
Nernst Lamp Co.....18
New York Ins. Wire Co..... 9
N. Y. Safety Steam Power Co.16
Norton Elec'l Instrument Co.—

Okonite Company, The..... 1
Osburn Flexible Conduit Co.—

Paragon Fan & Motor Co.....—
Parsell & Weed..... 8
Perrizo & Sons.....17
Phelps Company..... 5
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company..... 1
Phosphor Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo..... 9
Reliance Electric Company..15
Replogle Governor Works.. .16
Reynolds Electric Company.—
Rice, Cyrus W 11
Roebling's Sons Co., J. A.... 8
Rooney-Westbury El. Lmp. Co.10
Rose Electric Company 12

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....12
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 10
Smith Co., S. Morgan..... 8
Spies Electric Company..... 3
Sprague Electric Company... 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 6
Stanley Instrument Co..... 9
Station Equipment Co.....12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co.. 8
Sterling Electric Company...14
Sterling Varnish Co., The....10
Sterrett Pump Company.....13
Stilwell-Bierce & Smith-Vaile Company.....13
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Taylor Chemical Co..... 2
Toerring Company, C. J 10
Torrey Cedar Company.....17
Triumph Electric Co.....10

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....17
Vindex Electric Company.... 9
Vought-Berger Company 7
Vreeland, B. F. 17
Vulcanized Fiber Company..20

Wagner Electric Mfg. Co.....—
Wagor Mfg. Co., P. R..... 8
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G..... —
Wisconsin Central R. R.....16
Worcester Company, C. H....17

For Classified Index of Advertisements See Page 6.

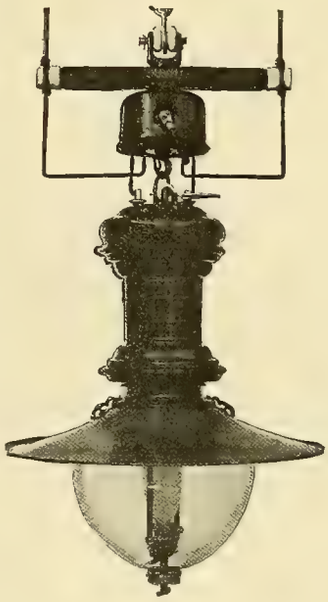
Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY
G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

THE GENERAL ELECTRIC COMPANY'S



Series Enclosed
Arc Lamps

LIGHT THE STREETS OF MOST OF THE PRINCIPAL CITIES OF THIS COUNTRY.

Write for New Catalogues.

GENERAL OFFICES: = = SCHENECTADY, N. Y.

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)

PITTSBURG TYPE K.

TYPE K TRANSFORMERS, COLUMBIA LAMPS,

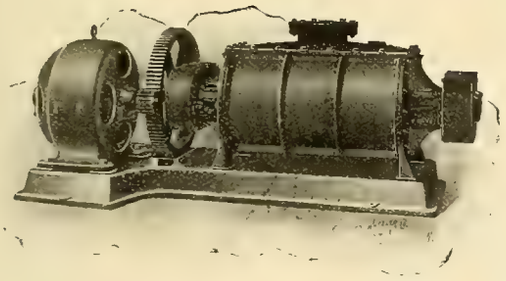
I. X. L. WEATHER - PROOF WIRE.

WE WANT YOUR ORDERS,

Central Electric Company, GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE.
CHICAGO.

CROCKER-WHEELER COMPANY
AMPERE, N.J., U.S.A.



This Motor

built to run continuously under hard service is an economical one to purchase.

HYLO LAMPS

ON A METER RATE EDUCATE PEOPLE

TO USE MORE CURRENT.

HOW?

Teaches People to Turn Lamps Down Instead of Out — See?

Profitable Points for Central Station Men.

If you sell light on flat rate, why don't you push the **HYLO** lamp and save current? You could afford to furnish it *free*. You certainly cannot afford to refuse to *sell* it.

If you are selling current on meter you need the **HYLO** for this reason: one baby filament will not start your meters, and you will make the customer a present of ten watts now and then. But are you letting this *one fault* (of the meter) outshine all the advantages of the **HYLO**? A meter too slow to catch 10 watts will be very likely to miss one 8 c. p. lamp or be altogether too slow if it moves at all. Therefore, it is much better to give a customer a 10-watt lamp all night, and no more, than to take the chance of giving him 25 or 30 watts. We insist that you will *gain* on the item of meter slip by using **HYLO**s.

Besides, we are advertising so heavily all over the world that your customers will eventually get the **HYLO** *anyway*, and you had better score a point and provide it for them.

PHELPS CO., DETROIT, U. S. A.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
McLennan & Co., K.
Allen Co., L. B.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer, George M.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nernst Lamps.
Nernst Lamp Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Platinum Bought and Sold.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Naugle Tie Co., E. E.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Chicago House Wrecking Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company.
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Bario Vacuum Co.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

Practical Running of Dynamos.

A little booklet on the care and the locating and remedying of troubles in dynamos and motors.

Price, 10 Cents.

Catalogue of mechanical and electrical books free.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

WITH THE KNOCK OF THE POSTMAN

comes a

TECHNICAL EDUCATION

of the Highest Quality to your very door.

Instruction by correspondence in the following subjects: **Mechanical, Electrical, Civil, Marine, Locomotive, Stationary and Sanitary Engineering, Navigation, Hydraulics, Architecture, Telegraphy, Sheet Metal Work, Mechanical and Perspective Drawing.** Also forty short special courses.

Instruction under Members of the Faculty of the Armour Institute of Technology.
Textile Course Under Foremost Authorities.

Young men not having the means to spend four years at college can begin their education in the American School of Correspondence, and later complete their courses by actual residence at the Armour Institute of Technology, as all work satisfactorily passed by students will be accepted by the Armour Institute. An exceptional opportunity to round out practical work with a course under teachers of recognized educational standing, who have at their command the equipment of a great resident technical school for testing and experimental work.

A Technical Reference Library (ten volumes) included with each full engineering course. Full particulars and a catalogue of courses may be had upon request. State subjects interested in.

AMERICAN SCHOOL OF CORRESPONDENCE
AT
ARMOUR INSTITUTE OF TECHNOLOGY.
CHICAGO, ILL.

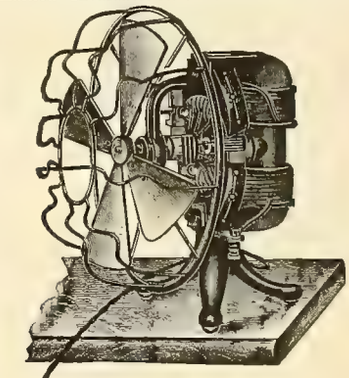
EDISON

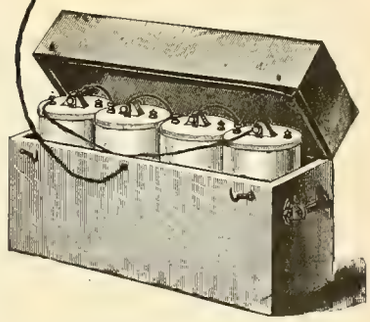
BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.

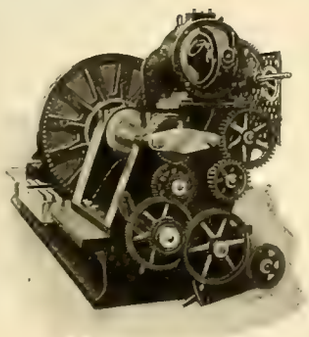




Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.



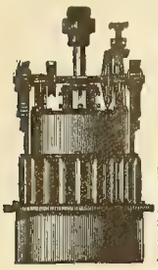
Write for Power Motor Catalogue.

Motor Applications.

. . . . . A Western Electric semi-encased motor, geared to a 72-inch Pond Machine Lathe. The gearing of this lathe is so arranged that a variable speed may be obtained.

Western Electric Company,

Chicago, Saint Louis — Philadelphia, New York.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. **LAMP CORD.**

POWER CABLES.
TELEPHONE CABLES. **OFFICE WIRE.**

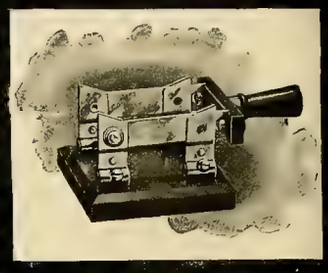
JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

"Imitation is the sincerest flattery."

When you see the Baby Knife Switch copied entire by one of the large old line Co's. (VERY old line, sic.), you can feel pretty sure the original is a "good thing."

Don't be fooled by counterfeits, but specify the genuine slate base, Marshall - Sanders baby. Slate bases don't break.



M.-S. Baby Knife Switch.

Parts made by automatic machinery to steel standards always function.

MARSHALL-SANDERS COMPANY,

301 CONGRESS STREET, BOSTON, MASS.

GASOLINE MOTORS

—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

The FRANKLIN Model Shop

The Franklin Model Shop

Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

THE ST. PAUL CALENDAR

FOR 1903,

six sheets 10x15 inches, of beautiful reproductions, in colors, of pastel drawings by Bryson, is now ready for distribution and will be mailed on receipt of twenty five (25) cents—coin or stamps.

Address

F. A. MILLER,
General Passenger Agent, Chicago.

When you get our **STERLING** We send you lamps.

THE
Sterling Electrical Mfg. Co.
WARREN, OHIO.

We get your **STERLING** You send us coin.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. **We also make Inventors' Models and Special Electrical Devices.** Write us for prices.

SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

NAME PLATES
FOR MACHINERY.

We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.

No Plate Too Large or Too Small.

MURDOCK PARLOR GRATE CO.,
161 Boylston St., Boston, Mass, U. S. A.

PROTECTION.

A GOOD INVESTMENT.

A Lamp Guard firmly fastened to socket protects completely.

THE P. R. WAGOR MFG. CO.,
SPRINGFIELD, MASS.

J. E. MOTT & CO.

HUNTINGTON, IND.—MARION, IND.
CONTRACTORS
CONSULTING, MECHANICAL AND ELECTRICAL
ENGINEERS
ESTIMATES FURNISHED ON ALL KINDS OF ELECTRICAL CONSTRUCTION.

Electric Railways Built by us:

For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.

For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.

For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.

We have been awarded the contract for the construction of an electric light plant at Lebanon, Tenn.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

NOTICE.

TO THOSE INTERESTED IN ELECTRIC LIGHTING.

If you haven't read Buckley's "ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION," you should order a copy at once. It is the only work of its kind in print and will prove an inseparable companion. It is just the book thousands of men have been waiting for; it will be what you want. 275 pages. Illustrated. Cloth, $2.00. Paper, $1.00. Postage free.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., Chicago.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Asst. Secretary.

The "Electra" Carbons are the recognized standard all the world over.

There are no Carbons better than the "Electra" and none "just as good."

Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

For Testing Consumers' Meters

the WHITNEY Portable Wattmeters are the standard. They can be used on any frequency, are dead beat and absolutely accurate. Send for Catalogue and Discounts to

Electric Appliance Co., Chicago, Ill.
Western Electrical Supply Co., St. Louis, Mo.
Electrical Engineering Co., Minneapolis, Minn.
Standard Electric Co., Cincinnati, Ohio.

MACHADO & ROLLER,
NEW YORK, N. Y.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By Herbert Laws Webb.

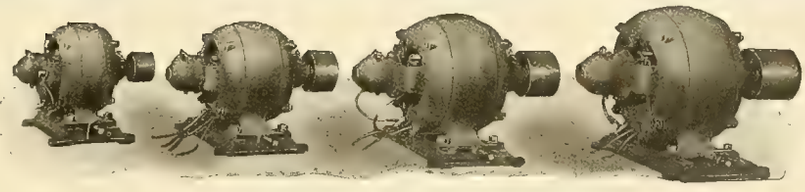
160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

THE MECHANICAL APPLIANCE COMPANY, - Milwaukee, Wis.

1-8 to 5 H. P.
1-10 to 3½ K.W.



Steel Frames Ventilated Form Coil Wound Armatures

Watson Multipolar Motors and Generators.

WE BUILD SPECIAL MOTORS FOR SPECIAL PURPOSES.

Write for Bulletin No. 55.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

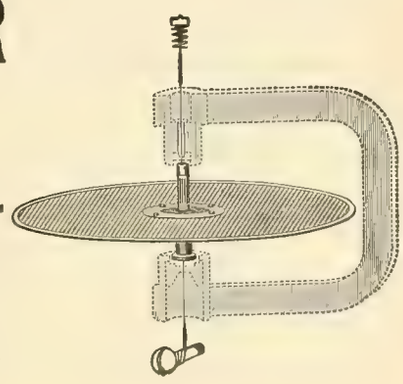
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

WHAT USERS THINK

No. 1661.

"We have used in the past two years fifteen or twenty thousand of the Packard Lamps and find that they have given perfect satisfaction. In the meanwhile we have used various other makes and have found that they in no way compare with your lamp. In fact we cannot sell any other lamp but Packard in our business."

No. 561.

"We have used quite a variety of lamps under many varying conditions and we have no hesitation in saying that we have found the Packard one of the best in efficiency, long life and holding up its candle-power, the three necessary requisites of a good lamp."

So it goes, no matter what the conditions or difficulties to be overcome

PACKARD LAMPS

give the service, give the absolute satisfaction desired, give the absolute satisfaction we guarantee.

ELECTRIC APPLIANCE COMPANY, - - Chicago.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 Cortlandt St.

MANY AN ARC LAMP

started in glare, was snuffed out in gloom. Neither the glare nor the gloom was what you thought to pay for when you bought it. An arc lamp such as the Toerring 200 hour lamp pursues the even tenor of its way, giving a quiet radiance which is the best guarantee of its permanence.

19th & Allegheny Ave.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS

AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,

Electrical Contractors,

312 Fisher Building,

Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,

ENGINEER AND CONTRACTOR,

Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,

CONTRACTING ELECTRICAL ENGINEERS.

LIGHTING POWER RAILWAYS

1804-1806-1808-1810-1812 Fisher Building,

CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.

SEND FOR FREE SAMPLE STICK.

It will put that high gloss on the Commutator you have so long sought after.

For sale by all supply houses, or

K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

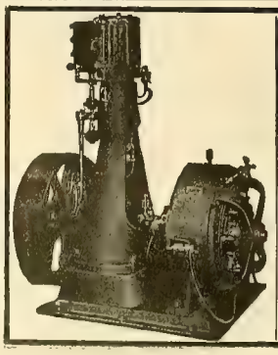
BEARDSLEE CHANDELIER MFG CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO.,
Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO.,
25 Colmore Row, Birmingham, England.



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

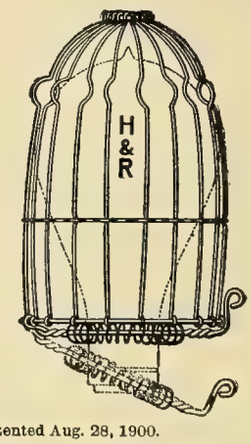
"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"NEVER BREAK"

ELECTRIC LIGHT GUARD.

SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket, Holds All Sizes Securely,

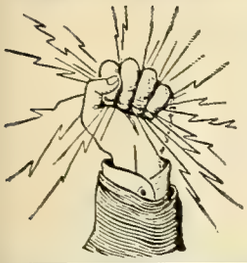
Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

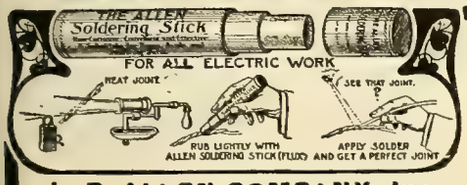
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.
NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

Six Years with General Electric Company.
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.



NEVER TOO LATE TO MEND
faulty wiring with the
ALLEN SOLDERING STICK!
Makes solder flow ON ANY METAL.
SAMPLE STICK FREE.
L. B. Allen
This signature on a pink label protects you from expensive, unsafe imitations.

L. B. ALLEN COMPANY, Inc.
Sole Manufacturers
1334 Columbia Avenue, CHICAGO.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

THE BEST
VERMONT SLATE
FOR
Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

EDWARDS AND CO.
New York, N.Y. U.S.A.

PUSHES.

Fits in ¾ inch Hole. Fits in ⅞ inch hole
Fits in ⅝ inch hole.
No screws needed to fasten them as the spring clips hold them securely in place.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

TELEPHONE Poles Are Guyed Best by Them.
TELEGRAPH Poles Are Guyed Best by Them.
STOMBAUGH

Worm's-Eye View.

GUY ANCHORS.
They Are the Best for Guying SMOKE STACKS
They Are the Best for Guying the Poles of STREET RAILWAYS

W. N. MATTHEWS & BRO.,
DISTRIBUTORS.
603 Carleton Building, - - ST. LOUIS.

TO CONTRACTORS
USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.
CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. GRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion: additional words 2c each.*

POSITION WANTED.

The undersigned, for seventeen years with Day's Kerite as superintendent and electrician, is open for offers. Understands the insulated wire and cable business from A to Z. Address J. F. OTTO, Seymour, Conn.

POSITION WANTED.

To read meters, collect and do other office work, by a young man of good education. Have had two years' experience in setting meters, doing inside wiring, etc. Address BOX 133, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

POSITION WANTED.

A young man of 23 years, with 4 years' experience in telephone work, desires position as inspector, electrician or manager of telephone system. Can put your plant in shape and keep it so. Moderate salary. Good references given. Am disengaged Nov. 15th. Address BOX 132, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

My 50 K. W. electric-light plant, as I wish to avail myself of a splendid business opportunity elsewhere. Plant is new and growing rapidly. Wood system, furnished by the Ft. Wayne Electric Works, Ft. Wayne, Ind. Absolutely free power from water. Solid rock dam. A splendid opening. Particulars furnished intending purchasers on application. F. D. RODOLF, Balmoral, Wis.

FOR SALE.

One 1,000 K. W., direct-connected, vertical, cross-compound, side crank McIntosh & Seymour engine now completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26-100. This engine was ordered previous to our purchase of the Citizens Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at the McIntosh & Seymour Factory, Auburn, N. Y. Address, Electrical Department, ROCHESTER GAS & ELECTRIC COMPANY, Rochester, N. Y.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select from. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

When in search of a position advertise in the WESTERN ELECTRICIAN.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

A well established electrical supply business, machine shop and plating plant. Address BOX 134, care Western Electrician, 510 Marquette Bldg., Chicago.

MONEY MADE EASY.

If you are employed in any branch of the electrical business, and want to increase your income in an easy and pleasant way, don't fail to **write us at once.** Our proposition is positively a necessity to all interested in the science of electricity. Address FREDERICK J. DRAKE & CO., 356 Dearborn St., Chicago, Ill.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.
Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

Wanted Central Station Managers

And Users of Machinery

TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger, more improved or more modern.

We have the following Quick Shipment Bargains.—
1—20x 8 -½Harrisburg Ideal Engine,
1—16x16 Erie Ball Engine,
1—15x15 " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine,
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps.

A. G SCHOONMAKER CO.,
126 Liberty St., New York City, U. S. A.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR

Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

BOILERS, HIGH PRESSURE.

2—104 H. P. Abendroth & Root Water tube, 125 lbs.
2—165 H. P. Abendroth & Root Water tube, 125 lbs.
2—120 H. P. Heine, 140 lbs., fine.
2—350 H. P. Climax, 150 lbs.
7—66x16 Erie City, 110 lbs.
6—72x18 Tubular. 125 lbs.
1—75 H. P. Erie City, 125 lbs.

CORLISS ENGINES.

1—16x30x48 Cross Cpd. Cooper.
1—20x30x42 Allis, Cross Cpd.
1—24x42 Wright.
1—22x48 Harris condenser attached.
1—20x48 Harris condenser attached.
1—18x48 Brown Corliss.

Write for complete price list of electrical apparatus, list just out. We have some fine machinery coming out.

THE STEAM & ELECTRICAL EQUIPMENT CO.
Wood and Water Sts., Pittsburg, Pa.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.

34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Allis Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

One Geary Water Tube Boiler, 175 H.P. for 150 pounds pressure, almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 H. P. Berryman Heater.
600 H. P. Berryman Heater.
125 H. P. Berryman Heater.
500 H. P. Excelsior Heater.
6 x 4 x 6 and 5¼ x 3½ x 5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 18 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric. A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W. Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
375 H. P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.
High speed automatics, from 250 H. P. down.
Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1,100-light, 60 K. W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric, 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS

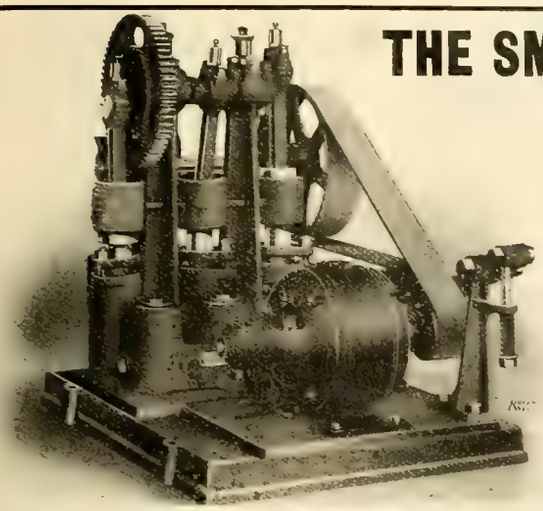
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.



THE SMITH-VAILE ELECTRIC TRIPLEX PUMPS

afford an excellent means for pumping water for House service, Hydraulic Elevator service Factories and Mills desiring an independent water supply, also for Mine Work and : : : :

WATER WORKS SUPPLY.

Can be located wherever electric current is available, and require little or no attention after once installed. We make steam and power : : : : : : : : : : : : : : : : : :

PUMPING MACHINERY FOR ALL PURPOSES.

Jet and Surface CONDENSERS, Feed Water Heaters and Victor Turbine Water Wheels

THE STILWELL-BIERCE & SMITH-VAILE CO.,

DAYTON, OHIO, U. S. A.

New York: 141 Broadway. Chicago: 311 Dearborn St. Boston: 73 Oliver St.
Philadelphia: 612 Arch St. Cleveland: 1116 New England Bldg. Baltimore: 1107 Continental Trust Bldg.
New Orleans: 304 Hennen Bldg.

Sales Agents: FREDERIC NELL, 97 Queen Victoria St., London, Eng. E. F. AUSTIN, Smith Blk., Pittsburg.

INCANDESCENT LAMPS

A BARGAIN PROPOSITION.

We bought at sale 150,000 new, perfect incandescent lamps of standard make. They are clean, regular goods, put up in barrels each containing 250 lamps. Our stock consists as follows:

Candle Power: 8, 10, 16, 20, 24, 25.

Voltage: 100, 102, 104, 105, 106, 107, 108, 110, 115, 120.

Bases: Edison, T. H. and Westinghouse.

Note Our Prices: In lots less than a barrel, 15 cents; in lots of 250, 13 cents; in lots of 1,000, 12 cents; in lots of 5,000 or over, 10 cents.

The above prices are for any candlepower or voltage, and for Edison or Westinghouse bases. Extra for lamps with T. H. base, each 3-4 cent. We handle electrical apparatus of any kind, also machinery of any description. Write for Catalogue 156.

CHICAGO HOUSE-WRECKING CO., W. 35th and Iron Sts., CHICAGO.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

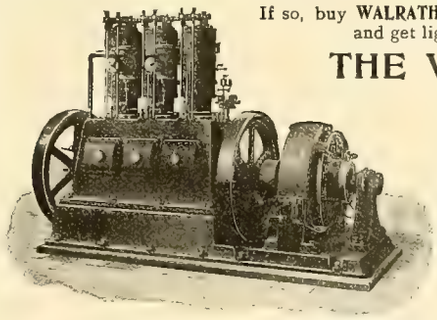
336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,

510 Marquette Bldg., Chicago.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

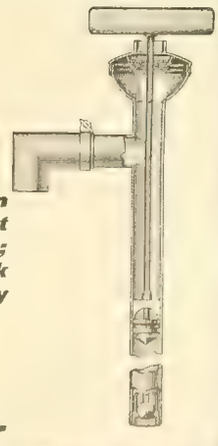
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,

MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

The Sterrett Oil Pump



will give you perfect satisfaction in handling your heavy valve oils. It will pump oil in any temperature; operates easily and does not leak oil. It has more capacity than any other pump on the market.

Write for circular and price.

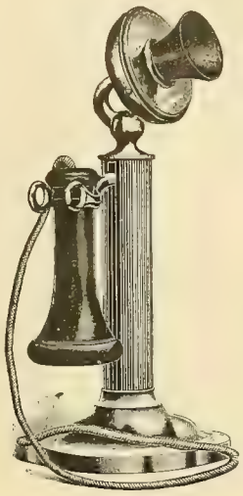
STERRETT PUMP CO.,

69 East Sixth St. ST. PAUL, MINN.

A DEFINITION.

Sterling—Genuine; pure; of excellent quality.

WEBSTER.



No. 19. Desk Phone.

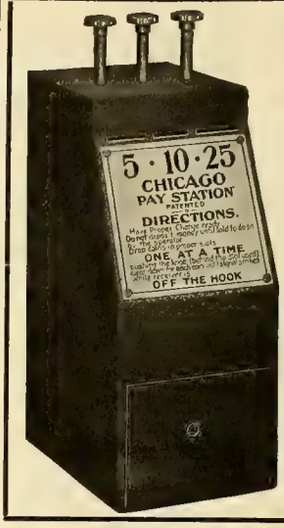
When you buy Silverware, you look for the "STERLING" mark.

Be equally wise in purchasing anything in the line of TELEPHONE APPARATUS and see that it has

"THE STERLING MARK"

STERLING ELECTRIC CO.,

LAFAYETTE, IND.



20th CENTURY CONUNDRUM.

"If a fish and a half is worth a cent and a half, how much are three fish worth?"

Three Cents. EASY.

It is just as easy to TUMBLE to the fact that Chicago

"Coin Collectors"

ARE A PROFITABLE INVESTMENT.

We will cheerfully forward one on approval. Write us TO-DAY if interested in ways and means to increase your revenue.

Chicago Pay Station Co.,

130 La Salle Ave., Chicago, Ill.

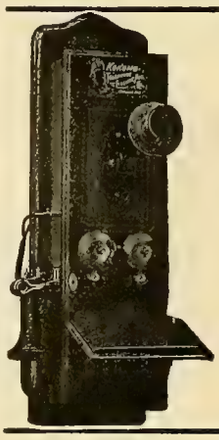
Western Electrician WANT ADS Bring Results.

...THE... "MAYER" DROP.

—Sold by—

THE MAYER ENGINEERING CO.
Monadnock Block,
Chicago, Ill., U. S. A.

WRITE FOR PRICES.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

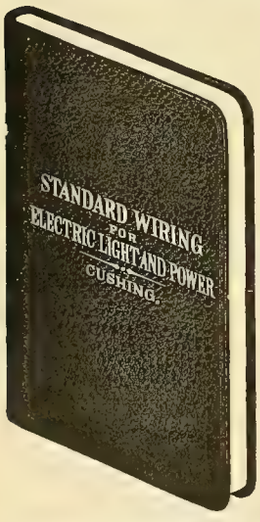
SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.



"The Recognized Authority on Wiring and Construction."

The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover (pocket size), $1.00.

Sent post paid upon receipt of price, by

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO, ILL.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.

CHAPTER 13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.

CHAPTER 28. Metallic Circuit.
29. Underground Wires
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
41. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

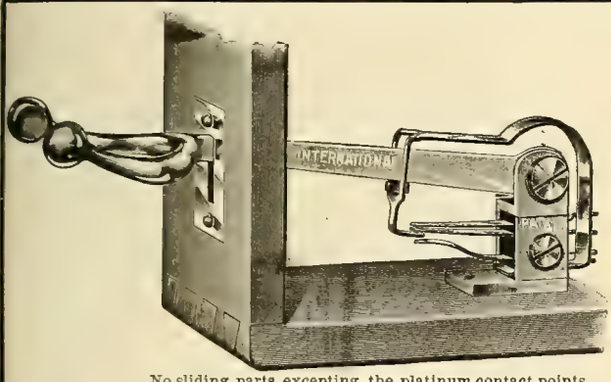
Published and for sale by ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago

Party Line Service ADVANTAGES.

1. Rings only party wanted.
2. Locks all others out.
3. Can have up to 35 on one line.

The U. S. Electric Mfg. Co.,
BUTLER, PA.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM
CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.



A SWITCH ON THE RIGHT LINE.

No sliding parts excepting the platinum contact points.
All springs German silver—long, live and durable.

Many improvements embodied in "INTERNATIONAL" Central Energy, Multiple and Trunking Switchboards, and Complete Line of Telephones.

Harrison and Clinton Streets, CHICAGO, U. S. A. **INTERNATIONAL TELEPHONE MFG. CO.**

Do You Think?

A COMPANY THAT HAS THE REPUTATION OF MAKING THE HIGHEST GRADE OF TELEPHONE AND SWITCHBOARD APPARATUS WOULD MAKE THIS STATEMENT IF THEY WERE NOT DEAD SURE THEY COULD BACK IT UP.

KELLOGG TRANSMITTERS Guaranteed

BETTER than the "BELL SOLID BACK."

WE STAND READY TO PROVE THIS STATEMENT.

Write for new booklet — "The Express and some of it's stopping places."

Kellogg Switchboard & Supply Co.
229 South Green Street, CHICAGO.

"RELIANCE"
GENERATORS AND MOTORS.

SEND FOR BULLETIN.

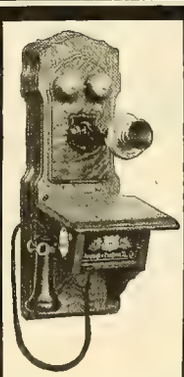
RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - WIS.
AGENTS WANTED EVERYWHERE.

"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

STROMBERG-CARLSON TELEPHONE MFG. CO.

ROCHESTER, N. Y. **CHICAGO, ILL.**

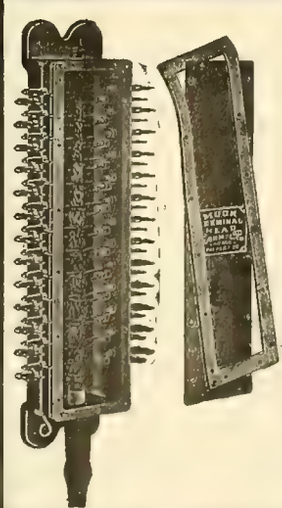


LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



MOON
TERMINALS
WITH
METALLIC OUTER CASE . . .

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street, CHICAGO.

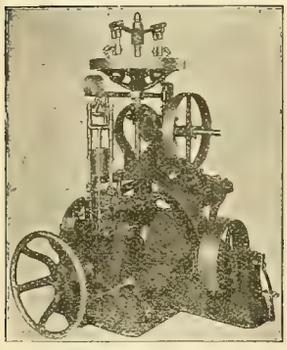
POWER INCREASED

AND BOILERS PROTECTED
BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H. EDGAR, President Telephone: Harrison 3930 and 3931.

RESISTANCE rods of Dixon's Graphite give high resistance in contracted space. Any size, any resistance. Ask for sample and booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

REG. TRADE MARKS
"Phosphor Bronze"
DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.



Water Wheel **Governors**

For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.

We are now prepared to

GUARANTEE ABSOLUTE SATISFACTION

Write for References in your Locality.

The Replogle Governor Works,
HIGH & CHESTNUT STS., AKRON, OHIO.

NEW CATALOGUE ELEVATING = CONVEYING — MACHINERY — NOW READY SEND FOR COPY
THE JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

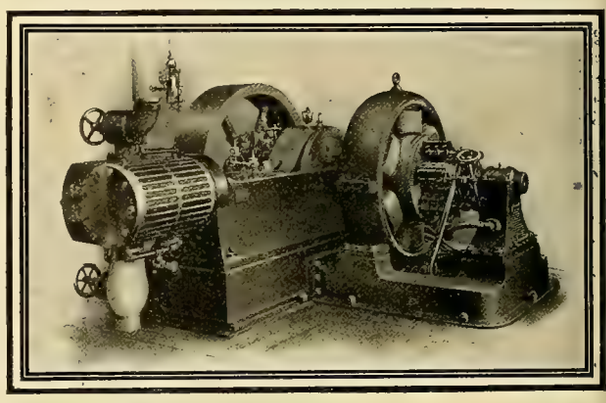
WESTERN CEDAR POLES—Low Prices.
Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

AUTOMATIC ENGINES
—VERTICAL OR HORIZONTAL—

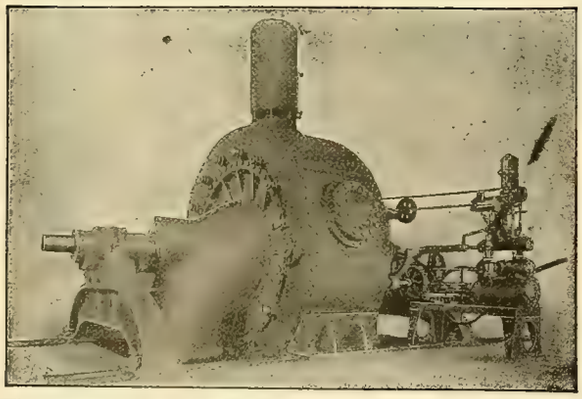
PISTON VALVES
SELF OILING

CONTROLLED BY NICHOLS GOVERNOR FOR HEAVY DUTY BELTED OR D. C.



Boston, New York, Philadelphia, San Francisco. **N. Y. SAFETY STEAM POWER CO.,** 60 S. CANAL ST., CHICAGO ILL.

BOOKS.
BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

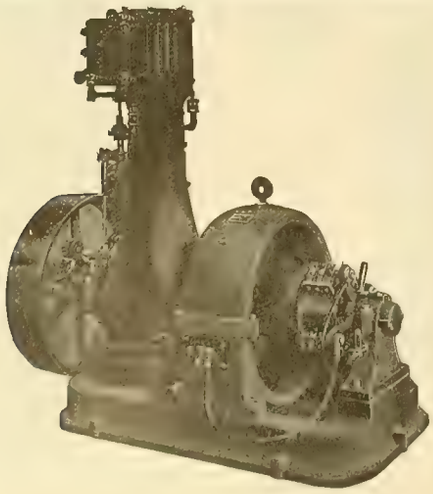


SAMSON TURBINE
UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.
Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.
We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.
WRITE DEPT. "D" FOR CATALOG.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



HIGH-GRADE
ENGINES
VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.
GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.
W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

STOCK—BIGGEST EVER.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice.
WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand

CEDAR POLES OF ALL LENGTHS AND SIZES. . . .

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1703-7 FISHER BLDG. CHICAGO.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 27-29 W. Van Buren St., CHICAGO, ILL.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

SOUTHERN White Cedar Poles
THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

CEDAR POLES
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

CEDAR POLES
THE VALENTINE-CLARK CO.,
234 LA SALLE ST., CHICAGO
YARDS: RHINELANDER, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

The

Revolving Element

of the

Westinghouse

Integrating Wattmeter

Has the lightest weight, insuring minimum wear on jewel support, and with high torque per unit of moving weight, assures permanency on light loads.

FOR ILLUSTRATED WATTMETER BOOKLET ADDRESS THE NEAREST SALES OFFICE OF THE ::

Westinghouse Electric
and Mfg. Co., Pittsburg, Pa.

New York, Atlanta, Dallas, Boston, Baltimore, Buffalo, Chicago, Cincinnati, Los Angeles, Cleveland, Detroit, Minneapolis, Philadelphia, Pittsburg, St. Louis, San Francisco, Salt Lake City, Syracuse, Seattle, Denver, Mountain Electric Co. Canada: Ahern & Soper, Limited, Ottawa. Mexico: G. & O. Braniff & Co., City of Mexico.

Nernst Lamps

Same as Daylight.

One-half the cost of Incandescents.

For indoor or outdoor service.

Write for illustrated booklet.

Nernst Lamp Co.

Pittsburg, Pa.

ANOTHER STRIKE

LOWER AMHERST ROLLER MILLS.
E. E. DWINELL & CO. PROPRIETORS
MANUFACTURERS OF
Wheat, Rye and Buckwheat Flours.

AND THE RESULT.

AMHERST, WIS. Sept. 27, 1902

Fort Wayne Electric Works,
Fort Wayne, Ind.

Gentlemen:-

Replying to your favor regarding our recent experience with your Type A transformers, would say on the night of July 13th, one sixty light transformer was struck by a lightning discharge and the cover broken in two parts, one part falling to the ground. On discovering this we thought the transformer was destroyed and did not attempt to replace the blown fuses. On taking it down the following day, we were surprised on examining the coils, that they did not seem burned or damaged in any way, and after a test in the station which showed O.K. we replaced the broken cover and this transformer has been in constant service ever since. Enclosed find photograph which we had taken at the request of your Chicago representative, we remain,

Yours truly
E. E. Dwinell & Co.

FORT WAYNE ELECTRIC WORKS,

FORT WAYNE, IND.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS

Possesses Many Up-To-Date Features.

JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF ELECTRICITY METERS. LAFAYETTE, IND.

A New Paper-Weight.

Sent on request to any Supply Company officer or P. A. Mailed to any address for ten cents to pay postage and packing.

We have tried to make a good paper-weight as we have always tried to make a good fuse wire.

CHICAGO FUSE WIRE & MFG. CO.

853 BROADWAY, NEW YORK.
358 DEARBORN ST., CHICAGO, U. S. A.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.

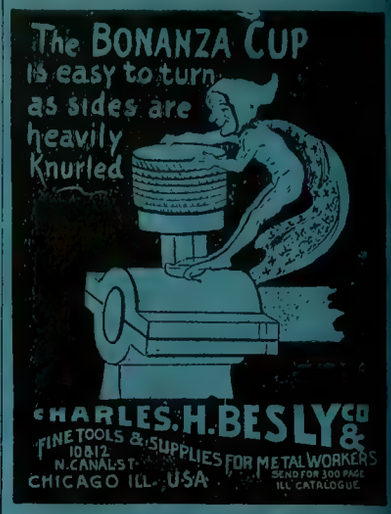
Reynolds Corliss Engine.

Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.



STURTEVANT ELECTRIC FANS

ARE SPECIALLY DESIGNED.

Our immense variety in styles and sizes of Electric Motors makes it possible for us to construct high or low pressure electric fans in great diversity to meet any possible conditions.
Motors are built of enclosed or open types, according to the amount of dust and moisture in surrounding atmosphere.

B. F. STURTEVANT CO.

185 BOSTON, MASS.

New York. Philadelphia. Chicago. London.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF **WIRES AND CABLES**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

General Office and Works, Wilkesbarre, Pa. | New York Office, 50 Dey St. | Chicago Office, 1201-2 Marquette Bldg.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

REFLECTORS!

Light is useless if you can't have it where you want it.

Paragon Reflectors throw the light **just where you want it.**

Our Incandescent Reflectors are neat and are superior to all others. They are green outside, glossy enamel white inside. Reflecting surface. Made in various styles and sizes. Get our catalog.

American Reflector & Lighting Co.,

271-273 FRANKLIN ST., CHICAGO.

Black Diamond File Works

Est. 1863. Inc. 1895.

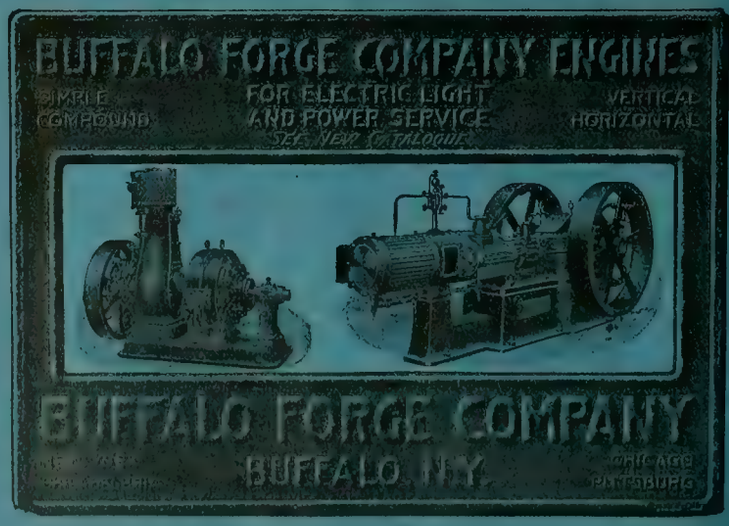
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY

PHILADELPHIA, PA.



Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 22, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 21.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON. 1137 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 78-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

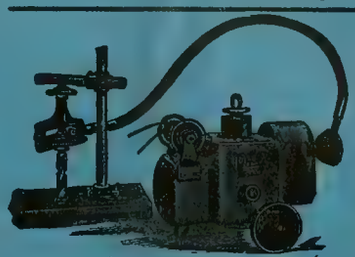
TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits to agents.
The Hobart Elec. Mfg Co. Troy, Ohio


ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

J. E. MOTT & CO.
BUNTINGTON, IND.—MARION, IND.
CONTRACTORS
Consulting, Mechanical and Electrical
ENGINEERS
Estimates Furnished on All Kinds of Electrical Construction.
Electric Railways Built by us:
For the Milwaukee, Racine & Kenosha Electric Ry. Co., from South Milwaukee to Kenosha, 24 miles.
For the Chicago & Milwaukee Electric Ry. Co., from Waukegan to N. Evanston, 26 miles.
For the Ft. Wayne (Ind.) Southwestern Traction Co., from Ft. Wayne to Wabash, 45 miles.
We have been awarded the contract for the construction of an electric light plant at Edmonton, Ont.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

The FRANKLIN Model Shop
The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.
3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient. Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50, $6, $8.50. Complete $12.50. Write for circular 16.
PARSELL & WEED,
129-131 W. 31st Street, New York.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices.
We also make Inventors' Models and Special Electrical Devices.
Write us for prices.
SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Ammeter, Type F.

Berlin—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
London—Elliott Bros., No. 101 St. Martin's Lane.

We desire to call attention to a line of **cheap** but excellent Switchboard Instruments for Direct Current Circuits, which we designate as

"Round Pattern," Style F.

These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

Mention the Western Electrician when writing for catalogue.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E"
CINCINNATI, O.

R. W. LYLE, President and Manager — B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

"Ceco." Electrical Machinery.

250 K. W 3-Phase "Ceco" Alternator.

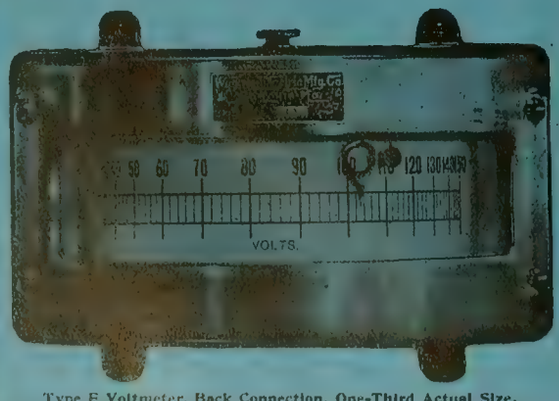
For Lighting, Power and Railway Service.

Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.



Type F Voltmeter, Back Connection, One-Third Actual Size.

STATIC GROUND DETECTORS, SYNCHRONIZERS, POWER FACTOR INDICATORS, GALVANOMETERS, switchboard and portable types of **VOLTMETERS, AMMETERS** and **INDICATING WATTMETERS** are as **ACCURATE, DEADBEAT** and **PERMANENT** as it is possible to build them and withstand ordinary commercial usage.

WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO., U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

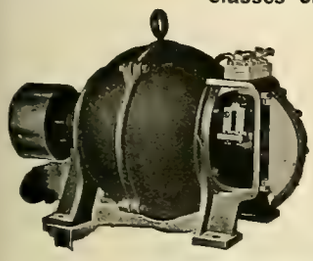
PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

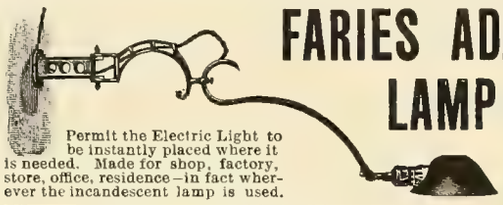
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



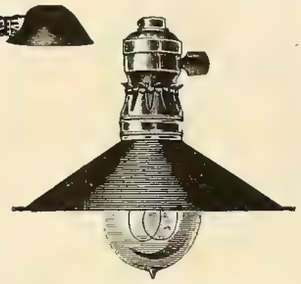
FARIES ADJUSTABLE LAMP HOLDERS

Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.

WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers.

Send for Catalogue No. 10, just issued.



FARIES MFG. CO., DECATUR ILL.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.

BRANCH OFFICES: NEW YORK-CHICAGO.

PLATINUM

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

BAKER & CO.,
MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....20
Allen Company, L. B..... 11
Allis-Chalmers Company....20
American Battery Co.....20
Amer. Electrical Heater Co..20
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refl. & Lighting Co.20
American School of Corresp. —
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....17
Audel & Company, Theo.... 13

Baker & Company..... 3
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg. Co.—
Beardsley Gravity Dam & Construction Co..... 9
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward 12
Bossert El. Construction Co.. 1
Brooks, Hall L..... 17
Brown & Leasure..... 10
Buffalo Forge Co.....20
Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co...17
Central Telephone & El. Co..14
Century Glass Co.....—
Chase-Shawmut Company...11

Chicago & Alton Railroad....16
C. & N. W. R. R.....13
Chicago Edison Company..4, 12
Chic. Fuse Wire & Mfg. Co....—
Chicago House Wrecking Co.13
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R.....14
Chicago Pay Station Co.....15
Christensen Engineering. Co. 2
Consumers Carbon Co..... 5
Continuous Rail Joint Company of America..... 17
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 5
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..16
Diamond Meter Company ... 4
Dixon Crucible Co., Joseph..16
Duncan Electric Mfg. Co.... 19

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....13
Edwards & Company.....16
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co.. 3
Electrician Pub. Company... 9

Faries Manufacturing Co.... 3
Federal Electric Company...—
Fisher Electric Company....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....17
General Electric Company... 4
General Incandescent Arc Light Company..... 7
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Great Western Smelting & Refining Company... ....—
Gregory Electric Company ..12

Hamblin & Russell Mfg. Co..10
Hartford Steam Boiler. Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Helios-Upton Company..... 5
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holmes Fibre Graph. Co.....—
Hopkins & Co., A. P.....17
Huebel Company, C. J.....17
Humphrey, Henry H.....10

Illinois Electrical Mfg. Co...12
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..15

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....12
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co..... .....—

Machado & Roller.....—
Maley, Martin.....—
Maltby Lumber Company.. .17
Manhattan Elec. Supply Co..—
Marinette Iron Wks. Mfg. Co.13
Marshall-Sanders Co. 5
Matthews & Bros., W. N.....11
Mayer Engineering Co.....11
McLennan & Company, K....10
McNamara Brothers 12
Mechanical Appliance Co.... 9
Metropolitan Tel. & El Co...14
Mica Insulator Company.....—
Miscellaneous Advs.....12
Monarch Fire Appl. Co.....—
Monon Railroad.....12
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Mott & Company, J. E..... 1
Munsell & Co., Eugene.....10
Murdock Parlor Grate Co....—

National India Rubber Co....—
Nernst Lamp Co.....18
New York Ins. Wire Co..... 9
N. Y. Safety Steam Power Co.11
Norton Elec'l Instrument Co. 5

Okonite Company, The..... 1
Osburn Flexible Conduit Co.—

Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....17
Phelps Company.....20
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo..... 9
Reliance Electric Company..13
Replogle Governor Works.. .—
Reynolds Electric Company.—
Rice, Cyrus W 11
Roebling's Sons Co., J. A....10
Rooney-Westbury El. Lmp. Co.10
Rose Electric Company 12

Sargent & Lundy.....11
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 10
Smith Co., S. Morgan.....16
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co..—
Standard Varnish Works 13
Standard Vitrified Cond. Co. 2
Stanley Instrument Co..... 9
Station Equipment Co.....12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co..20
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Sterrett Pump Company.....16
Stilwell-Bierce & Smith-Vaile Company.....13
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 15
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company..... .17
Triumph Electric Co..... 1

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....—
Vindex Electric Company....—
Vought-Berger Company 9
Vreeland, B. F. 17
Vulcanized Fiber Company. 20

Wabash R. R.....16
Wagner Electric Mfg. Co..... 2
Wagor Mfg. Co., P. R.....—
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co..... 8
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....14
Wisconsin Central R. R.....14
Worcester Company, C. H....17

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

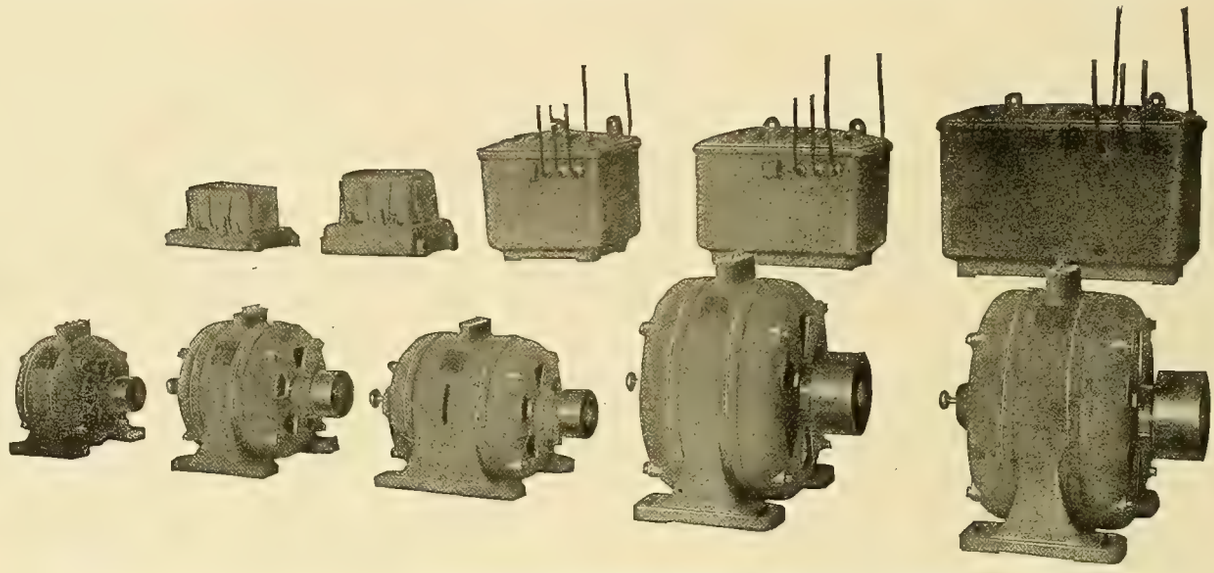
CHICAGO EDISON COMPANY,

WRITE FOR PRICES.

139 ADAMS STREET, CHICAGO.

THE GENERAL ELECTRIC COMPANY'S

SINGLE PHASE CONDENSER-COMPENSATOR MOTOR.

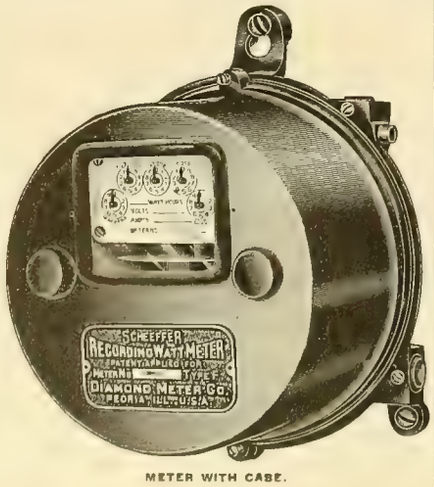


These Motors start under full load with very moderate starting current, creating no disturbance on lighting circuits. They are built for 60 and 125 cycles.

GENERAL OFFICE: Schenectady, N. Y.

NEW YORK OFFICE, 44 Broad Street. CHICAGO OFFICE, Monadnock Block.

Sales Offices in all Large Cities.



METER WITH CASE.

SCHEEFFER
INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

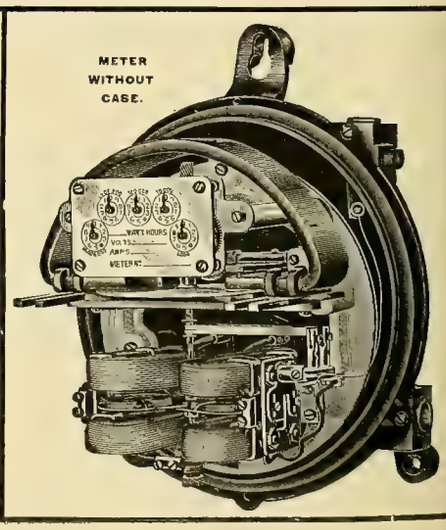
Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.

METER WITHOUT CASE.



Indicating Fuse Before Blowing.

Indicating Fuse After Blowing.

A BLOW INDICATED
NO MATTER WHAT THE WEATHER.

D. & W. Junction Boxes, Motor Cut-outs, Transformer Cut-outs Feeder Blocks of any Capacity, Service Boxes, Two or Three Wire, Service Switches, Two or Three Wire, Cut-outs for Lighting System, Telephone, Burglar and Fire Alarm Cut-outs.

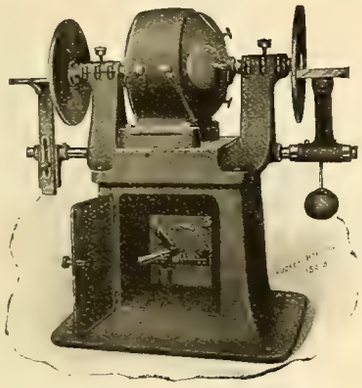
ALL EQUIPPED WITH D. & W. NON-ARCING FUSES.

SEND FOR BULLETINS AND PRICE LIST.

Central Electric Company, GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE. CHICAGO.

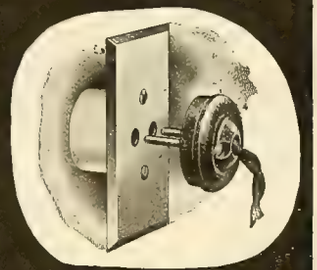
CROCKER-WHEELER COMPANY AMPERE, N.J., U.S.A.



An increase of efficiency and machine output is a result of motor drive.

"Einfacheit"

This Rosette Plug Receptacle is a bit the simplest thing we ever produced. Funny, but it took a lot of complicated thinking to design it. Easy enough after you "see how," as Columbus said about balancing the egg.



M.-S. ROSETTE PLUG AND RECEPTACLE.

It is perfectly flush without the plug, and with plug connected, makes a neat rosette finish to the plate.

Wired from the front. Goes in standard conduit boxes, or a 1⅜-inch round hole.

It is economical in price. Mailed sample, 80c.

MARSHALL-SANDERS COMPANY,
301 CONGRESS ST., - - - BOSTON, MASS.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.

The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.
Agents.–Kohler Bros., Chicago, Ill ; Newman-Spranley Co., New Orleans, La.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

TRADE MARK.

STORAGE BATTERY INSTALLATIONS

FOR

RAILROAD REGULATING, LIGHTING, POWER AND ISOLATED PLANTS.

GOULD C, E-M-F BOOSTER SYSTEMS.

GOULD STORAGE BATTERY CO.

SALES OFFICES:

Boston, 53 State Street, Chicago, Rookery Building, New York, 25 West 33rd Street,
Century Electric Company, San Francisco, Cal. Pittsburg Engineering Company, Pittsburg, Pa.

WORKS: DEPEW. N. Y.

Bulletin No. 2, describing "GOULD BOOSTER SYSTEMS," on application.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
McLennan & Co., K.
Allen Co., L. B.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Mott & Company, J. E.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec.&Mfg.Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Reliance Electric Company.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Mott & Company, J. E.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Platinum Bought and Sold.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Chicago House Wrecking Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co.
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

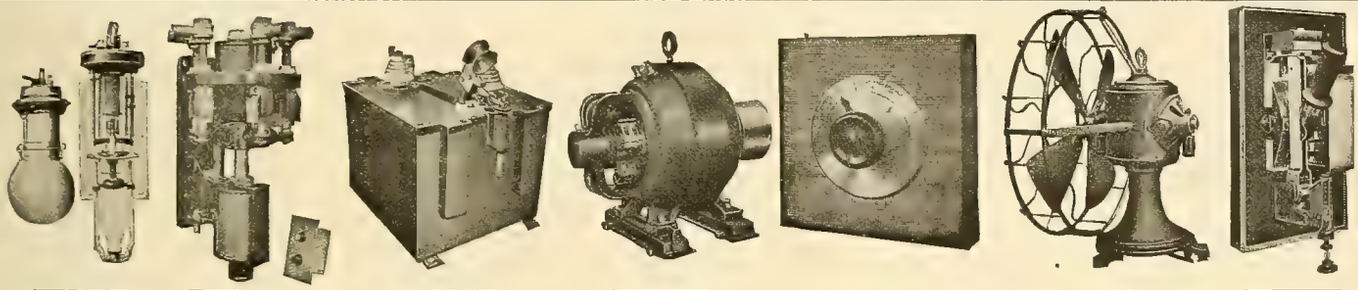
MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.



BULLETIN No. 172 | BULLETIN No. 54 | BULLETIN No. 53 | BULLETIN No. 164 | BULLETIN No. 155 | BULLETIN No. 162 | BULLETIN No. 152

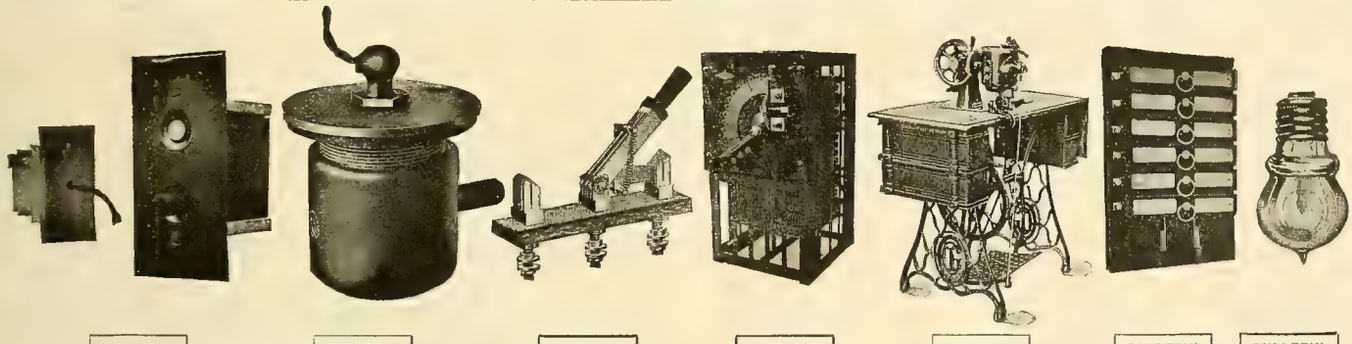
TRADE **G. I.** MARK

STANDS FOR ELECTRICAL AND MECHANICAL PERFECTION.

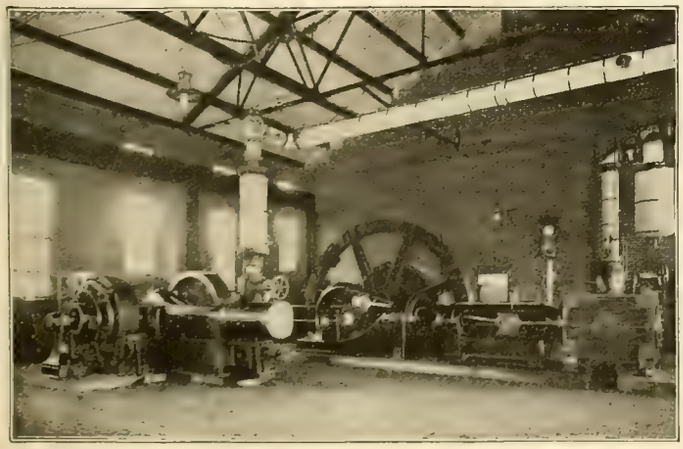
Bulletins, Blueprints, Photographs, Estimates, Etc., Mailed Upon Application.

GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK, N. Y.

220 Devonshire St., Boston, Mass.
48 West Jackson Blvd., Chicago, Ill.
638 Century Bldg., St. Louis, Mo.
1732 Champa St., Denver, Colo.
510 New England Bldg., Cleveland, Ohio.
319 Hayward Bldg., San Francisco, Cal.
57 Perin Bldg., Cincinnati, Ohio.
115-117 Cannon St., London, E. C. Eng.



BULLETIN No. 54 | BULLETIN No. 94 | BULLETIN No. 50 | BULLETIN No. 240 | BULLETIN No. 65 | BULLETIN No. 51 | BULLETIN No. 190



Motors, Generators
Arc Lamps, Switchboards
Automatic Circuit Breakers

and

Electrical Supplies.

Western Electric Company,

Chicago. Saint Louis. Philadelphia. New York.

Wesco Wesco

ELECTRIC AND COMBINATION FIXTURES

One of the most complete lines of Chandeliers, Brackets and Accessories in the Country. We can furnish you anything in this line and at prices that will enable you to get orders.

We guarantee workmanship and material to be the very best.

WESTERN ELECTRICAL SUPPLY COMPANY.

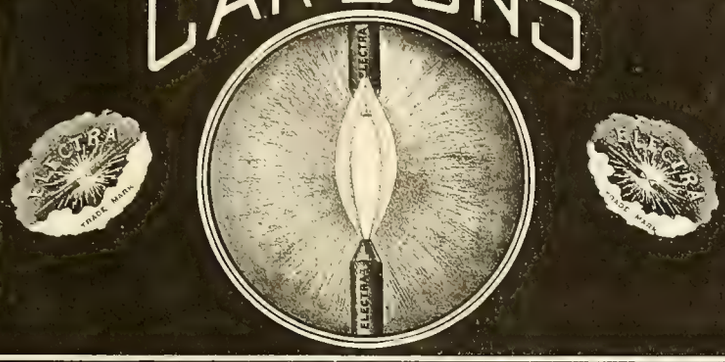
Write To-day for Catalogs.

ST. LOUIS, U. S. A.

"ELECTRA" FLAME LIGHT CARBONS

MARVELOUS EFFECT

"ELECTRA" Flame Light Carbons are suitable for all types of Open Arc Lamps, either direct or alternating current, with slight change in regulation of lamp.



HIGHEST INTENSITY

The intensity and brilliancy of light is three times that of regular "ELECTRA," and five times that of other carbons, making them eminently suitable for all special lighting purposes.

HUGO REISINGER, SOLE IMPORTER, 11 BROADWAY, NEW YORK.

Grimshaw. Raven White Core. Raven Black Core.

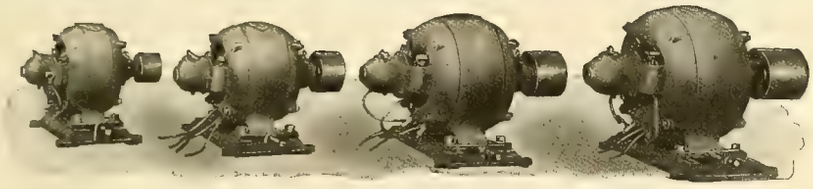
ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

THE MECHANICAL APPLIANCE COMPANY, - Milwaukee, Wis.

1-8 to 5 H. P.
1-10 to 3½ K.W.



Steel Frames Ventilated Form Coil Wound Armatures

Watson Multipolar Motors and Generators.

WE BUILD SPECIAL MOTORS FOR SPECIAL PURPOSES.

Write for Bulletin No. 55.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78-page book on Dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.

Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building

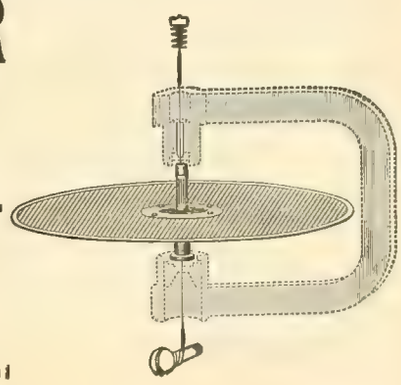
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO FRICTION. NO LOST REVENUE. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION "ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

ITS LAMPS LIKE THESE

THAT LIGHT THE WORLD

PACKARD
INCANDESCENT LAMPS

THE ONLY KNOWN SUBSTITUTE.

Packard lamps are "quality" lamps—you get something more than a mere lamp when you buy Packards. They are built to meet conditions—actual conditions. They will satisfy both you and your customers—all along the line. Its lamps like these you need.

ELECTRIC APPLIANCE COMPANY,
ELECTRICAL SUPPLIES, :: CHICAGO.

A STOCK OF
EDISON MINIATURE LAMPS

Should be kept by every **Central Station** for rental to their customers. They popularize electric lighting and bring a profitable income from a small investment. Very desirable for **Christmas Tree** and **Holiday Decorations.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 CORTLANDT ST.

LONG LIFE

is usually the result of a strong, hearty constitution. Toerring Long Life Arc Lamps have an especially strong constitution, enabling them to successfully withstand such troubles as arc lamps are heir to. They require no dosing because they are constructed on the principle that an ounce of prevention is better than a pound of cure.

19th & ALLEGHENY AVE.

NEW YORK CITY. **C. J. TOERRING CO.** PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS
AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

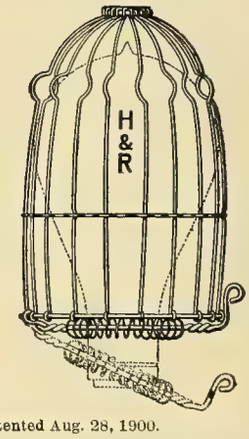
Cale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, 909, 100 Washington Street, - CHICAGO.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.
JOHN A. ROEBLING'S SONS CO.
NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

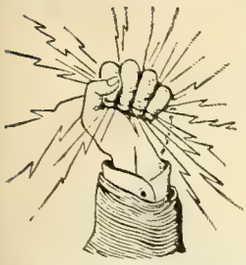
A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

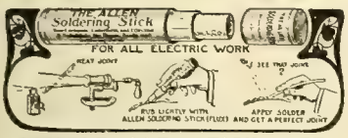
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.



SAMPLE ALLEN STICK FREE.

An ALLEN patron accepted a substitute (?) which he returned to his dealer, saying: "Works like thunder!" His explosion almost needs an apology but—

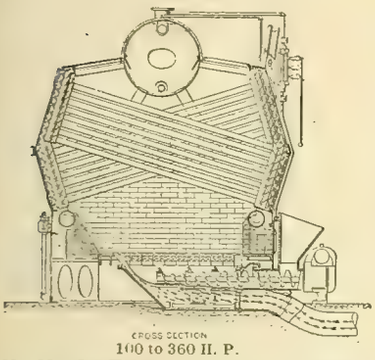
He got his ALLEN SOLDERING STICK.

Makes Solder Flow on Any Metal.
Watch for what he says next week.

L. B. ALLEN CO., Inc., 1334 Columbia Avenue, - CHICAGO.
If your dealer won't supply you, we will.

Bear in Mind THE WORTHINGTON

THE WORTHINGTON WATER-TUBE BOILER WITH THE AMERICAN STOKER ATTACHED



CROSS SECTION
100 to 360 H. P.

Water-Tube Sectional

BOILER

is side-fired, and set in battery in units from 100 to 360 H. P. We make our end-fired type in powers from 20 to 125 H. P.

NO BRICKWORK.
NO BENT TUBES.
NO SCREWED JOINTS.

Iron casing a system of doors makes all parts accessible.

CASING Lined with Non-Conductor.
LARGE Power in Small Space.
High Pressure with Safety.

N. Y. SAFETY STEAM POWER CO. 60 S. Canal Street, **Chicago, Ill.**
Send for Catalog
NEW YORK PHILADELPHIA SAN FRANCISCO BOSTON

THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

SARGENT & LUNDY,
Engineers,
1000, 46 E. VAN BUREN ST., CHICAGO.
FREDERICK SARGENT. A. D. LUNDY

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

TELEPHONE Poles. Use the 5, 6 and 8-inch.
TELEGRAPH Poles. Use the 5 and 6-inch.
STOMBAUGH
ELECTRIC LIGHT Poles. Use the 6 and 8-inch.
WIRE FENCES Use the 3½-inch.

Worm's-Eye View.

GUY ANCHORS.
Use the 6 and 8-inch for SMOKE STACKS
Use the 6, 8 and 10-inch for Poles of STREET RAILWAYS

W. N. MATTHEWS & BRO.,
DISTRIBUTERS.
603 Carleton Building, - - ST. LOUIS.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, Intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative:
WM. S. BROWN, 39 Cortlandt St., New York City.

Western Representative:
THOMAS G. GRIER CO., 128 W. Jackson Blvd., Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent of electric plant in city of five to ten thousand inhabitants. Have been in charge of plants for past ten years. Am expert meter and arc-lamp repair man. Own and understand use of steam engine indicator, and am good mechanical draftsman. Married and strictly sober. References from present and former employers. Address BOX 137, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

AT LIBERTY MAY 1ST.

Will accept position as superintendent of lighting plant or similar work. Ten years' experience installing and operating steam, water-power and electric plants. Can give you good service and make your plant pay. Salary $150 per month. Address Box 135, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Salesmen calling on telephone and electric-light plants to handle cedar poles as a side line. Liberal commission paid. To right party regularly covering territory, we will give exclusive territory. Address BOX 138, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

To lease telephone or electric-light property by practical all around electrical man, with some capital. Address BOX 136, care Western Electrician, 510 Marquette Bldg., Chicago.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select rom. **THE SCIENTIFIC EXCHANGE,**
Room 60, 6 Sherman St., Chicago.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Two Royal Electric Company, Standard dynamos of 150 K. W. each. These machines are alternators, 133-cycle, new and of excellent design and make, connected for furnace work, but suitable for town lighting. Address D. M. HILLIS, 112 Hartford Building, Chicago.

FOR SALE.

One 1,000 K. W., direct-connected, vertical, cross-compound, side crank McIntosh & Seymour engine now completed. Revolutions per minute, 120. Steam pressure, 125 lbs. Rated load and indicated horsepower, 1,520. Cut-off, 26-100. This engine was ordered previous to our purchase of the Citizens Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at the McIntosh & Seymour Factory, Auburn, N. Y. Address, Electrical Department, ROCHESTER GAS & ELECTRIC COMPANY, Rochester, N. Y.

NOTICE.

I have a number of buyers for Electric-Light Plants in Central states in towns of not less than 2,500 people. If your plant is on paying basis, can furnish you a buyer. Address BOX 139, care Western Electrician, 510 Marquette Bldg., Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each. Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

McNAMARA BROS.

ELECTRIC SWITCHBOARDS, SLATE AND MARBLE.

Write for Catalogue B. Fair Haven, Vt.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

When in search of a position advertise in the WESTERN ELECTRICIAN.

BOILERS, HIGH PRESSURE.

2—104 H. P. Abendroth & Root Water tube, 125 lbs.
2—165 H. P. Abendroth & Root Water tube, 125 lbs.
2—120 H. P. Heine, 140 lbs., fine.
2—350 H. P. Climax, 150 lbs.
7—66x16 Erie City, 110 lbs.
6—72x18 Tubular, 125 lbs.
1—75 H. P. Erie City, 125 lbs.

CORLISS ENGINES.

1—16x30x48 Cross Cpd. Cooper.
1—20x30x42 Allis, Cross Cpd.
1—24x42 Wright.
1—22x48 Harris condenser attached.
1—20x48 Harris condenser attached.
1—18x48 Brown Corliss.

Write for complete price list of electrical apparatus, list just out. We have some fine machinery coming out.

THE STEAM & ELECTRICAL EQUIPMENT CO.
Wood and Water Sts., Pittsburg, Pa.

REPAIRS AND SECOND-HAND MACHINERY.

STREET RAILWAY, LIGHTING AND POWER.
Write for List of Machines.
ILLINOIS ELECTRICAL MFG. CO., PEORIA, ILL.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.
34x60 International Power Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x48 Allis Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x36 Harris Corliss.
24x48 Buckeye Automatic.
18x24 Allis Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.
8½x9 Armington & Sims Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.
One Geary Water Tube Boiler, 175 H.P. for 150 pounds pressure, almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
1,000 H. P. Berryman Heater.
600 H. P. Berryman Heater.
125 H. P. Berryman Heater.
500 H. P. Excelsior Heater.
6 x 4 x 6 and 5¼ x 3½ x 5 Worthington Pumps.
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY,
DAVENPORT, IOWA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric. A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.

375 H. P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.
High speed automatics, from 250 H. P. down.
Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1,100-light, 60 K.W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric. 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of **Slates for Electrical Purposes**
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE VICTOR TURBINE WATER WHEEL.

PARTICULARLY ADAPTED FOR DRIVING ELECTRIC PLANTS.

Its high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion will particularly commend it to all contemplating developing plants of this kind.

OUR OTHER SPECIALTIES ARE:

STEAM and POWER PUMPING MACHINERY for all purposes, AIR COMPRESSORS for the Air Lift system and general use, JET and SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS, STILWELL'S FEED WATER HEATERS, FILTER PRESSES and OIL MILL MACHINERY.

IF INTERESTED, WRITE

The STILWELL-BIERCE & SMITH-VAILE CO.

DAYTON, OHIO.

NEW YORK, 141 Broadway. PHILADELPHIA, 612 Arch Street.
BOSTON, 73 Oliver Street. CHICAGO, 311 Dearborn Street.
NEW ORLEANS, 304 Hennen Building. LONDON, 97 Queen Victoria Street.
BALTIMORE, 1507 Continental Trust Building. CLEVELAND, 1116 New England Building.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

INCANDESCENT LAMPS

A BARGAIN PROPOSITION.

We bought at sale 150,000 new, perfect incandescent lamps of standard make. They are clean, regular goods, put up in barrels each containing 250 lamps. Our stock consists as follows:

Candle Power: 8, 10, 16, 20, 24, 25.

Voltage: 100, 102, 104, 105, 106, 107, 108, 110, 115, 120.

Bases: Edison, T. H. and Westinghouse.

Note Our Prices: In lots less than a barrel, 15 cents; in lots of 250, 13 cents; in lots of 1,000, 12 cents; in lots of 5,000 or over, 10 cents.

The above prices are for any candlepower or voltage, and for Edison or Westinghouse bases. Extra for lamps with T. H. base, each 3-4 cent. We handle electrical apparatus of any kind, also machinery of any description. Write for Catalogue 156.

CHICAGO HOUSE-WRECKING CO., W. 35th and Iron Sts., CHICAGO.

STEAM ENGINEERS' LICENSES

Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

Theo. Audel & Co., Publishers, 63 Fifth Avenue, New York City.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

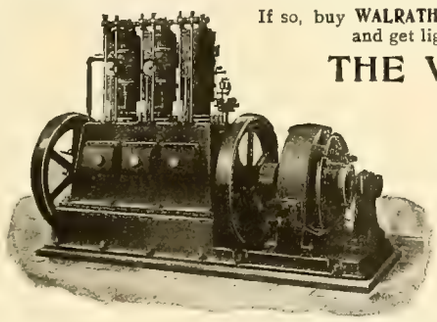
The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

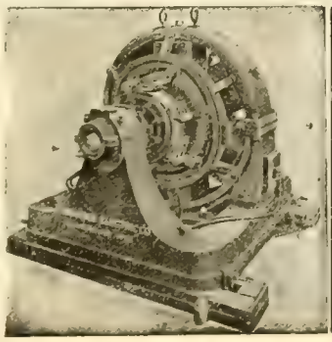
THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.



"RELIANCE"
GENERATORS AND MOTORS.

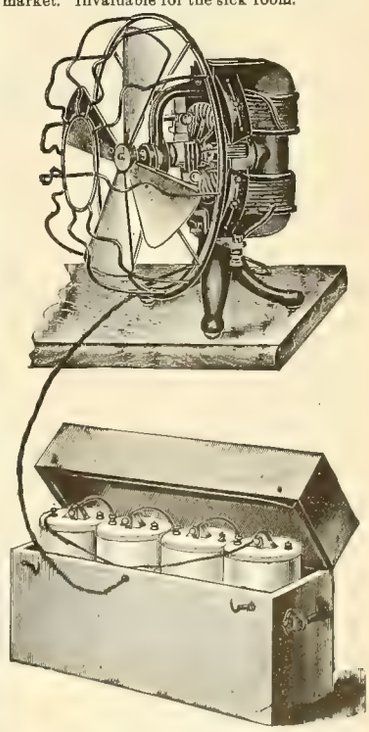
SEND FOR BULLETIN.

RELIANCE ELECTRIC COMPANY,
MILWAUKEE, - - - WIS.
AGENTS WANTED EVERYWHERE.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A. NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

Interstate Independent Telephone CONVENTION

Auditorium Hotel, Chicago,

DECEMBER 9, 10, 11, 1902.

Officers of the association expect this to be the largest convention of Independent telephone men ever held, from 1,200 to 1,500 delegates being expected to attend.

The Western Electrician of December 6th will be distributed at the meeting. The issue of December 13th will contain a full report of the proceedings.

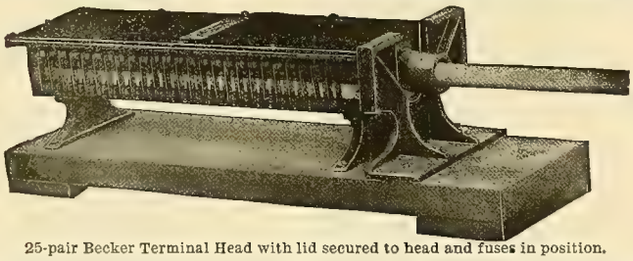
If you wish to increase your business with the Independent Telephone companies you will find it greatly to your advantage to be largely represented in the advertising columns of these two important numbers.

Send in your order NOW.

WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

PROTECTION

THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.

Chicago Office: 59 W. Jackson Boul. | Post-Glover Electric Co., Cincinnati Agents. | W. G. Nagel Electric Co., Toledo (O.) Agents.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

TEST INSTRUMENTS.

Portable Sets for Resistance Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

The Pioneer Limited. **Famous Train of the World.**

Chicago—St. Paul—Minneapolis
VIA
THE ST. PAUL ROAD.
(Chicago, Milwaukee & St. Paul Ry.)
Equipment and Service Unequaled.

Time tables, maps and information furnished on application to
F. A. MILLER, General Passenger Agent, Chicago, Ill.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

KOKOMO TELEPHONES
Always Up-to-Date.
WE MANUFACTURE
SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.
Write for Catalog and Prices.
KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

It Doesn't Pay!

To start in with a short-lived Telephone.
Kellogg Telephones are Centenarians!

It Doesn't Pay!

To go near a short-winded Telephone.
Kellogg Telephones are as wonderfully distinct for a thousand miles distance, as they are for a mile!
Send for our Catalogue.

KELLOGG SWITCHBOARD AND SUPPLY CO.

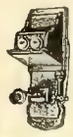
Green and Congress Streets, CHICAGO.

NEW YORK *PHILADELPHIA* *CLEVELAND*

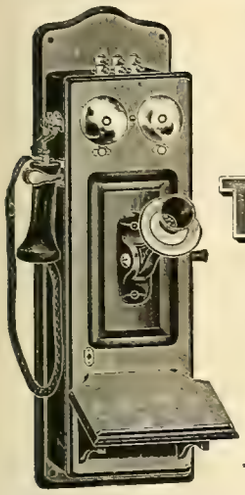
"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

STROMBERG-
CARLSON
TELEPHONE
MFG. CO.



ROCHESTER, N. Y. CHICAGO, ILL.



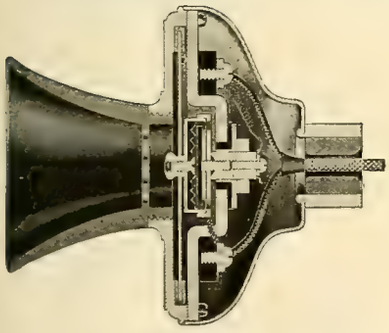
WE ALSO MAKE

FIRST-CLASS
BRIDGING AND SERIES
TELEPHONES
COMBINING
QUALITY AND SIMPLICITY.

WRITE US AND WE WILL
TELL YOU ALL ABOUT IT.

THE U. S. ELECTRIC MFG. CO., - Butler, Pa

INTERNATIONAL TRANSMITTER



PATENT ALLOWED.

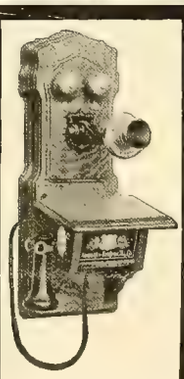
STANDS UNEQUALLED IN
Workmanship,
Efficiency and
Durability.

It is Clear, Distinct and Powerful.

IMPOSSIBLE
to become packed or deadened.

We manufacture a full line of public exchange central energy and generator call Telephones and multiple and trunking switchboards. Correspondence solicited.

INTERNATIONAL TELEPHONE MFG. CO.,
HARRISON AND CLINTON STREETS, - - - CHICAGO, U. S. A.



LET US SEND OUR
CATALOGUE
AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO

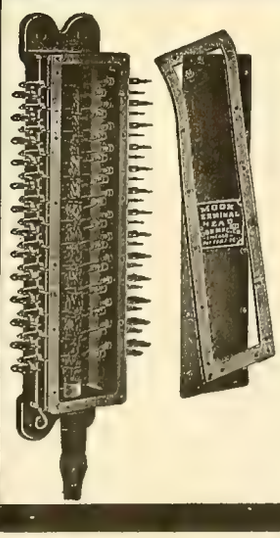
Where are you going my pretty maid?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

WHY? Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,
130 La Salle Ave., Chicago, Ill.



MOON
TERMINALS
WITH
METALLIC OUTER CASE...

Protect the Telephone Cables.
The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

POWER INCREASED

AND BOILERS PROTECTED BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS.
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

RESISTANCE rods of Dixon's Graphite give high resistance in contracted space. Any size, any resistance. Ask for sample and booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

THE STERRETT OIL PUMP

Has been improved so that it is better now than ever for handling heavy valve oils.

OUR NEW PATTERNS

will be out in a short time. You should send in your order at once for early delivery.

SENT ON 30 DAYS' TRIAL.

STERRETT PUMP CO.
67 EAST SIXTH ST., ST. PAUL, MINN.

M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

Hot Springs, Ark.

Via The WABASH

Commencing Nov. 9 the Wabash established its system of through Pullman tickets from Chicago to Hot Springs, Ark., via St. Louis and the Iron Mountain Route. Passengers leaving Chicago on the Wabash fast day express, at 11:03 a. m, will arrive at Hot Springs next morning at 8 o'clock. For illustrated printed matter giving full information regarding this wonderful health and pleasure resort, address F. A. Palmer, Asst. Gen. Pass. Agt., Wabash R. R., 97 Adams St., Chicago.

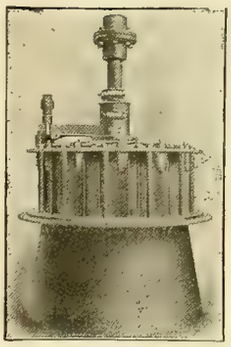
Copyright, 1902 by C. & A. R'y.

ART CALENDAR
Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"
to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

NEW CATALOGUE ELEVATING = CONVEYING — MACHINERY —
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.



SAMSON TURBINE

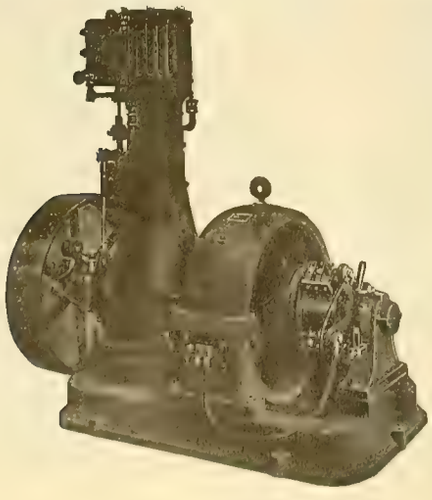
UPRIGHT AND HORIZONTAL

ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.

These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.

Write Dept. "D" for Catalog.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.



HIGH-GRADE
ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

EDWARDS AND CO.

ELECTRO-MECHANICAL GONG.

Is entirely encased in iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

NEW YORK N.Y.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

PRICES—WORTH INQUIRY.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice.
WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.

Large Stock Constantly on Hand

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

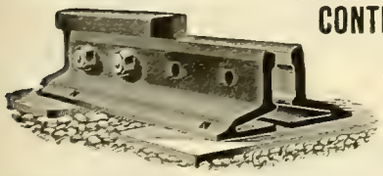
CROSS ARMS.
LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

M. KLEIN & SON
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St. CHICAGO, ILL.

Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

CEDAR POLES OF ALL LENGTHS AND SIZES

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn

Central Manufacturing Co.

Chattanooga, Tenn.
Mfrs. and Dealers in
Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
LARGE STOCKS ON HAND.
Delivered prices quoted, F. O. B. cars, your city, in any quantity.
WRITE US.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES.

HALL L. BROOKS,
TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES

LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES TIES.

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

CEDAR POLES

IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa.; Electric Building, Cleveland, Ohio.; 346 Broadway, New York.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

POLES, TIES, POSTS.

THE PORTER CEDAR CO.,
SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

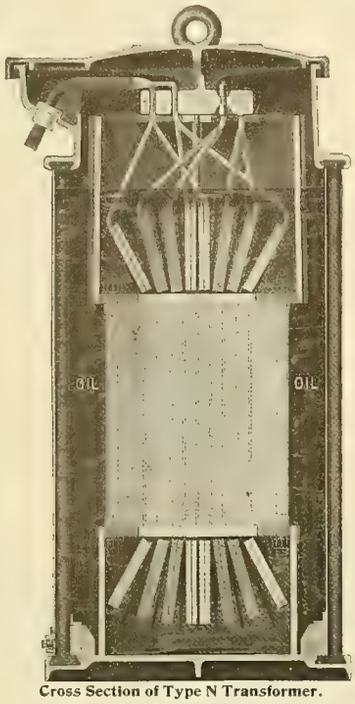
C. J. HUEBEL CO.

Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

SOUTHERN White Cedar Poles

THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

Westinghouse



Cross Section of Type N Transformer.

O. D. and Type N

Transformers

show practically no difference between the temperature measured by a thermometer placed between the coils, and that measured in the copper by the resistance method.—This is actual proof of uniform temperature.

For Transformer booklet address nearest sales office of the

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities. Pittsburg, Pa.

Nernst Lamps

Operative on all Alternating Circuits.
For Indoor or Outdoor Service.

Their striking advantage is that the operating expense for the same illumination is about one-half that of incandescent lamps.

For illustrated booklet No. 6 telling all about them address

Nernst Lamp Co.

Pittsburg, Pa.

Sales Offices: New York, 120 Broadway. Boston, 131 State St. Philadelphia, 710 G'rard Trust Bldg.

TYPE E

small direct-current motors are giving satisfactory operation in every installation.

UPRIGHT

INVERTED

SEMI-INVERTED

OPEN

SEMI-ENCLOSED

OR

ENCLOSED

On 115, 230 or 500-volt circuits at any speed desired, belted, back-geared or direct-connected.

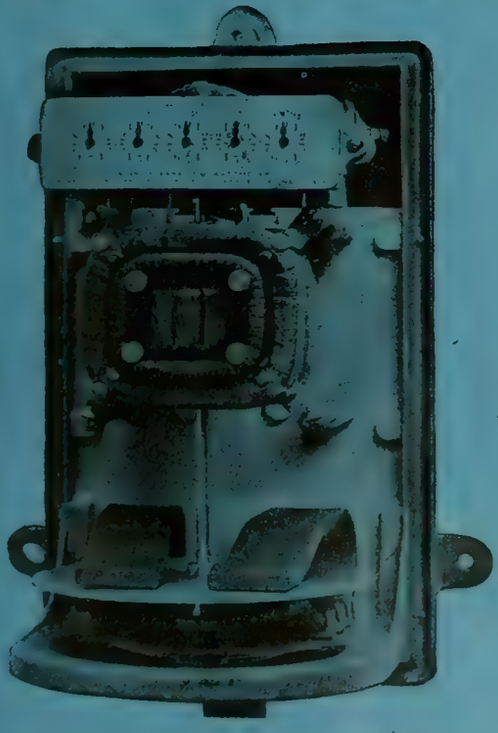
SEND FOR BULLETIN 1036.

FORT WAYNE ELECTRIC WORKS, MAIN OFFICE: Fort Wayne, Ind.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS

Possesses Many Up-To-Date Features.



JUST THE METER FOR DIRECT CURRENT LIGHTING AND POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF ELECTRICITY METERS. LAFAYETTE, IND.

HYLO

TURN-DOWN LAMP

Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.

PHELPS CO., 50 State St., Detroit, U. S. A.

"AMERICAN" STORAGE CELLS

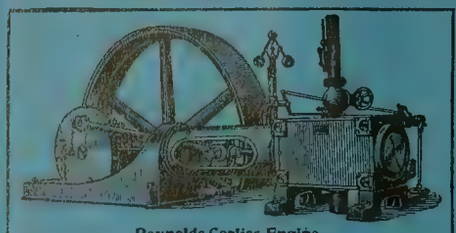
Absolutely Non-Refilling
Protection Guaranteed
AMERICAN BATTERY CO.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,

THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

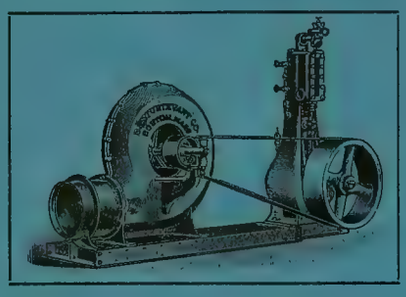
SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

CHARLES H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
108-12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE

STURTEVANT

BLOWERS

ARE BUILT IN ENDLESS VARIETY



HIGH PRESSURE BLOWERS FOR

Cupola Furnaces and Forges are capable of producing pressures up to 16 ounces per square inch The shells are of cast iron, the shafts of high-grade steel, carefully finished, and the wheels of thin galvanized steel mounted on extra strong arms and accurately balanced. The great length and special oiling features of the journal boxes render them practically non-heatable. They can be arranged on adjustable beds so that belts can be tightened while running

B. F. STURTEVANT CO.

109 BOSTON, MASS.

New York Philadelphia Chicago London

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

When you get our **STERLING** We send you lamps.

THE **Sterling Electrical Mfg. Co.** WARREN, OHIO.

We get your **STERLING** You send us coin.

MODERN HEAT

ELECTRICITY.

AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances.
Write for catalogue. 108-197 River St. DETROIT MICH

PARAGON REFLECTORS

Silver-Plated Mirror Reflectors.

A deep cone, for use with any system of incandescent electric light, where it is desired to concentrate a very powerful light on a small space. Lined with silver-plated mirror-plate glass. Increases the light from twelve to fifteen times. Most valuable in show windows and over machines, work-benches, type cases, etc., etc.

Thousands of this style used in show windows. Get our Catalogue and Prices.

American Reflector & Lighting Co.,

271-273 FRANKLIN ST., CHICAGO.

Black Diamond File Works

Est. 1863. Inc. 1895.

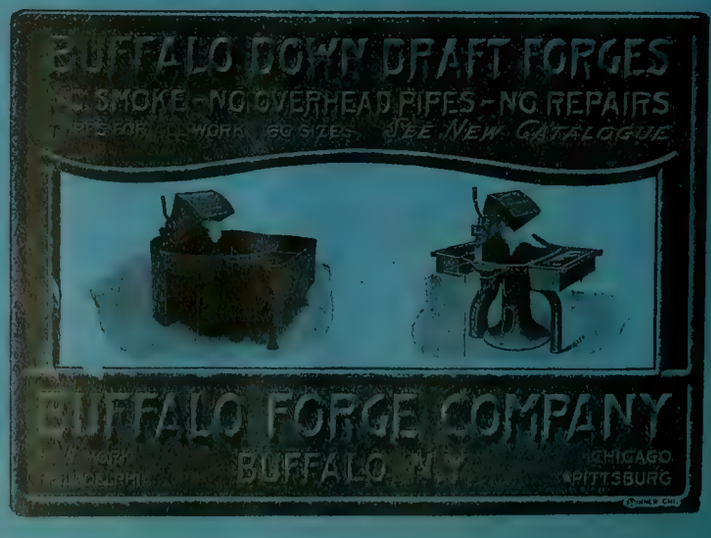
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

E. & H. BARNETT COMPANY

PHILADELPHIA, PA.



Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 29, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 22.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

The Simplex Electrical Co., 78-81 Cornhill, BOSTON, MASS.

National India Rubber Co.'s RUBBER COVERED WIRES AND CABLES. OFFICE AND FACTORY, BRISTOL, R. I.

OKONITE TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

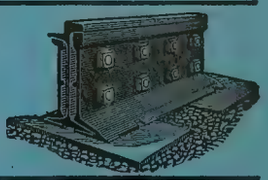
CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building, NEWARK, N. J.

Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

STANDARD

Standard Underground Cable Co.

322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Mills Bldg., San Francisco. 101 Milk St., Boston.

Electric Cables, Conduits, Wires and Accessories.

Also High Grade Rubber Covered Wires and Cables.

MORSE AUTOMATIC LAMP ADJUSTER

For Mills, Factories and Offices

Incandescent Electric Light Manipulator Company, 116 Bedford Street, Boston, Mass.

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.

Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits to agents. The Hobart Elec. Mfg Co. Troy, Ohio

GASOLINE MOTORS

—FOR—

BICYCLES, VEHICLES, LAUNCHES.

LOWELL MODEL CO., NORTH CHELMSFORD, MASS.

THE PHOENIX GLASS CO.

MANUFACTURERS OF

GAS AND ELECTRIC GLOBES, SHADES, Etc.

SEND FOR COPY OF OUR NEW AND LATEST CATALOGUE.

Pittsburg. New York. Chicago.

FIBRE-GRAPHITE COMMUTATOR BRUSH NOISELESS SELF-LUBRICATING

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO. 5155 Wakefield St., Germantown, PHILADELPHIA.

Kilfyre TRADE MARK DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO., 247-249 Pearl St., New York City.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Ammeter.

Berlin—European Weston Electrical Instrument Co., Ritterstrasse, No. 88.

London—Elliott Bros., No. 101 St. Martin's Lane.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.

Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.

Mention the Western Electrician when writing for catalogues.

SILVER-PLATED MIRROR REFLECTORS.

A flat Reflector, for use with any system of incandescent electric light, where it is desired to spread the light considerably. Its silver-plated mirror plate lining makes it most effective and pleasing, and always as good as new.

Convex, reflecting slightly below the horizontal in all directions. Used in stores, etc., for general illumination.

GET OUR PRICES.

American Reflector & Lighting Co.,

271-273 FRANKLIN STREET, CHICAGO.

FOR HIGH GRADE INSULATING VARNISHES ADDRESS STANDARD VARNISH WORKS CHICAGO NEW YORK LONDON

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

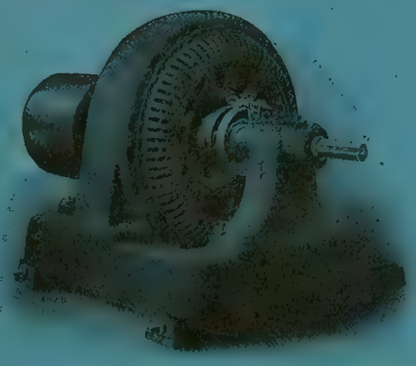
Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street - - - - New York

"Ceco." Electrical Machinery.



250 K. W. 3-Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.

Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

"A B C"

SYSTEM OF MECHANICAL DRAFT

Insures Maximum Boiler Efficiency at Minimum Cost
Frequently Saves the Installation of Additional Boilers

CATALOGUE No. 118 Q ON REQUEST.

AMERICAN BLOWER CO., DETROIT, MICH.

141 BROADWAY, NEW YORK. MARQUETTE BUILDING, CHICAGO.
70 GRACECHURCH STREET, LONDON.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

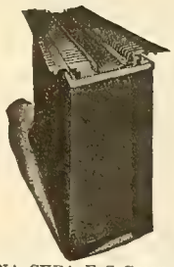
MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 84 Empedrado St.

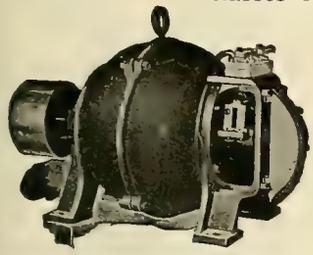


SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

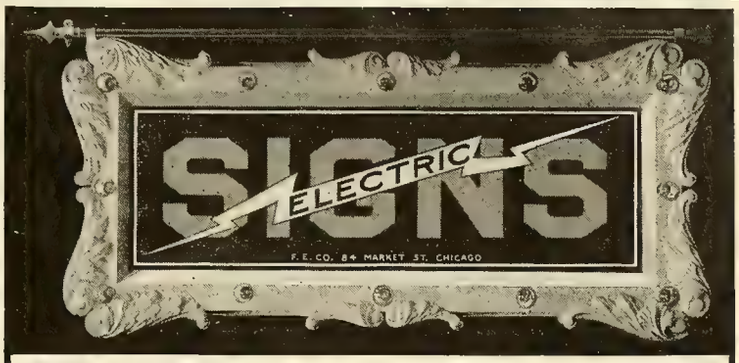
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw. of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
STURTEVANT ENGINEERING CO., LONDON, ENG.
KILBOURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY: MILWAUKEE.
BRANCH OFFICES: NEW YORK-CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co.....—
Allen Company, L. B.....11
Allis-Chalmers Company....20
American Battery Co.....—
American Blower Co.....2
Amer. Electrical Heater Co...—
Amer. El. Telephone Co.....15
American Electrical Works..11
American Refi.& Lighting Co. 1
American School of Corresp. —
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....7
Audel & Company, Theo.....—

Baker & Company.....3
Barnett Company, G. & H....20
Barron & Co., J. S.....—
Bayley & Sons Co., W.....16
Beardslee Chandelier Mfg.Co.10
Beardsley Gravity Dam & Construction Co.....—
Berthold & Jennings.....17
Besly & Co., Charles H.....20
Bonville, Edward.....8
Bossert El. Construction Co..4
Brooks, Hall L.....17
Brown & Leasure.....10
Buffalo Forge Co.....20

Camp Company, H. B.....5
Central Electric Co.....6
Central Manufacturing Co...—
Central Telephone & El. Co...—
Century Glass Co.....—
Chase-Shawmut Company...11
Chicago & Alton Railroad....14
C. & N. W. R. R.....14
Chicago Edison Company.4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago House Wrecking Co.13
Chicago Insulated Wire Co...—
C., M. & St. P. R. R.....14
Chicago Pay Station Co.....15
Christensen Engineering. Co. 2
Commercial Elec. Supply Co. 9
Consumers Carbon Co.....7
Continuous Rail Joint Company of America.....1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 7
Cutler-Hammer Mfg. Co.....3
Cutter Elec. & Mfg.Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Co...16
Diamond Meter Company....—
Dixon Crucible Co., Joseph..16
Duncan Electric Mfg. Co....19

Edison Decorative & Miniature Lamp Department....10
Edison Mfg. Company.....8
Edwards & Company.....4
Electrical Engineer Institute.—
Electric Appliance Company.10
Electric Storage Battery Co..3
Electrician Pub. Company...3

Faries Manufacturing Co....—
Federal Electric Company...3
Fisher Electric Company....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works., Inc.19
Fowler, John H.....17
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...17

General Electric Company... 5
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Great Western Smelting & Refining Company.... 12
Gregory Electric Company...12

Hamblin & Russell Mfg. Co..10
Hartford Steam Boiler Inspection & Insurance Co...16
Hazard Manufacturing Co....20
Helios-Upton Company.....4
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....1
Hopkins & Co., A. P.....17
Huebel Company, C. J.....16
Humphrey, Henry H.....10

Illinois Electrical Mfg. Co...—
Illinois Maintenance Co.....12
Incandescent Electric Light Manipulator Company.....1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel.Mfg. Co. ..15

Jeffrey Manufacturing Co....16
Johnston, Thomas J.....11

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Klein & Son, Mathias.....17
Kohler Brothers. 10
Kokomo Tel. & El. M. Co....14

Leather Preserv. M. Corp....—
Leffel & Co., James.....16
Lindsley Brothers Company..17
Lowell Model Co.....1

Machado & Roller.....—
Maley, Martin.....8
Maltby Lumber Company...17
Marinette Iron Wks. Mfg. Co.11
Marshall-Sanders Co. 8
Matthews & Bros., W. N.....15
Mayer Engineering Co.....14
McLennan & Company, K....10
McNamara Brothers 8
Mechanical Appliance Co.....8
Metropolitan Tel. & El Co...14
Mica Insulator Company.....—
Miscellaneous Advs.....12
Monarch Fire Appl. Co.....1
Monon Railroad.....—
Moon Mfg. Co., The.....15
Morse Cedar Company.....17
Munsell & Co., Eugene.....10
Murdock Parlor Grate Co....4

National India Rubber Co....1
Nernst Lamp Co.....18
New York Ins. Wire Co.....4
N. Y. Safety Steam Power Co.11
Norton Elec'l Instrument Co.—

Okonite Company, The.....1

Paragon Fan & Motor Co.....—
Parsell & Weed.....8
Perrizo & Sons.....17
Phelps Company.....20
Phillips, Eugene F.....11
Phillips Insulated Wire Co..11
Phœnix Glass Company.....1
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Porter Cedar Company.....17

Rauscher, John .....—
Reisinger, Hugo.....7
Replogle Governor Works.. .—
Reynolds Electric Company.10
Rice, Cyrus W 11
Roebling's Sons Co., J. A.....20
Rooney-Westbury El.Lmp.Co.10
Rose Electric Company 12

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....12
Schott, W. H. 10
Schureman & Hayden.....12
Scientific Exchange.....12
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 10
Smith Co., S. Morgan.....16
Spies Electric Company.....14
Sprague Electric Company... 3
Standard Pole & Tie Co.... .17
Standard Underg. Cable Co.. 1
Standard Varnish Works 1
Standard Vitrified Cond. Co. 2
Stanley Instrument Co.....5
Station Equipment Co.....12
Steam & Elec'l Equipment Co.12
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co.. 4
Sterling Electric Company...14
Sterling Varnish Co., The....14
Sterrett Pump Company.....16
Stilwell-Bierce & Smith-Vaile Company.....13
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 14
Sturtevant Company, B. F...20

Toerring Company, C. J 10
Torrey Cedar Company.....17
Triumph Electric Co..... 4

U. S. Electric Mfg. Co.....15

Valentine-Clark Co., The....17
Vindex Electric Company....11
Vought-Berger Company 8
Vreeland, B. F. 16
Vulcanized Fiber Company..20

Wabash R. R.....4
Wagner Electric Mfg. Co.....—
Wagor Mfg. Co., P. R.....20
Walsh's Sons & Company....12
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....12
Whitmore, A. E.....17
Wickes Bros.....12
Willyoung, Elmer G.....—
Wisconsin Central R. R.....16
Worcester Company, C. H....17

For Classified Index of Advertisements See Page 6.

Motors, Switches, Arc Lamps, Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

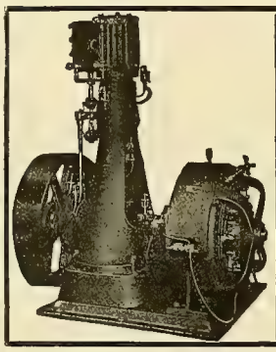
EDWARDS AND CO

Lock Gravity Drop Annunciator.

Extra heavy, well finished case of ornamental design.

The drops being fastened to the back-board, the case may be removed without disconnecting wires.

NEW YORK N.Y



TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

NAME PLATES

FOR MACHINERY.

We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.

No Plate Too Large or Too Small.

MURDOCK PARLOR GRATE CO.,
161 Boylston St., Boston, Mass., U. S. A.

When you get our STERLING We send you lamps.

THE Sterling Electrical Mfg. Co. WARREN, OHIO.

We get your STERLING You send us coin.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

Hot Springs, Ark.

Via The WABASH

Commencing Nov. 9 the Wabash established its system of through Pullman tickets from Chicago to Hot Springs, Ark., via St. Louis and the Iron Mountain Route. Passengers leaving Chicago on the Wabash fast day express, at 11:03 a. m., will arrive at Hot Springs next morning at 8 o'clock. For illustrated printed matter giving full information regarding this wonderful health and pleasure resort, address F. A. Palmer, Asst. Gen. Pass. Agt., Wabash R. R., 97 Adams St., Chicago.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

WESTERN OFFICE

Room 85 Hartford Building, CHICAGO.

GENERAL ELECTRIC COMPANY

Capacity 1,875,000 Watts. Capacity 600 Watts.

MANUFACTURER OF

Transformers of all sizes and types for any voltage and frequency.

GENERAL OFFICES: SCHENECTADY, N. Y.

New York Office, 44 Broad Street. Sales Offices in all large cities.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

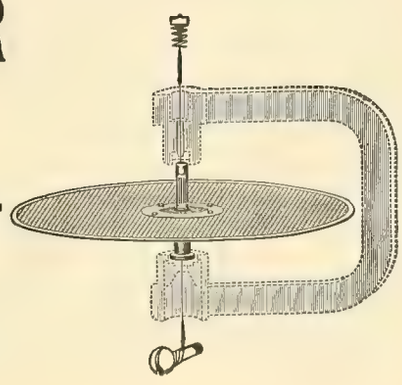
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

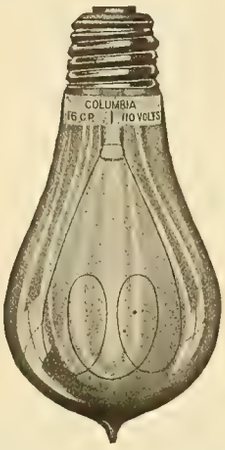
NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.



—A LAMP—

THAT WILL GIVE YOU THE FULL VALUE OF YOUR MONEY IN CANDLE-POWER EFFICIENCY AND LIFE.

—THE COLUMBIA—

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
American Blower Co.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
Allen Co., L. B.
McLennan & Co., K.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Bayley & Sons Co., W.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Commercial Elec. Supply Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Commercial Elec. Supply Co.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Hopkins & Co., A. P.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Chicago House Wrecking Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Steam & Elec. Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Technical Agency.
Scientific Exchange.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS.
FOR DIRECT CURRENT.
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

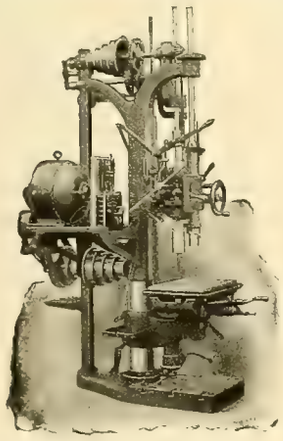
UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY, NEW YORK.

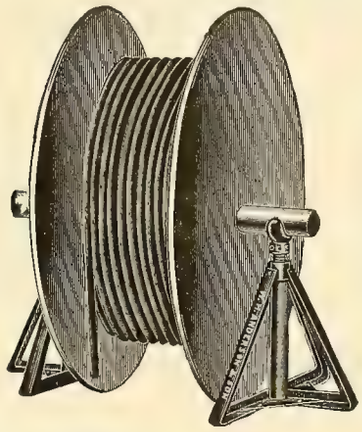
There are no Carbons better than the "Electra" and none "just as good."

CROCKER-WHEELER COMPANY
AMPERE, N.J., U.S.A.

ELECTRICAL MACHINERY.
The distinctive feature of our apparatus is its ability to retain customers.



CABLE REEL JACK.



Made in Two Styles.

No. 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No. 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,
Tool Manufacturers.
Established 1871.
St. Aubin Ave., DETROIT, MICH.

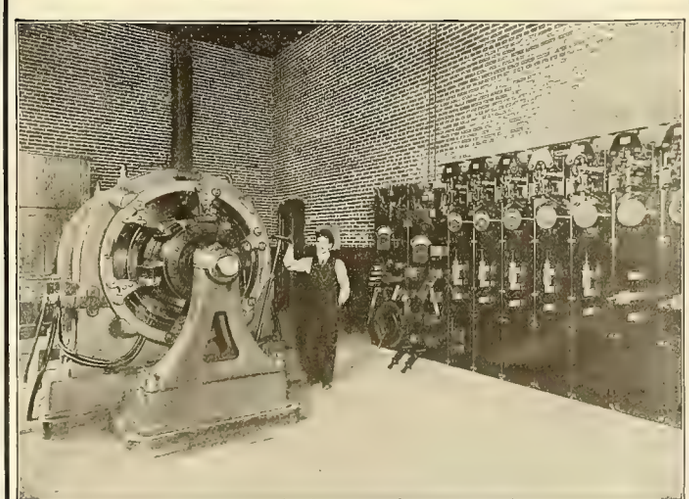
A LONG-FELT WANT.
THE HANDY ELECTRICAL DICTIONARY
BY W. L. WEBER, M. E.
225 PAGES, SIZE 2½ x 6 INCHES.
Price: { Cloth Binding, - - - - 25c.
Flexible Leather Binding, 50c.

This is a practical book in a convenient vest pocket size; alike suitable for workman, student or anyone employed or interested in the electrical science. It contains clear, concise definitions of every used electrical term or phrase and is sold at a price within the reach of all.

Promptly Mailed on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

Motors-Generators
Arc Lamps-Circuit Breakers
Switchboards



Western Electric Storage Battery Booster.

Western Electric Company
Chicago Saint Louis New York Philadelphia

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

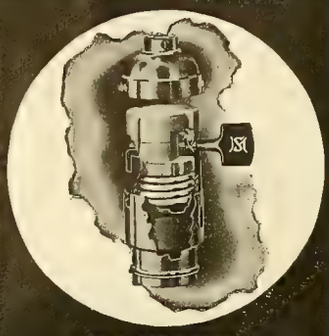
"Things are not always what they seem"

—Phædrus.

The M.S. Key Socket for example, except for the finer finish of the shell, looks much like an ordinary product, but when you get beneath the "skin," the shrewd buyer will see the difference that comes of automatic production and exact steel gauges.

The porcelain body is as sharp and exact as a piece of tooled metal. The action shows the stuff the spring is made of. The copper screw shell makes a sure contact.

A sample shows other dividend paying qualities.



M.S. KEY SOCKET.

MARSHALL-SANDERS COMPANY,

301 CONGRESS ST., - - - BOSTON MASS.,

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of **Slates for Electrical Purposes**

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

MARTIN MALEY,

MANUFACTURER OF ALL KINDS OF

VERMONT SLATE

FOR ELECTRICAL USE.

Switchboards A Specialty.

FAIR HAVEN, VERMONT.

McNAMARA BROS.

ELECTRIC SWITCHBOARDS,

SLATE AND MARBLE.

Write for Catalogue B. Fair Haven, Vt.

WATSON

MULTIPOLAR MOTORS AND GENERATORS ARE EASILY ATTACHED TO THE CEILING, WALL OR FLOOR.

THEY POSSESS EVERY QUALIFICATION GOOD MACHINES SHOULD.

1-8 TO 3 H. P.
1-10 TO 2 1-2 K. W.

WE BUILD SPECIAL MOTORS FOR SPECIAL APPLICATIONS OF ELECTRIC DRIVE.

THE MECHANICAL APPLIANCE COMPANY,

MILWAUKEE.

Ask for Bulletin No. 55.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

The FRANKLIN Model Shop

The Franklin Gas Engine

One-Half Horsepower.

Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 10,000 of the new.

Electrician Publishing Co.,

510 Marquette Building, CHICAGO.

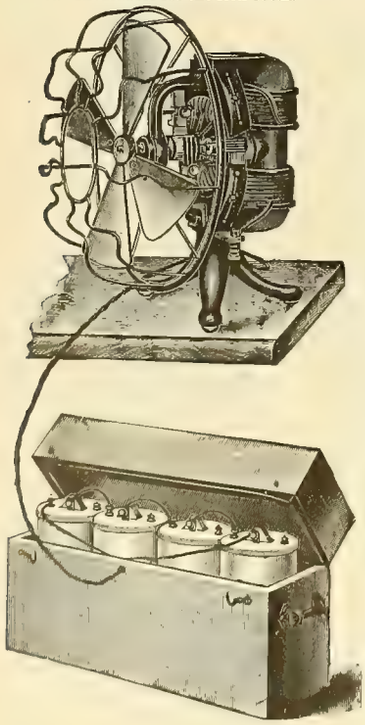
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

CHICAGO OFFICE, 144 Wabash Avenue.

ELECTRICAL BOOKS

FOR THE

HOLIDAYS

WE CARRY THE MOST COMPLETE STOCK

SEND FOR CATALOGUE

Electrician Publishing Co.

510 Marquette Building, CHICAGO.

No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers

THE VOUGHT-BERGER COMPANY,

LA CROSSE, WIS., U. S. A.

A NERNST LAMP BUYS ITSELF—HOW?

Let us show you how a 50 c. p. NERNST LAMP in 100 days (saving $6.50) PAYS FOR ITSELF.

"BEAUTY OF THE INCANDESCENT LAMP."

"EFFICIENCY OF THE ARC."

Write for other detailed and illustrated information, and remember that for a given candlepower the price is about the same as that for a like candlepower of Alternating Arc Lamp.

COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1000 Market St., St. Louis.

AGENTS FOR THE FOLLOWING STATES:

MISSOURI, TENNESSEE, IOWA, S. ILLINOIS, NEBRASKA, KANSAS, ARKANSAS, TEXAS, LOUISIANA, MISSISSIPPI, and the TERRITORIES.

NO WORRY.

A-B Arc Lamps

FOR ALL CIRCUITS.

ELECTRIC APPLIANCE COMPANY,
CHICAGO.

A STOCK OF
EDISON MINIATURE LAMPS

Should be kept by every **Central Station** for rental to their customers. They popularize electric lighting and bring a profitable income from a small investment. Very desirable for **Christmas Tree** and **Holiday Decorations.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 Cortlandt St.

HE WHO EXPECTS MUCH
sometimes gets much that he didn't much expect.
But no matter how high your expectations,
Toerring Arc Lamps never disappoint.
We guarantee results.

19th & Allegheny Ave.

NEW YORK CITY — C. J. TOERRING CO. — PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS
AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: 1220-21 Marquette Building,
Central Station Heating Plants,
Water Works Steam Plants,
Electric Light, Gas and
Street Railway Plants. CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

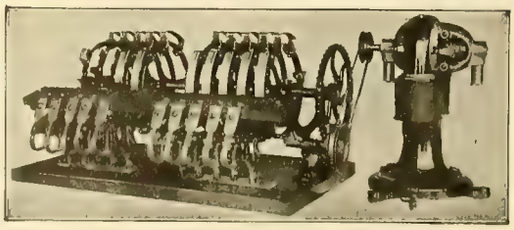
K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg.. CHICAGO, ILL.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO.
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

EVERY ELECTRICAL SUPPLY DEALER AND CONTRACTOR SHOULD WRITE US FOR PARTICULARS OF OUR

FLASHERS

For producing the flashing effect in **ELECTRIC SIGNS** and **SHOW WINDOW DISPLAYS.**



The proposition you can make with our Flashers appeals to all up-to-date merchants. Pronounced by all electrical experts as being the only practical and simplest Flasher in the world.

WRITE NOW for Particulars, we'll tell you all about them.

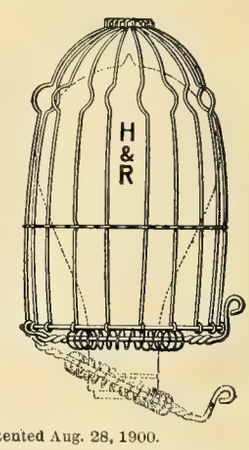
REYNOLDS ELECTRIC CO., Inc. 21 Fifth Avenue, CHICAGO, ILL.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. **Adjustable Clamp Socket. Holds All Sizes Securely,**

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,

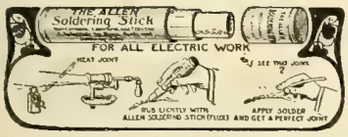
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

Six Years with General Electric Company.

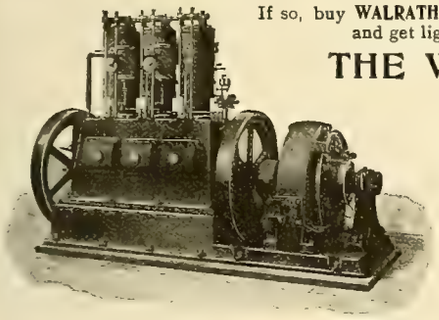
THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.



Our Allen Patron Returns:
"WORKS LIKE LIGHTNING!" No apology needed for this explosion. "Nothing but the ALLEN Soldering Stick for me, thank you. No more substitutes(?)"
The ALLEN Soldering Stick makes solder flow.

Sample Allen Stick Free. Write:
L. B. ALLEN CO., Inc., 1334 Columbia Avenue, - CHICAGO.
If your dealer won't supply you, we will. C U Next Week.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

TRANSFORMERS.
THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

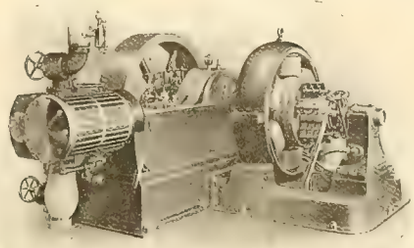
Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

ENGINES AUTOMATIC
CONTROLLED BY THE NICHOLS GOVERNOR.

VERTICAL OR HORIZONTAL

PISTON VALVES.



Self Oiling. For Direct-Connected or Belted Service.
High Speed—High Pressures. Units from 6 to 200 H. P.

DUPLICATE PARTS ALWAYS ON HAND.

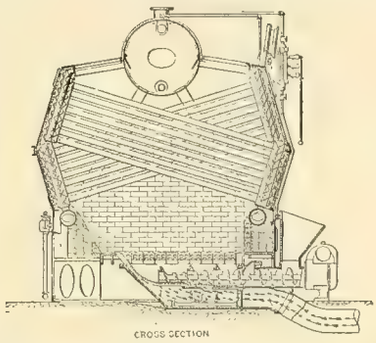
New York, Philadelphia, **N. Y. SAFETY STEAM POWER CO.** Boston, San Francisco.
60 SO. CANAL STREET, CHICAGO.

WATER-TUBE BOILERS

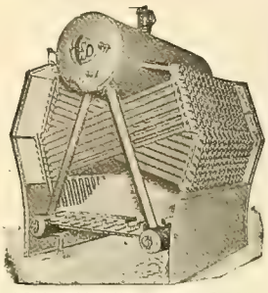
NO BRICKWORK—BENT TUBES—SCREWED JOINTS GASKETS.

WORTHINGTON SECTIONAL

End-Fired Type, 20 to 125 H. P.
Side-Fired Type, 100 to 360 H. P.

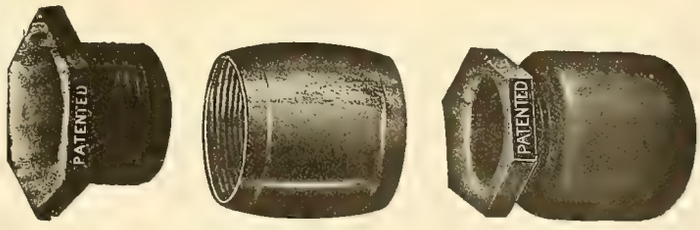


Large Power in Small Space.
Being sectional can be delivered through an ordinary window or sidewalk opening.



WRITE FOR OUR BOILER BOOK.

TO CONTRACTORS
USE THE
CHASE NIPPLE COMBINATION
IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. CRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent or manager of an electric-light or power plant on the Pacific coast by thoroughly experienced man. Have been in the business since 1880 and have owned own plant for 10 years; also experienced in electro deposition and electro chlorination, and own patents on the latter process. Address H. B. SLATER, care General Electric Co , Los Angeles, Cal.

POSITION WANTED.

By young man, 24 years old, as manager or electrician of telephone plant. Experienced in general telephone work. A1 references. Preference given to company whose plant is incompleted or not begun. Address B 3X 141, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By young electrical engineer; graduate of Swiss Polytechnicum; four years' experience in calculation of light and high tension power stations, in design of generators, motors and transformers; best references. Address BOX 140, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Salesmen calling on telephone and electric-light plants to handle cedar poles as a side line. Liberal commission paid. To right party regularly covering territory, we will give exclusive territory. Address BOX 138, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Traveling and city salesmen, for an excellent line of incandescent lamps. Territory—all states north and west of Chicago, Ill. Also Canada, Cuba and Hawaii. Address BOX 142, care Western Electrician 510 Marquette Bldg., Chicago.

WANTED CAPITAL.

For development of a water power into electric power. First-class proposition. Address Attorney, Box 73, Canton, Ga.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Electric-light Plant. Direct System. 750 lights on. City Contract. Address N. H. CROWELL, Sioux Rapids, Iowa.

FOR SALE.

Two Royal Electric Company, Standard dynamos of 150 K. W. each These machines are alternators, 133-cycle, new and of excellent design and make, connected for furnace work, but suitable for town lighting. Address D. M. HILLIS, 112 Hartford Building, Chicago.

NOTICE.

I have a number of buyers for Electric Light Plants in Central states in towns of not less than 2,500 people. If your plant is on paying basis, can furnish you a buyer. Address BOX 139, care Western Electrician, 510 Marquette Bldg., Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St. and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

Wanted Central Station Managers

And Users of Machinery

TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger, more improved or more modern.

We have the following Quick Shipment Bargains:—
1—20x18—½ Harrisburg Ideal Engine,
1—16x16 Erie Ball Engine,
1—15x15 " " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine,
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps.

A. G. SCHOONMAKER CO.,
126 Liberty St., New York City, U. S. A.

ATTENTION!

General Managers of Electric Light Plants.

We have on our list a large number of especially good engineers, electricians, etc., to select rom.

THE SCIENTIFIC EXCHANGE,
Room 60, 6 Sherman St., Chicago.

Western Electrician WANT ADS Bring Results.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work, Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

BOILERS, HIGH PRESSURE.

2—104 H. P. Abendroth & Root Water tube, 125 lbs.
2—165 H. P. Abendroth & Root Water tube, 125 lbs.
2—120 H. P. Heine, 140 lbs., fine.
2—350 H. P. Climax, 150 lbs.
7—66x16 Erie City, 110 lbs.
6—72x18 Tubular, 125 lbs.
1—75 H. P. Erie City, 125 lbs.

CORLISS ENGINES.

1—16x30x48 Cross Cpd. Cooper.
1—20x30x42 Allis, Cross Cpd.
1—24x42 Wright.
1—22x48 Harris condenser attached.
1—20x48 Harris condenser attached.
1—18x48 Brown Corliss.

Write for complete price list of electrical apparatus, list just out. We have some fine machinery coming out.

THE STEAM & ELECTRICAL EQUIPMENT CO.
Wood and Water Sts., Pittsburg, Pa.

When in search of a position advertise in the WESTERN ELECTRICIAN.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.
34x60 International Power Corliss.
26x48 Dickson Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
13x18 Frost Center Crank Automatic.
11¼x 14 Taylor-Beck Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.
One Geary Water Tube Boiler. 175 H. P. for 150 pounds pressure, almost new.
Two 150 Babcock & Wilcox Water Tube Boilers, 135 pounds pressure.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
200 H. P. Baragwanath Heater.
150 H. P. Kroeschell Heater.
500 H. P. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps, Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY, DAVENPORT, IA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W. Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.

375 H. P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.

High speed automatics, from 250 H. P. down.

Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1,100-light, 60 K. W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric, 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

CHICAGO EDISON COMPANY REPAIR SHOPS

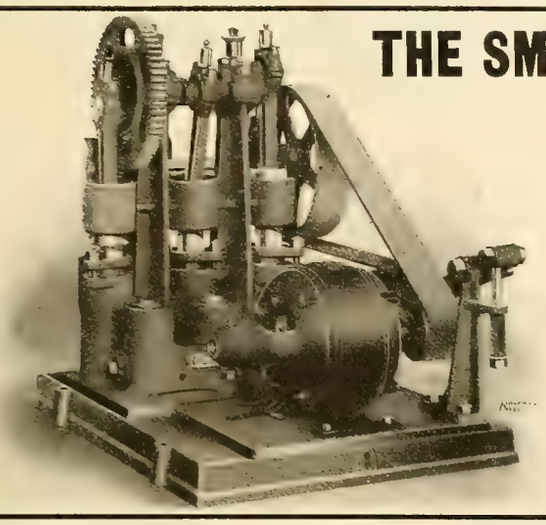
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.



THE SMITH-VAILE ELECTRIC TRIPLEX PUMPS

afford an excellent means for pumping water for House service, Hydraulic Elevator service Factories and Mills desiring an independent water supply, also for Mine Work and : : :

WATER WORKS SUPPLY.

Can be located wherever electric current is available, and require little or no attention after once installed. We make steam and power : : : : : : : : : : : : : : : : :

PUMPING MACHINERY FOR ALL PURPOSES.

Jet and Surface CONDENSERS, Feed Water Heaters and Victor Turbine Water Wheels

THE STILWELL-BIERCE & SMITH-VAILE CO.,

DAYTON, OHIO, U. S. A.

New York: 141 Broadway. Chicago: 311 Dearborn St. Boston: 73 Oliver St.
Philadelphia: 612 Arch St. Cleveland: 1116 New England Bldg. Baltimore: 1107 Continental Trust Bldg.
New Orleans: 304 Hennen Bldg.

Sales Agents: FREDERIC NELL, 97 Queen Victoria St., London, Eng. E. F. AUSTIN, Smith Blk., Pittsburg.

INCANDESCENT LAMPS

A BARGAIN PROPOSITION.

We bought at sale 150,000 new, perfect incandescent lamps of standard make. They are clean, regular goods, put up in barrels each containing 250 lamps. Our stock consists as follows:

Candle Power: 8, 10, 16, 20, 24, 25.

Voltage: 100, 102, 104, 105, 106, 107, 108, 110, 115, 120.

Bases: Edison, T. H. and Westinghouse.

Note Our Prices: In lots less than a barrel, 15 cents; in lots of 250, 13 cents; in lots of 1,000, 12 cents; in lots of 5,000 or over, 10 cents.

The above prices are for any candlepower or voltage, and for Edison or Westinghouse bases. Extra for lamps with T. H. base, each 3-4 cent. We handle electrical apparatus of any kind, also machinery of any description. Write for Catalogue 156.

CHICAGO HOUSE-WRECKING CO., W. 35th and Iron Sts., CHICAGO.

Interstate Independent Telephone CONVENTION

Auditorium Hotel, Chicago,

DECEMBER 9, 10, 11, 1902.

Officers of the association expect this to be the largest convention of Independent telephone men ever held, from 1,200 to 1,500 delegates being expected to attend.

The Western Electrician of December 6th will be distributed at the meeting. The issue of December 13th will contain a full report of the proceedings.

If you wish to increase your business with the Independent Telephone companies you will find it greatly to your advantage to be largely represented in the advertising columns of these two important numbers.

Send in your order NOW.

WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

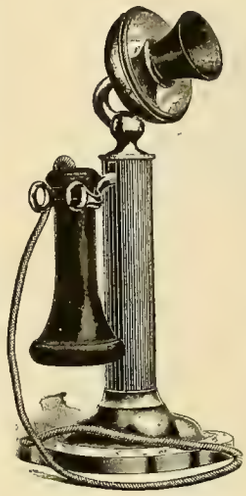
STROMBERG-CARLSON TELEPHONE MFG. CO.

ROCHESTER, N. Y. CHICAGO, ILL.

A DEFINITION

Sterling—Genuine; pure; of excellent quality.

WEBSTER.



No. 19. Desk Phone.

When you buy Silverware, you look for the "STERLING" mark.

Be equally wise in purchasing anything in the line of TELEPHONE APPARATUS and see that it has

"THE STERLING MARK"

STERLING ELECTRIC CO.,

LAFAYETTE, IND.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
8th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR

Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,
KOKOMO, IND.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

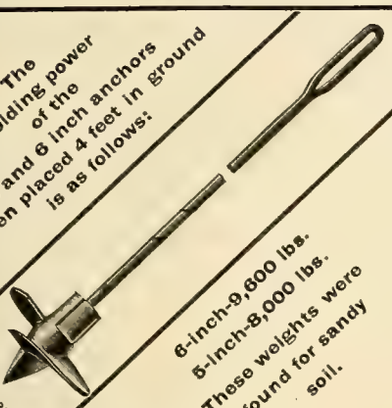
The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

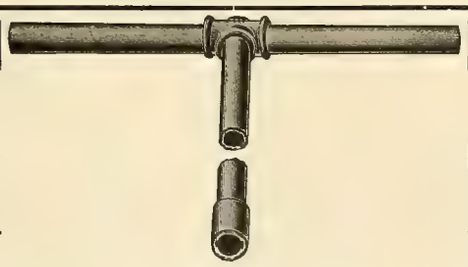
The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pasg'r and Tkt. Agt.
CHICAGO, ILL.

STOMBAUGH GUY ANCHORS

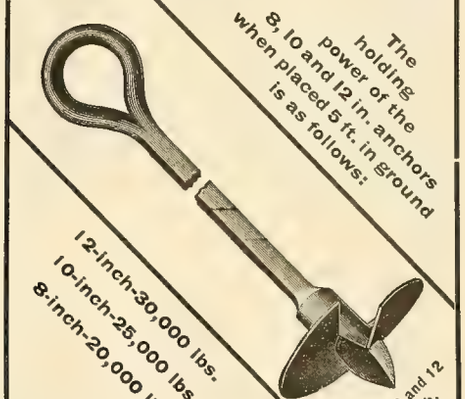




THIS IS THE WRENCH
that must be used to install the
3½, 5 and 6 inch anchors.

W. N. MATTHEWS & BRO.,
DISTRIBUTERS,
603 Carleton Bldg., - - ST. LOUIS.

HGUABMOTS GUY



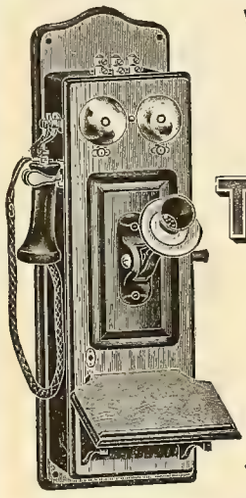
It Doesn't Pay!

To start in with a short-lived Telephone.
Kellogg Telephones are Centenarians!

It Doesn't Pay!

To go near a short-winded Telephone.
Kellogg Telephones are as wonderfully distinct for a thousand miles distance, as they are for a mile!
Send for our Catalogue.

KELLOGG SWITCHBOARD AND SUPPLY CO.
Green and Congress Streets, CHICAGO.
NEW YORK PHILADELPHIA CLEVELAND

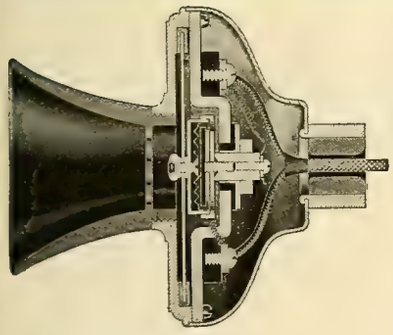


WE ALSO MAKE
FIRST-CLASS
BRIDGING AND SERIES
TELEPHONES
COMBINING
QUALITY AND SIMPLICITY.

WRITE US AND WE WILL TELL YOU ALL ABOUT IT.

THE U. S. ELECTRIC MFG. CO., - Butler, Pa.

INTERNATIONAL TRANSMITTER



PATENT ALLOWED.

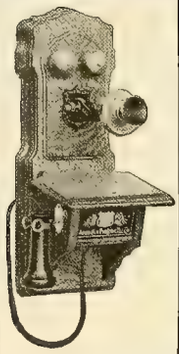
STANDS UNEQUALLED IN
Workmanship, Efficiency and Durability.

It is Clear, Distinct and Powerful.

IMPOSSIBLE
to become packed or deadened.

We manufacture a full line of public exchange central energy and generator call Telephones and multiple and trunking switchboards. Correspondence solicited.

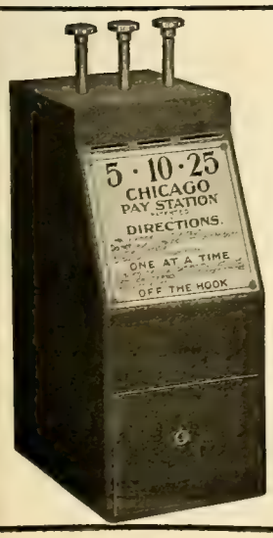
INTERNATIONAL TELEPHONE MFG. CO.,
HARRISON AND CLINTON STREETS, . - - CHICAGO, U. S. A.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



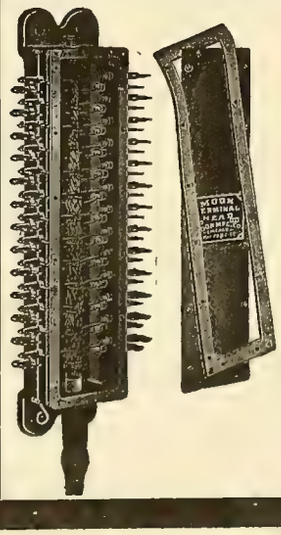
Where are you going my pretty maid?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

WHY? Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,
130 La Salle Ave., Chicago, Ill.



MOON TERMINALS
WITH
METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

POWER INCREASED

AND BOILERS PROTECTED BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

RESISTANCE rods of Dixon's Graphite give high resistance in contracted space. Any size, any resistance. Ask for sample and booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

REG. TRADE MARKS
"Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

NEW CATALOGUE

ELEVATING = CONVEYING
— MACHINERY —
NOW READY SEND FOR COPY
THE JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

THE STERRETT OIL PUMP

Has been improved so that it is better now than ever for handling heavy valve oils.

OUR NEW PATTERNS

will be out in a short time. You should send in your order at once for early delivery.

SENT ON 30 DAYS' TRIAL.

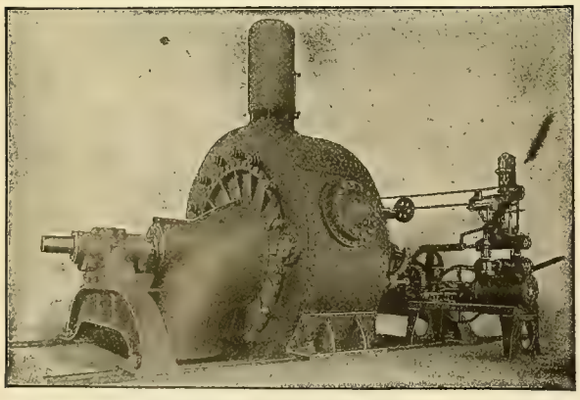
STERRETT PUMP CO.
67 EAST SIXTH ST., ST. PAUL, MINN.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

C. J. HUEBEL CO.
Producers and Wholesalers of
White Cedar Poles
Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.
We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.



SAMSON TURBINE

UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.

Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.

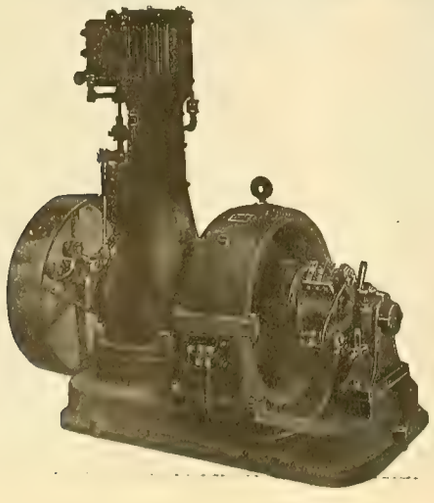
We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.
WRITE DEPT. "D" FOR CATALOG.

JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



HIGH-GRADE
ENGINES

VERTICAL AND HORIZONTAL.
AUTOMATIC AND THROTTLING.
BELTED OR DIRECT CONNECTED.

GUARANTEE PERFECT REGULATION FOR ELECTRIC LIGHTING AND POWER SERVICE FROM 2 HORSEPOWER TO 50 HORSEPOWER.

W. BAYLEY & SONS CO.,
MILWAUKEE, WIS., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

THOROUGH INSPECTIONS

AND

Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by

STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Asst. Secretary.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

COMPETING PRICES.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice.
WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar Poles

TORREY CEDAR CO.,
CLINTONVILLE, WIS.

Large Stock Constantly on Hand

CEDAR POLES OF ALL LENGTHS AND SIZES.

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

John H. Fowler
CEDAR POLES POSTS, SHINGLES & TIES
1705-7 FISHER BLDG. CHICAGO.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Western Electrician
WANT ADS
Bring Results.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES STREET RY. TIES PERRIZO SONS DAGGETT MICH.

WHITE CEDAR POLES.

HALL L. BROOKS,
TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

CEDAR POLES
LONG DISTANCE 'PHONE WRITE US
A. P. HOPKINS & CO. ESCANABA, MICH.

POLES, TIES, POSTS.

THE PORTER CEDAR CO.,
SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

POLES

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.
TIES.

SOUTHERN White Cedar Poles

THE BEST POLE IN THE MARKET FOR TROLLEY & ELECTRIC LIGHT WORK.
Yellow Pine Cross-Arms, Locust and Oak Pins.
Large Stock Always on Hand. Ask for Prices.
STANDARD POLE & TIE CO., No. 44 Broad Street, New York, N. Y.

CEDAR POLES

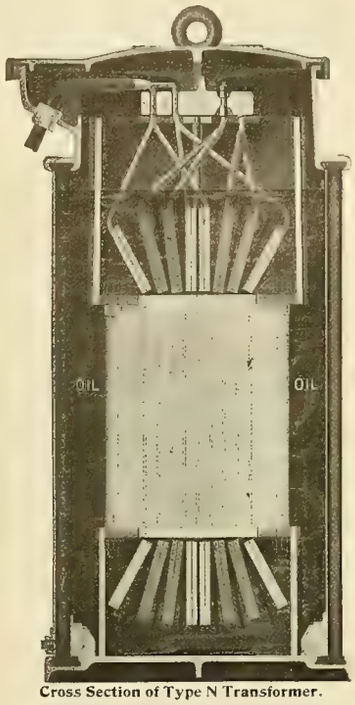
IT WILL PAY YOU
To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.
KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.
BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES

THE VALENTINE-CLARK CO.,
234 LA SALLE ST., CHICAGO
YARDS: ANCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

Westinghouse



Cross Section of Type N Transformer.

O. D. and Type N

Transformers

show practically no difference between the temperature measured by a thermometer placed between the coils, and that measured in the copper by the resistance method.—This is actual proof of uniform temperature.

For Transformer booklet address nearest sales office of the

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities. Pittsburg, Pa.

Nernst Lamps

Operative on all Alternating Circuits.

For Indoor or Outdoor Service.

Their striking advantage is that the operating expense for the same illumination is about one-half that of incandescent lamps.

For illustrated booklet No. 6 telling all about them address

Nernst Lamp Co.

Pittsburg, Pa.

Sales Offices: New York, 120 Broadway. Boston, 131 State St. Philadelphia, 710 Girard Trust Bldg.

TYPE E

small direct-current motors are giving satisfactory operation in every installation.

UPRIGHT

SEMI-INVERTED

INVERTED

OPEN

SEMI-ENCLOSED

OR

ENCLOSED

On 115, 230 or 500-volt circuits at any speed desired, belted, back-geared or direct-connected.

SEND FOR BULLETIN 1036.

FORT WAYNE ELECTRIC WORKS,

MAIN OFFICE:
Fort Wayne, Ind.

DUNCAN INTEGRATING WATTMETER

COMMUTATOR TYPE FOR DIRECT AND ALTERNATING CURRENTS

Possesses Many Up-To-Date Features.

JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS.

WRITE FOR PRICES.

DUNCAN ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF ELECTRICITY METERS.

LAFAYETTE, IND.

HYLO

TURN-DOWN LAMP

Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.

PHELPS CO., 50 State St., Detroit, U. S. A.

PROTECTION.

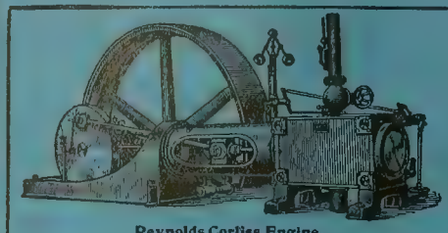
A GOOD INVESTMENT.

A Lamp Guard firmly fastened to socket protects completely.

THE P. R. WAGOR MFG. CO.,
SPRINGFIELD, MASS.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



Reynolds Corliss Engine.

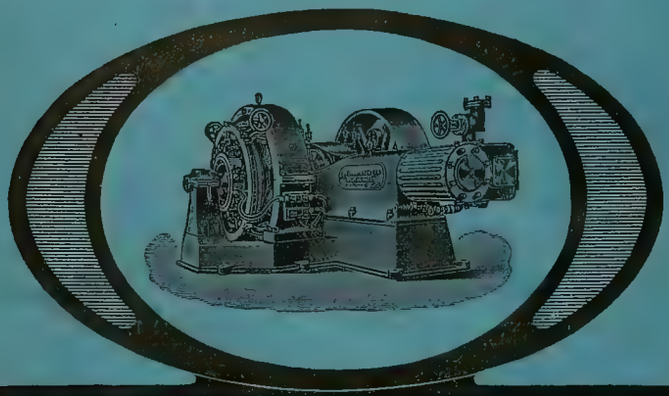
Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

CHARLES.H.BESLY CO. &
FINE TOOLS & SUPPLIES FOR METAL WORKERS
10 & 12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE



STURTEVANT GENERATING SETS

ENGINES · MOTORS
BLOWERS · FORGES
MECHANICAL DRAFT

B.F. STURTEVANT CO.
BOSTON, MASS. NEW YORK · CHICAGO PHILADELPHIA · LONDON

STEAM HEATING
VENTILATING AND
DRYING APPARATUS

246

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF **WIRES AND CABLES**

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. **TRENTON, N. J.** CLEVELAND. SAN FRANCISCO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

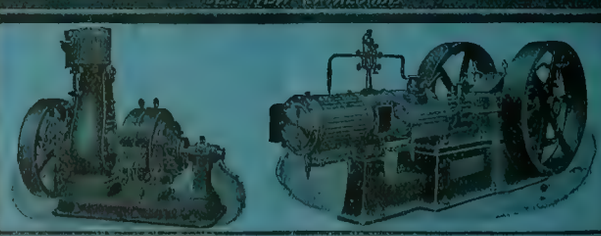
G. & H. BARNETT COMPANY

PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES

SIMPLE COMPOUND FOR ELECTRIC LIGHT AND POWER SERVICE VERTICAL HORIZONTAL

SEE NEW CATALOGUE



BUFFALO FORGE COMPANY

BUFFALO, N.Y. CHICAGO PITTSBURG

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 6, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 23.

SIMPLEX INSULATED WIRES AND CABLES

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

The Simplex Electrical Co., 76-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.

HEADQUARTERS FOR

ELECTRIC LIGHT LINE WIRE.

Chicago Insulated Wire Co.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of Slates for Electrical Purposes

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.,

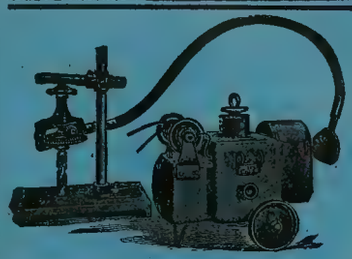
MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.



ESTABLISHED 1870.

COMBINATION OF

Stow Flexible Shaft

AND

MULTI-SPEED MOTOR.

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

2,000 IN USE.

Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.

The Hobart Elec. Mfg Co. Troy, Ohio

The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,

THE AKRON SMOKING PIPE CO., MOGADORE, OHIO

BARE AND INSULATED

ELECTRICAL WIRES

OF EVERY DESCRIPTION.

CROWN RAIL BONDS.

American Steel & Wire Co.

CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

McNAMARA BROS.

ELECTRIC SWITCHBOARDS,

SLATE AND MARBLE.

Write for Catalogue B. Fair Haven, Vt.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.

Write for our free Illustrated Book, "Can I Become an Electrical Engineer."

We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.

Electrical Engineer Institute, Dept. K. 240-242 W. 23d St., New York.

LIGHT

If you want light to see objects below the lamp

USE SHELBY LAMPS.

16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.

THE COIL DOES IT—IT'S FLATTENED.

LIFE

The Longest Life at Best Efficiency.

SHELBY USEFUL LIGHT LAMPS.

Pat. Oct. 20, 1900.

A TRIAL WILL PROVE OUR CLAIMS.

THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Voltmeter. Type F.

We desire to call attention to a line of cheap but excellent Switchboard Instruments for Direct Current Circuits, which we designate as

"Round Pattern," Type F.

These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

Mention the Western Electrician when writing for catalogues.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.

THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

TRIUMPH

SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.

WE MANUFACTURE

GENERATORS AND MOTORS

OF ALL KINDS AND FOR ALL PURPOSES.

TRIUMPH ELECTRIC CO.,

SEND FOR BULLETIN "W E" CINCINNATI, O.

THE ADAMS-BAGNALL ELECTRIC CO.

A. B. ENCLOSED ARC LAMPS.

Inside and Out, Electrically and Mechanically, the best lamp on the market.
It's good to look at and built to stand the most severe service.
Never has been beaten in a competitive test.

Their Efficiency and Regulation are Perfect.
Easiest lamp to trim made.
Made in weatherproof solid copper or pressed steel cases.

OVER 90,000 IN USE.

THE ADAMS-BAGNALL ELECTRIC CO.

CHICAGO OFFICE:
J. G. POMEROY,
No. 309 Dearborn Street.

Cleveland, Ohio, U.S.A.

NEW YORK OFFICE:
G. A. THOMSON,
No. 136 Liberty Street.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | BOSTON, 60 State Street. | BALTIMORE, Continental Trust Building. | DETROIT, Michigan Electric Company.

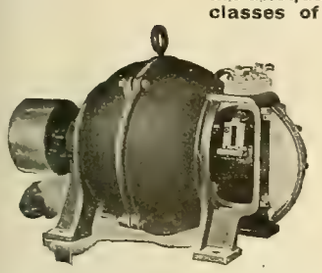
ST. LOUIS, Wainright Building. | NEW YORK, 100 Broadway. | CHICAGO, Marquette Building. | CLEVELAND, New England Building. | SAN FRANCISCO, Nevada Block. | HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

are unequaled for driving all classes of machine tools.

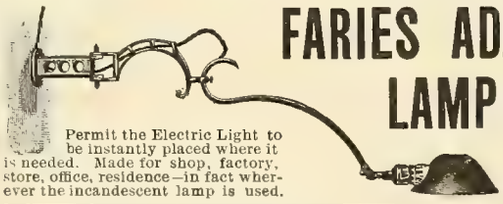
Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.

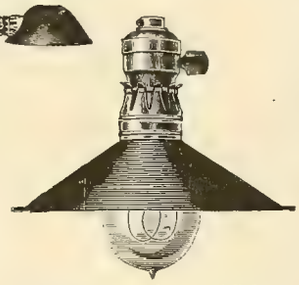
FARIES ADJUSTABLE LAMP HOLDERS



Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.

WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers. | Send for Catalogue No. 10, just issued.



FARIES MFG. CO., DECATUR, ILL.

MAXIMUM LIFE, EFFICIENCY AND LIGHT.

THE **STERLING SPECIAL** THAT'S ALL.

MINIMUM COST PER CANDLE-POWER.

STERLING ELECTRICAL MFG. CO., WARREN, OHIO.

Platinum

In Sheet or Wire for all Purposes.
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS
Formerly C. F. Croselmire.
CHAS. ENGELHARD, Gen. Mgr.
251 to 255 New Jersey R. R. Ave., Newark, N. J.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

PLATINUM FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,
MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 2
Akron Smoking Pipe Co..... 1
Allen Company, L. B..... 17
Allis-Chalmers Company....32
American Battery Co.....26
Amer. Electrical Heater Co..32
Amer. El. Telephone Co.....25
American Electrical Works..17
American Platinum Works.. 3
American Red. & Lighting Co.16
American School of Corresp. 7
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....29
Audel & Company, Theo.... 20

Baker & Company..... 3
Barnett Company, G. & H....32
Barron & Co., J. S.....15
Beardslee Chandelier Mfg. Co.—
Beardsley Gravity Dam & Construction Co..... 20
Berthold & Jennings.....29
Besly & Co., Charles H.....32
Bonville, Edward 1
Bossert El. Construction Co..32
Brooks, Hall L..... 20
Brown & Leasure..... 16
Buffalo Forge Co.....32

Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co...29
Central Telephone & El. Co..17
Century Glass Co..... 7
Chase-Shawmut Company...22
Chicago & Alton Railroad....28
C. & N. W. R. R.....28
Chicago Die & Electric Co...14
Chicago Edison Company..4, 18
Chicago Flexible Shaft Co.. 21
Chic. Fuse Wire & Mfg. Co...17
Chicago House Wrecking Co.19
Chicago Insulated Wire Co.. 1
Chicago Writing Mach. Co...20
C., M. & St. P. R. R.....28
Chicago Pay Station Co.....25
Christensen Engineering Co.20
Commercial Elec. Supply Co.—
Consumers Carbon Co.....21
Continuous Rail Joint Company of America..... ... 14
Cook, Frank B.....12
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .22
Cutler-Hammer Mfg. Co.....15
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..26
Diamond Meter Company .. 28
Dixon Crucible Co., Joseph..26
Duncan Electric Mfg. Co.... 31

Edison Decorative & Miniature Lamp Department..4, 16
Edison Mfg. Company.....15
Edwards & Company.....28
Electrical Engineer Institute. 1
Electric Appliance Company.16
Electric Storage Battery Co.. 3
Electrician Pub. Company...27
Elliott Telephone Co.....32

Faries Manufacturing Co.... 3
Farr Tel. & Construction Supply Co..... 19
Federal Electric Company...—
Fisher Electric Company....14

"For Sale" Advertisements..13
Ft. Wayne Elec. Works., Inc.31
Fowler, John H.....29
Franklin Eng. & Elec. Co....21
Fulmer Lumber Co., D. M. ...29

General Electric Company...13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Great Western Smelting & Refining Company.... ...—
Gregory Electric Company...18

Hamblin & Russell Mfg. Co..18
Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co...—
Helios-Upton Company..... 4
Hemingray Glass Co.....10
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....18
Holmes Fibre-Graph. Co.....—
Huebel Company, C. J.....29
Humphrey, Henry H.....16

Illinois Electrical Mfg. Co...18
Illinois Maintenance Co.....18
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....23
Inland Printer Co.....26
Internat'l Corres. Schools....17
International Tel. Mfg. Co. ..21
Iwan Bros.....16

Jeffrey Manufacturing Co....26
Johnston, Thomas J.....17

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....11, 29
Klein & Son, Mathias.....29
Kohler Brothers. 16
Kokomo Tel. & El. M. Co....28

Leather Preserv. M. Corp....26
Leffel & Co., James.....26
Lindsley Brothers Company..29
Lowell Model Co..... .....—

Machado & Roller..... 7
Maley, Martin.....—
Maltby Lumber Company.. .29
Manhattan Electrical Supply Co.....14
Marinette Iron Wks. Mfg. Co.26
Marshall-Sanders Co. 14
Matthews & Bros., W. N.....21
Mayer Engineering Co.....17
McLennan & Company, K....16
McNamara Brothers 1
Mechanical Appliance Co....20
Mechanical Boiler Cleaner Co.....26
Metropolitan Tel. & El Co...20
Mica Insulator Company.....—
Miscellaneous Advs..... ..18
Monarch Fire Appl. Co.....—
Monon Railroad.....28
Moon Mfg. Co., The.....21
Morse Cedar Company.....29
Munsell & Co., Eugene.....16
Murdock Parlor Grate Co....—

National India Rubber Co....—
Nernst Lamp Co.....30
New York Ins. Wire Co.....15
N. Y. Safety Steam Power Co.17
Norton Elec'l Instrument Co.—
Okonite Company, The..... 8

Paragon Fan & Motor Co.....—
Parsell & Weed.....14
Perrizo & Sons.....29
Phelps Company.....20
Phillips, Eugene F.....17
Phillips Insulated Wire Co..17
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....26
Pignolet, L. M.....16
Pittsburg & L. S. Iron Co.....29
Porter Cedar Company.....29
Rauscher, John .....—
Reisinger, Hugo.....15
Replogle Governor Works.. .—
Reynolds Electric Company.—
Rice, Cyrus W 17
Roche, Wm.....10
Roebling's Sons Co., J. A.....32
Rooney-Westbury El. Lmp. Co.16
Rose Electric Company 18

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G .....—
Schott, W. H. 16
Schureman & Hayden.....18
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 16
Smith Co., S. Morgan.....18
Spies Electric Company.....20
Sprague Electric Company... 3
Standard Pole & Tie Co.... .28
Standard Underg. Cable Co..—
Standard Varnish Works 17
Standard Vitrified Cond. Co. 5
Stanley Instrument Co.....15
Station Equipment Co.....18
Sterling & Son, W. C.....29
Sterling Electrical Mfg. Co.. 3
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Sterrett Pump Company.....26
Stilwell-Bierce & Smith-Vaile Company.....19
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 9
Sturtevant Company, B. F...32
Swedish-American Tel. Co...13

Toerring Company, C. J 16
Torrey Cedar Company..... .29
Triumph Electric Co..... 1

U. S. Electric Mfg. Co.....21

Valentine-Clark Co., The....—
Vindex Electric Company....—
Vought-Berger Company 26
Vreeland, B. F. 29
Vulcanized Fiber Company..32

Wagner Electric Mfg. Co.....10
Wagor Mfg. Co., P. R.....—
Walsh's Sons & Company....18
Western Electric Company... 7
Western El. Supply Co.....22, 23
Westinghouse Electric & Manufacturing Company..30
Weston Electrical Inst. Co.... 1
Whitehead Machinery Co....18
Whitmore, A. E.....29
Wickes Bros.....18
Willyoung, Elmer G.....17
Wisconsin Central R. R.....26
Worcester Company, C. H....29

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

EDISON TELEPHONE LAMPS

ARE THE

STANDARD FOR VISUAL SIGNALS.

They save the exchange time and money because every lamp is perfect—sure to fit—sure to burn. The life is extremely long—running into years.

Be sure to get the EDISON.

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY,

Harrison, N. J.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

OKONITE INSULATION

IS THE SOLID FOUNDATION

UPON WHICH

OKONITE TRADE MARK **Success is Built.** OKONITE TRADE MARK

OKONITE WIRES—CABLES

OKONITE TAPE AND MANSON TAPE

THEY MAKE A PLANT PAY DIVIDENDS.

Central Electric Company,

GENERAL WESTERN AGENTS,

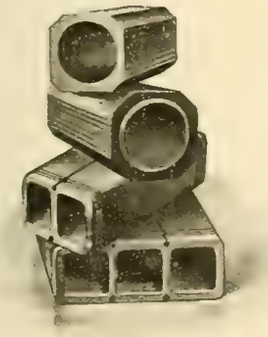
264-266-268-270 Fifth Avenue, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

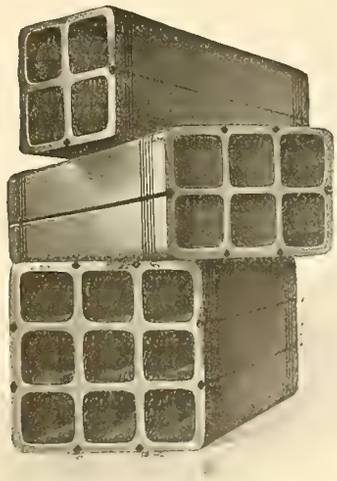
OKONITE IT NEVER DISAPPOINTS

R. W. LYLE, President. B. S. BARNARD, Vice-President and Secretary.

STANDARD VITRIFIED CONDUIT CO.



VITRIFIED SALT GLAZED CONDUITS



39-41 Cortlandt Street, NEW YORK.

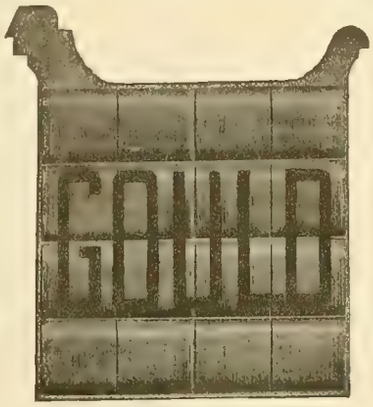
Baltimore—United Traction Co. awards us contract 200,000 feet of conduit.

Richmond, Va.—Richmond Telephone Co. awards us 200,000 feet of conduit.

Atlanta, Ga, New Castle, Pa., Perth Amboy, N. J., Trenton, N. J., many other cities.

LARGEST PLANT — BEST STOCK — SKILLED WORKMEN.

ANNUAL CAPACITY, 25,000,000 FEET.



TRADE MARK.

STORAGE BATTERY INSTALLATIONS

FOR

RAILROAD REGULATING, LIGHTING, POWER AND ISOLATED PLANTS.

COULD C, E-M-F BOOSTER SYSTEMS.

GOULD STORAGE BATTERY CO.

SALES OFFICES:

Boston, 53 State Street, Chicago, Rookery Building, New York, 25 West 33rd Street,
Century Electric Company, San Francisco, Cal. Pittsburg Engineering Company, Pittsburg, Pa.

WORKS: DEPEW. N. Y.

Bulletin No. 2, describing "GOULD BOOSTER SYSTEMS," on application.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Roche, Wm.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Cleaners.
Mechanical BoilerCleaner Co.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
Allen Co., L. B.
McLennan & Co., K.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec.&Mfg.Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Corresond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Commercial Elec. Supply Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Hemingray Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Hemingray Glass Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Commercial Elec. Supply Co.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Heating Furnaces.
Chicago Flexible Shaft Co.

Magnet Wires.
(See Insulated Wires.)

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Post Hole Augers.
Iwan Bros.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pumps (Oil).
Sterrett Pump Company.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co
Western Electric Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Chicago House Wrecking Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Cook, Frank B.
Elliott Telephone Co.
Farr Tel & Const. Supply Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
Swedish-American Tel. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Telephone Holders.
Chicago Writing Machine Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

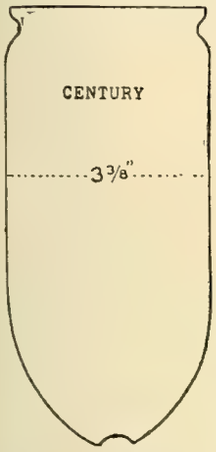
MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

SALES OFFICES

Room 85 Hartford Building, Chicago. 170 Broadway, New York.



ALL STYLES OF

GLOBES AND SHADES

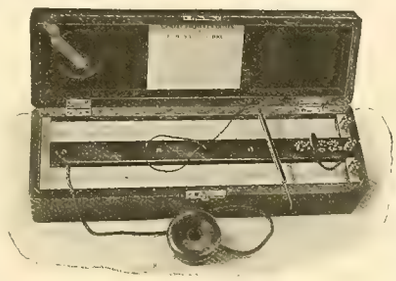
FOR ALL TYPES OF LAMPS.

WE ARE THE ONLY HOUSE IN AMERICA MAKING A SPECIALTY OF ELECTRICAL GLASSWARE.

WE CAN MAKE ANY STYLE YOU DESIRE.

WRITE FOR CATALOGUE.

THE CENTURY GLASS COMPANY, BELLAIRE, OHIO.



THE SAGE OHMMETER

is unquestionably the ***best*** resistance measuring device on the market. No other approaches it in accuracy, length of scale, finish or grade of material.

We satisfied ourselves fully of its vast superiority before taking over the exclusive manufacturing and selling rights.

We carry a large stock and are pleased to announce a

MARKED REDUCTION FROM FORMER PRICES.

List price of this four-scale range, $45.00

Send for discounts to **MACHADO & ROLLER,**

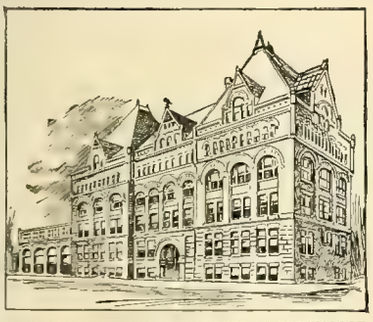
203 BROADWAY, NEW YORK CITY,

General selling agents for Whitney Electrical Instrument Co.

OR TO

Electric Appliance Co., Chicago. Electrical Engineering Co., Minneapolis

Western Elec'l Supply Co., St. Louis. Standard Electric Co., Cincinnati.



MAIN BUILDING, ARMOUR INSTITUTE OF TECHNOLOGY.

CORRESPONDENCE COURSES IN

Engineering

Electrical, Mechanical, Locomotive, Stationary, Marine, Sanitary Engineering, Navigation, Architecture, Mechanical and Perspective Drawing, Sheet Metal Work, Textile Manufacturing, Telephone, Telegraphy; also forty short special engineering courses.

INSTRUCTION UNDER MEMBERS OF THE FACULTY OF ARMOUR INSTITUTE OF TECHNOLOGY.

All students are under the instruction of the men who preside over the laboratories and teach the classes of the Armour Institute of Technology. All work, therefore, will receive full credit toward resident work at the Armour Institute should the student at any time continue his studies there.

FOR EXAMPLE: Parts 1-6 of the work on Mechanical Drawing mastered under these auspices will be accepted as entrance preparation on that subject to the College of Engineering.

As a help in their studies, students in full engineering courses are furnished a Technical Reference Library (in 10 volumes) in addition to the regular instruction papers.

Full Particulars and Catalogue may be had upon request. State Course in which you are interested and present occupation.

AMERICAN SCHOOL OF CORRESPONDENCE,

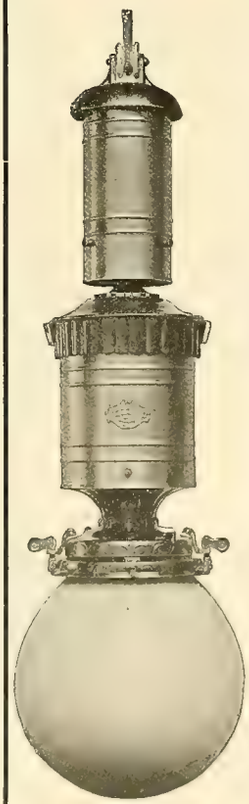
AT

ARMOUR INSTITUTE OF TECHNOLOGY,

CHICAGO, ILL.

Mention Western Electrician.

Bulletin Sent



on Request

Street Railway Lighting

Arc Lamps

For Uniform Operation on Circuit with Fluctuating Voltage

Western Electric Company

Chicago New York Saint Louis Philadelphia

THE OKONITE COMPANY LTD.

253 BROADWAY, NEW YORK.

OKONITE INSULATED WIRES AND CABLES

Especially Adapted for Telephone Service

CANDEE PATENTED POTHEADS

Absolutely Watertight and Reliable

OKONITE AND MANSON TAPES

For Making Joints

THE STANDARD FOR RUBBER INSULATION.

GOOD SERVICE

Has given the citizens of Louisville great confidence in the Home Telephone Company. This could not have been gained by using ordinary apparatus, for the Bell Company only recently changed over their system to a modern multiple relay, lamp-signal board. The switchboard and telephones used by the Home Company were built by the Stromberg-Carlson Telephone Manufacturing Co. The switchboard is known as a full bridged multiple relay lamp line signal Central Energy type. The exchange is in every particular the most complete, up-to-date and modern installation in the Independent field. The switchboard is composed of 25 three-operator position sections.

Louisville, Ky., 12,600 lines capacity, 6,000 lines installed. In operation June 22, 1902.

STROMBERG - CARLSON TELEPHONE MANUFACTURING CO.

ROCHESTER, N. Y. ***CHICAGO, ILL.***

New Standard Specialties.

DRY CELL.

If kept out of the sun, in a cool dry place this cell will not run down on the shelf in two years, and at the end of that time will be as good as other makes fresh from the factory. To maintain its superiority to all others, no expense is spared, and only the best materials and chemicals are used in its manufacture.

This cell will save the consumer money, because a fewer number will perform a given amount of work four times as long as any other cell of equal size.

ELECTROMOTIVE FORCE, 1.52 VOLTS.
CURRENT, - 14 TO 18 AMPERES.

..CATALOGUE FOR THE ASKING..

HOME SEARCHLIGHTS ALWAYS READY FOR INSTANT USE.

QUICK,
SAFE,
CHEAP.

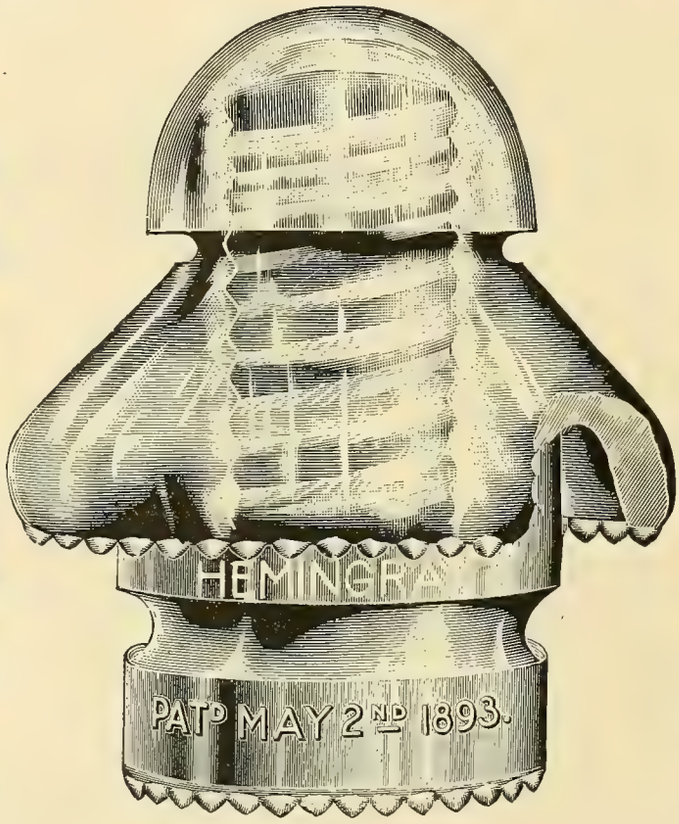
By pushing button a steady, brilliant, strongly reflected electric light is obtained; illuminates the darkest corner instantly; handy at bedside, and in all cases of emergency. Takes the place of lamp or candle, without need of matches, or danger of fire. Will last for years. **PRICE, PREPAID, $2.00.** Extra batteries for recharging, **35c** each. Send for booklet, with further information and illustrations of other electric household articles. **Electric Gas Lighters, $1.50 each.**

WM. ROCHE,
INVENTOR AND SOLE MANUFACTURER. 42 VESEY ST., NEW YORK, N. Y.

HEADQUARTERS FOR TELEPHONE INSULATORS.

No. 9 PONY INSULATOR.

Weight per piece.....9½ oz.
Weight per 1,000 packed.....675 lbs.
Packed 400 in a barrel.



TRANSPOSITION INSULATOR.

Weight per piece.....30 oz. | Weight per 1,000 packed .....2,115 lbs.
Packed 125 in a barrel.

No. 11 DOUBLE GROOVE PONY INSULATOR.

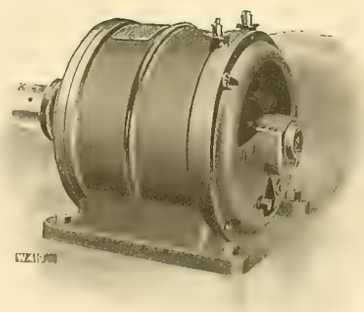
Weight per piece.....10 oz.
Weight per 1,000 packed.....700 lbs.
Packed 400 in a barrel.

FACTORIES AT
MUNCIE, IND.
OFFICE AT
COVINGTON, KY.

HEMINGRAY GLASS CO.

Established 1848 MANUFACTURERS. Incorporated 1870.

R. G. HEMINGRAY, President.
BRADFORD SHINKLE, Vice-President.
D. C. HEMINGRAY, Sec'y and Treas.



TYPE "B" MOTOR CAN BE MOUNTED ON SIDEWALL OR HUNG INVERTED FROM CEILING.

ARE YOU SATISFIED
WITH YOUR PRESENT EARNINGS?

If not then why not encourage the use of our

Single Phase Self Starting A.C. Motors

on your circuits? You can materially increase your day load and consequently make your investments earn you

INCREASED DIVIDENDS.

Advise us of the difficulties which confront you, that we may endeavor to offer a solution of same.

WAGNER ELECTRIC MANUFACTURING COMPANY
ST. LOUIS, MO., U. S. A.

VISITORS

TO THE

Interstate Telephone Convention

TO BE HELD AT THE

Auditorium Hotel, December 9, 10 and 11

Are cordially invited to inspect the

NEW BUILDING

OF THE

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

The largest, most modern and best equipped Independent telephone factory in the world.

The newest of the five buildings of the Kellogg Telephone Plant.

The Kellogg Switchboard and Supply Company's factory is equipped to meet the heaviest demands for every detail of telephone and switchboard construction.—And is meeting them.

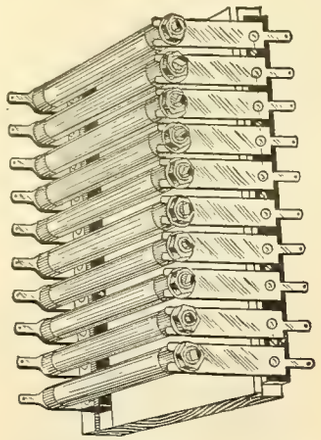
Convention visitors will be personally conducted over the factory, and will be enabled to inspect large and small switchboards in all stages of construction, as well as all the other manifold accessories of telephone supply, from the giant switchboard to portable desk telephones.

KELLOGG

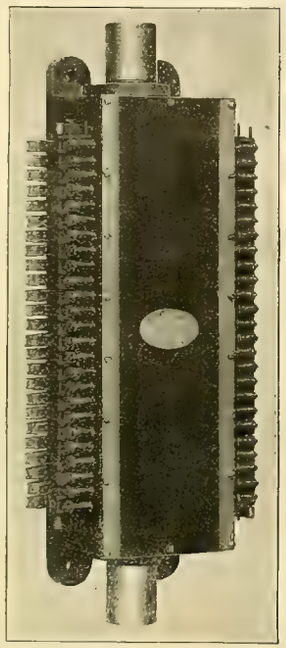
SWITCHBOARD & SUPPLY CO. CHICAGO.

346 Broadway, New York. Electric Building, Cleveland. Keystone Telephone Building, Philadelphia.

COOK PROTECTORS STANDARD



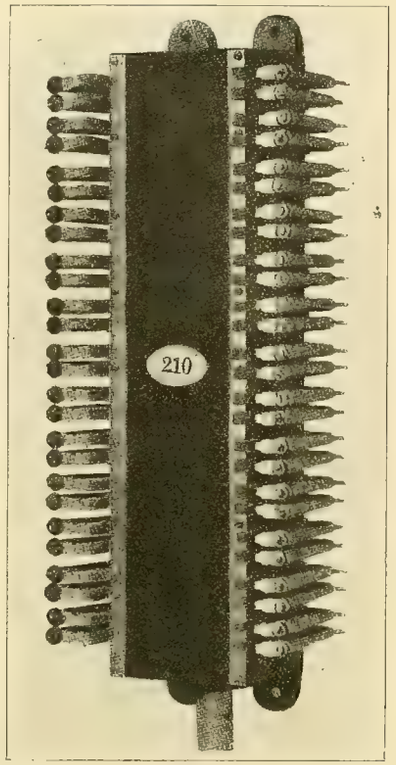
Type F—Cook Tubular Line Fuses mounted on strips. Any number of pairs. Patented Oct. 21, 1902.



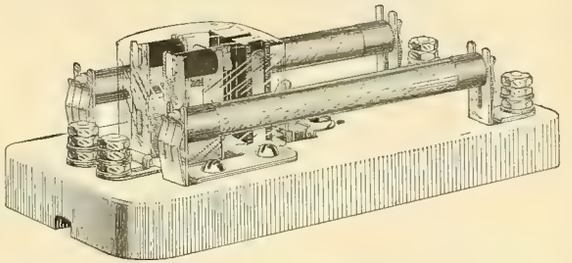
Type J.—Cook Combined Cable Terminal and Protectors, with heat coil and carbon plate arrester for strong and sneak currents. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902. All sizes, 25 to 200 pairs.

All apparatus broadly covered by United States Letters Patent.

Don't buy trouble. There is enough without buying more.



Type N.—Cook Pole Cable Terminal with Line Fuse and Carcon Plate Arrester. Patented May 20, 1890; Oct. 21, 1902. Other patents pending. All sizes, 25 to 100 pairs.

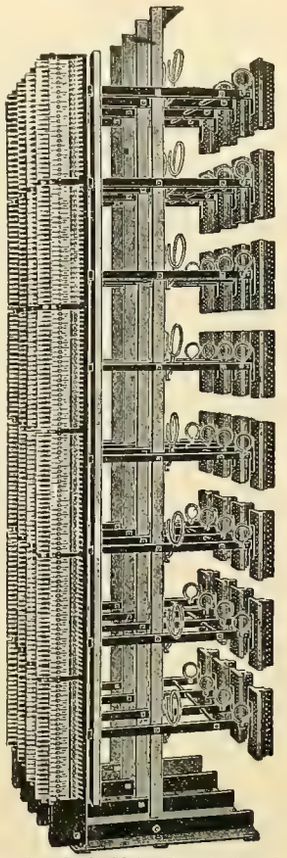


Type AA.—Cook No 12 Strong and Sneak Current Protector for subscriber's station, with carbon plate, heat coil and tubular line fuse. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Oct. 21, 1902. Other patents pending.

IMPORTANT

Absolute protection guaranteed both as to foreign currents and liability to patent infringement.

No exchange equipment modern and up-to-date without this line of apparatus.



Type L.—Cook Main Distributing Iron Frame with Strong and Sneak Current Protectors. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902. Other patents pending. All sizes. Any capacity.

FRANK B. COOK,

MANUFACTURER OF

COMBINED CABLE TERMINALS AND PROTECTORS, LOCK-NUT CABLE TERMINALS, POLE TOP CABLE TERMINALS, GUY CLAMPS, CABLE HANGERS, LIGHTNING ARRESTERS, STRONG CURRENT PROTECTORS, SNEAK CURRENT PROTECTORS, HEAT COILS, LINE FUSES, COPPER TEST CONNECTORS, TERMINAL STRIPS, DISTRIBUTING BOARDS, MAIN OR INTERMEDIATE.

ANY COMBINATIONS OF ABOVE MOUNTED ON IRON OR WOOD.

240-244 WEST LAKE STREET. **TEL. MONROE 1117.** **CHICAGO, U. S. A.**

"A Word To The Wise."

IF YOU'RE NOT WISE, GET WISE.

Investigate Our 'Phones.

Investigate Our Prices.

Investigate Our Reputation.

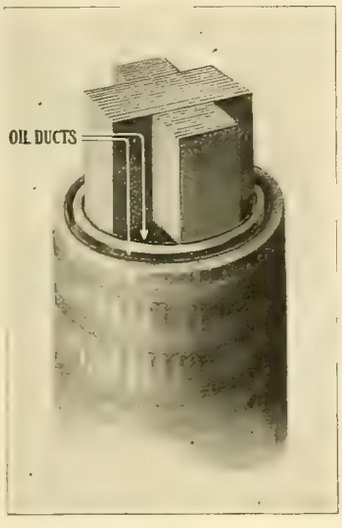
THEN BUY.

SWEDISH-AMERICAN TELEPHONE CO.,

CHICAGO.

GENERAL ELECTRIC COMPANY'S

TYPE "H" TRANSFORMERS—CORE TYPE.



Type "H" Transformers for high potentials, and of the largest sizes, are not only provided with ducts for circulation of cooling oil between the secondary winding and the core, but also between the secondary and primary windings, thus securing perfect insulation between primary and secondary and a low uniform temperature rise.

PRINCIPAL OFFICE: Schenectady, N. Y.

CHICAGO OFFICE, Monadnock Block. Sales Offices in all Large Cities.

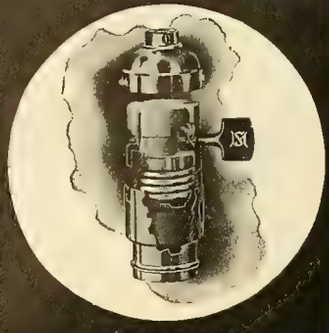
"Things are not always what they seem"

—Phædrus

The M Key Socket for example, except for the finer finish of the shell, looks much like an ordinary product, but when you get beneath the "skin," the shrewd buyer will see the difference that comes of automatic production and exact steel gauges.

The porcelain body is as sharp and exact as a piece of tooled metal. The action shows the stuff the spring is made of. The copper screw shell makes a sure contact.

A sample shows other dividend paying qualities.

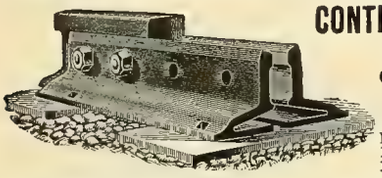


M.-S. KEY SOCKET.

MARSHALL-SANDERS COMPANY,

301 CONGRESS ST., - - - BOSTON MASS.,

MILLS BLDG., SAN FRANCISCO. STIMSON BLDG., LOS ANGELES.
STARR-BOYD BLDG., SEATTLE, WASH. MONADNOCK BLDG., CHICAGO.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER TEN THOUSAND (10,000) MILES IN USE.

Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

FISHER ELECTRIC CO.

TOLEDO, O

ELECTRIC SUPPLIES AND CONSTRUCTION.

WE CARRY A FULL LINE.

54 FRANKLIN Model Shop

The Franklin Model Shop

Experimental work for inventors; anything in metal from a single piece to a complete working model. Apparatus for colleges. Exhibition models. Introduction samples of patented articles. Special tools for making metal novelties. Inventions perfected. Drawings and designs worked out from inventors' ideas. Send for circular 16.

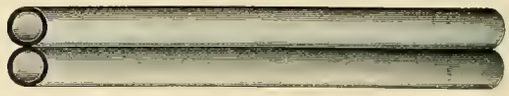
PARSELL & WEED,
129-131 W. 31st Street, New York.

THE CHICAGO DIE & ELECTRIC CO.

SOLE OWNERS OF THE MAXSTADT PATENT NO. 655,905.

We manufacture our joints under the **patent** we advertise.

PATENTED AUGUST 14, 1900, IN THE UNITED STATES AND FOREIGN COUNTRIES.



No. 882.

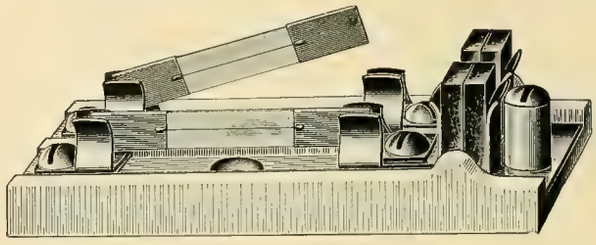
The illustration, No. 882, represents the Maxstadt patent improved American Joint, ready for use. Made in copper and tinned steel, for copper and galvanized iron wire. This joint is absolutely perfect and costs less money than any other joint on the market. Our Tinned Steel Joints are especially adapted for iron wire, and give entire satisfaction wherever used.

Prices and samples on application.

SOLE MANUFACTURERS OF THE

MAXSTADT PATENT IMPROVED FUSIBLE CUT-OUT CARBON LIGHTNING ARRESTERS.

No. 416 represents a full size Maxstadt Patent Improved Double Pole Porcelain Cut-Out and Carbon Lightning Arrester. The object of this Arrester is to economize space. Its compactness and efficiency has made it the most practical combination cut-out and lightning arrester on the market to-day, and it costs less money than any other arrester made.



Patented March 31, 1891. No. 416.

The above is one of the many different styles of Maxstadt Fuse Blocks we manufacture. We can also furnish fuses, paper sleeves, fuse wire and links.

Write for prices and samples.

Manufacturers of the Maxstadt Patent Improved American Joint:

CHICAGO DIE & ELECTRIC CO.,

87-91 W. LAKE STREET, CHICAGO, ILL.

Manhattan Electrical Supply Co.

BOYCOTTED!

On some goods the Company find it impossible to buy only at retail prices. Having ample resources and a large factory to help them out, they do not anticipate any serious trouble in carrying on their business in its regular way. They will have more to say about the unjust discrimination, and the parties connected in the scheme, in the near future. While the Manhattan Electrical Supply Company are not making any new prices at present, retaliatory steps of some nature may be expected at an early date.

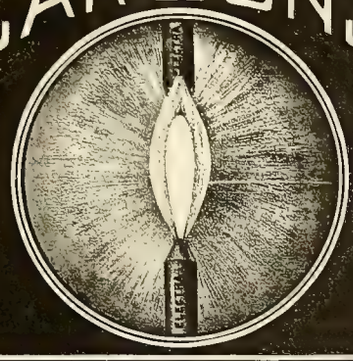
MANHATTAN ELECTRICAL SUPPLY CO.

32 Cortlandt St., NEW YORK. 188 Fifth Ave., CHICAGO.

"ELECTRA" FLAME LIGHT CARBONS

MARVELOUS EFFECT

"ELECTRA" Flame Light Carbons are suitable for all types of Open Arc Lamps, either direct or alternating current, with slight change in regulation of lamp.



HIGHEST INTENSITY

The intensity and brilliancy of light is three times that of regular "ELECTRA," and five times that of other carbons, making them eminently suitable for all special lighting purposes.

HUGO REISINGER, SOLE IMPORTER, 11 BROADWAY, NEW YORK.

Grimshaw.

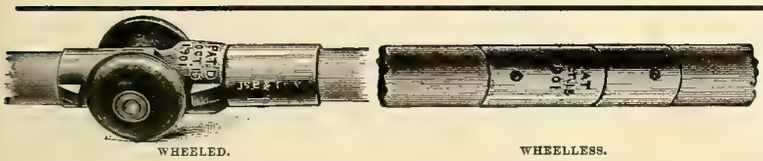
Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Grimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.



WHEELED. WHEELESS.

Villard Automatic Wheeled and Wheelless Conduit Rods

Are Coupled and Uncoupled Instantly and with Ease.

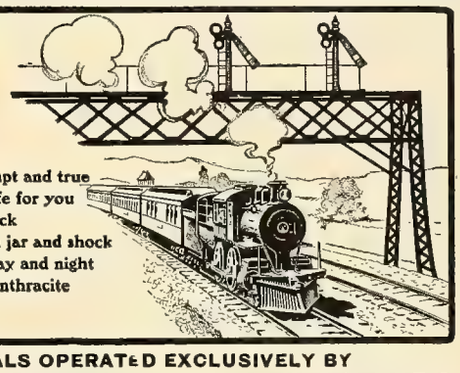
Furnished with and without wheels, as desired. They will not buckle or form a zig-zag line, and, with wheels, friction is removed, making them very light running. They are perfectly rigid when pushed, and become flexible when pulled. The rods cannot become uncoupled by any means in the ducts. The rear end of the rod has to be raised to an angle of about 45 degrees to uncouple it. One man can push with ease 600 feet, and a hard blow can be struck with telling effect without the slightest injury to the rods. The wheels serve as duct cleaners as well as to remove friction. The castings are of bronze with wheels of chilled cast iron. The rods are made of hickory, well seasoned in oil to prevent decay. Prices and circulars on application.

JAMES S. BARRON & CO., Sole Agents,
200-206 West Broadway. NEW YORK.

SOME OF THE MANY USERS OF VILLARD RODS:

New York Telephone Co., New York.
New York & New Jersey Telephone Co., Brooklyn, N. Y.
Manhattan Elevated Railway Co., New York.
Standard Underground Cable Co., Pittsburg, Pa.
United Railways Company of London, London, Eng.
Chesapeake & Potomac Telephone Co., Washington, D. C., and Baltimore, Md.
Etc., etc., etc.

Lackawanna Railroad
THIS IS THE ROAD OF ANTHRACITE.



These are the signals prompt and true
That make the journey safe for you
Over the bed of ballast rock
That keeps the trains from jar and shock
That smoothly run both day and night
On the dustless Road of Anthracite

ALL SIGNALS OPERATED EXCLUSIVELY BY

EDISON PRIMARY BATTERIES

Formerly Known as Edison-Lalande.

FULL DESCRIPTION IN BOOKLET NO. 4.

EDISON MANUFACTURING COMPANY

Factory, ORANGE, NEW JERSEY, U. S. A. New York Office, 83 CHAMBERS STREET
Chicago Office, 144 WABASH AVENUE

Only workmen of experience and proven ability are engaged in manufacturing our goods. When you buy, you get the best that money can buy and no trouble follows your bargain.

C & H RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

invite your investigation. Write to us for any desired information.

THE CUTLER-HAMMER MFG. CO.

AGENTS: Sturtevant Engineering Co. Ltd., London, Eng.
Edge & Edge, Sidney, Australia.
Kilbourne & Clark Co., Seattle, Wash.

MAIN OFFICES AND FACTORY—MILWAUKEE
BRANCH OFFICES—NEW YORK & CHICAGO

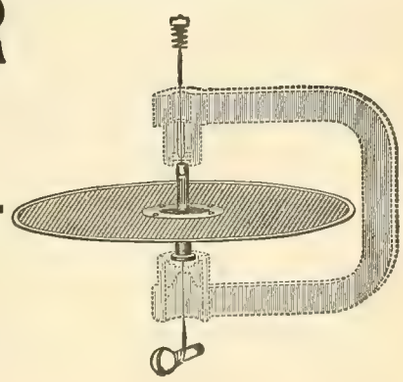
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR **ALTERNATING CURRENT**
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

HANG THEM UP
GIVE THEM JUICE
THAT'S ALL

A-B ARC LAMPS FOR ALL CIRCUITS.

ELECTRIC APPLIANCE COMPANY,
CHICAGO.

A STOCK OF
EDISON MINIATURE LAMPS

Should be kept by every **Central Station** for rental to their customers. They popularize electric lighting and bring a profitable income from a small investment. Very desirable for **Christmas Tree** and **Holiday Decorations.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 CORTLANDT ST.

MODERN MACHINERY

all tends towards greater or more economical production. **Toerring Arc Lamps** have doubled the life of a twelve-inch carbon, decreasing carbon bills, cutting down the cost of maintenance and greatly decreasing glass breakage.

TOERRING LAMPS ARE MODERN.

19th & ALLEGHENY AVE.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS
AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO.

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

SPARKING

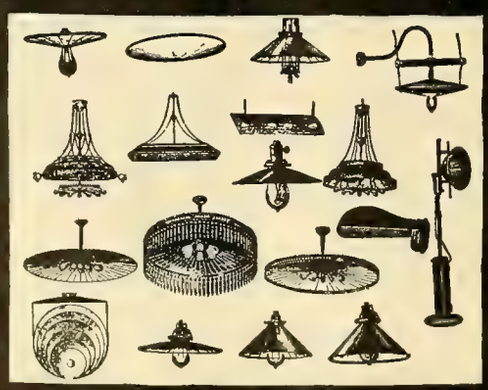
Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
It will put that high gloss on the Commutator you have so long sought after.
K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

WRITE FOR ILLUSTRATED CATALOGUE



AMERICAN REFLECTOR & LIGHTING CO.
CHICAGO.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

IWAN'S PATENT IMPROVED
Post Hole AND Well Auger

THE BEST IN THE WORLD. The 10 and 12-inch are especially adapted for telephone and telegraph post holes.

West Bend, Ia. June 19, 1902.

Gentlemen: — In reply to your letter of June 7th, will say that we have two of your 12-inch Patent Post Hole Augers, and we are well pleased with them. Two men can bore from 50 to 60 five-foot holes a day with each auger. Please ship us one more 12-inch auger at once, and oblige. Yours respectfully,
WEST BEND TELEPHONE CO.

They will save you time and money in your
TELEPHONE CONSTRUCTION
work, and give satisfaction in all kinds and under all conditions of soil.

For Sale by Hardware and Implement Jobbers and Dealers.

Write for prices and circular of our complete line of post hole augers and diggers.

Manufactured Exclusively by
IWAN BROS.
Box 105,
STREATOR, ILL.

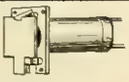
FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.



THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

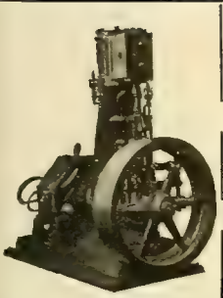
EVER SPILL YOUR ACID BOTTLE?
Full Size ALLEN Stick Free for Trial.

DODGE SUBSTITUTES (?) FOR THE **ALLEN** SOLDERING STICK MAKES SOLDER FLOW WE PROTECT YOU

BY THIS on a pink Label — Beware of Imitations. L. B. Allen. None Genuine without Signature

You Protect Yourself.

L. B. ALLEN CO., Inc. Sole Manufacturers, 1334 Columbia Ave. CHICAGO.



FOR SMALL ISOLATED ELECTRIC PLANTS
OUR VERTICAL AUTOMATICS HAVE NO PEER
PISTON VALVE SHAFT GOVERNOR
GUARANTEED Speed Regulation

8 to 40 Horsepower.

WE ALSO BUILD THE VERTICAL TYPE FOR BELTED OR D RECT-CONNECTED SERVICE.
From 40 to 120 Horsepower.
AND HORIZONTALS FROM
20 to 200 Horsepower.

N. Y. SAFETY STEAM POWER CO.
60 S. CANAL ST., CHICAGO, ILL.
New York Boston Philadelphia San Francisco

Chicago Fuse Wire & Mfg. Co.

Manufacturers,
Fuse Wire,
Fuse Links,
Telephone Fuses and Supplies.

ANNOUNCEMENT.

Owing to the steady growth of our business, and to enable us to supply our Eastern customers more promptly,

We have equipped a complete factory for the manufacture of our goods at
187 PRATT STREET, - BUFFALO, N. Y.

We are now manufacturing and shipping at this address under the supervision of competent and experienced men, who are thoroughly trained in the details of the business.

New York Office, - 853 Broadway.
MAIN OFFICE:
358 Dearborn Street, - Chicago, Ill.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

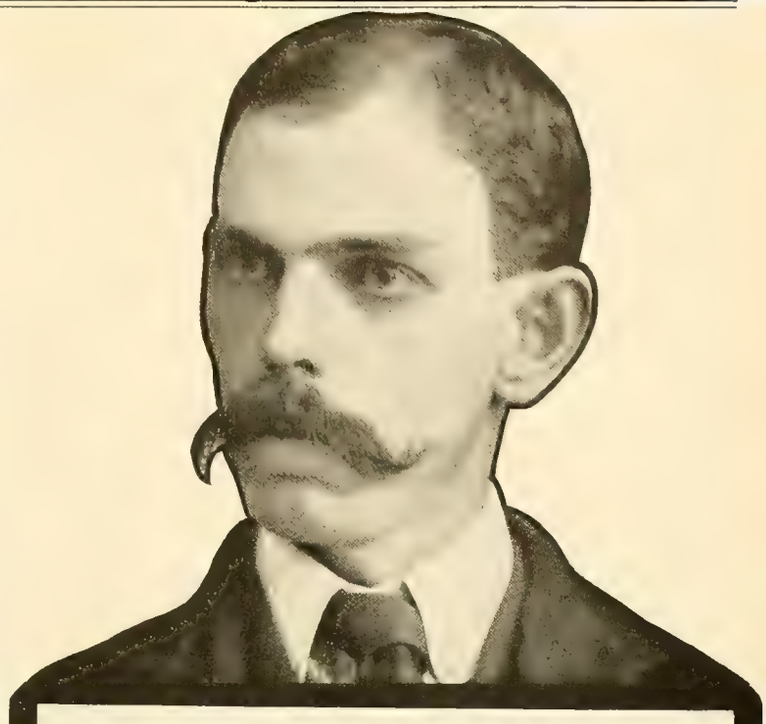
NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.



From $1 a Day to $90 a Month.

I cannot praise the I. C. S. too highly for what they have done for me, and would not take $10,000 for what I have learned from them. When I enrolled I was a dynamo tender receiving $1 a day; but today, as a result of my training by mail, I hold the position of Electrical Engineer. I am under contract at $90 per month. I am positive that I would have never met with this success had it not been for my I. C. S. training.
T. M. STREET, Daytona, Fla.

We have hundreds of indorsements just as strong and convincing as the foregoing. You owe it to yourself to find out just what we can do for ***you***. During the past eleven years our advice and assistance have put many a man on the road to progress and prosperity. You should ask it at once.

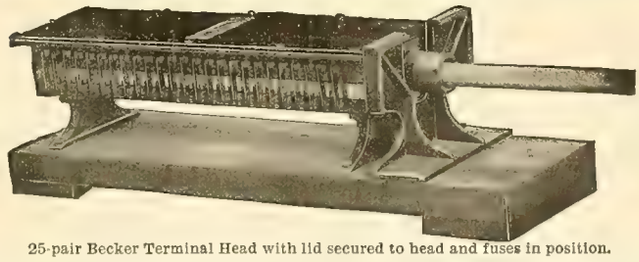
Fill Out and Send in the Coupon TODAY!

INTERNATIONAL CORRESPONDENCE SCHOOLS,
Box 1002, Scranton, Pa.
Please explain how I can qualify for position marked X below.

Electrical Engineer	Mechanical Draftsman	Textile Designer
Electrical Machine Designer	Refrigeration Engineer	Sanitary Engineer
Electrician	Steam Engineer	Contractor and Builder
Electric Lighting Supt.	Marine Engineer	Architectural Draftsman
Electric Railway Supt.	Civil Engineer	Sign Painter
Telephone Engineer	Hydraulic Engineer	Chemist
Telegraph Engineer	Municipal Engineer	Sheet-Metal Draftsman
Wireman	Bridge Engineer	Bookkeeper
Dynamo Tender	Railroad Engineer	Stenographer
Motorman	Architect	To Speak French
Mechanical Engineer	Cotton Mill Supt.	To Speak German
Machine Designer	Woolen Mill Supt.	To Speak Spanish

*Name*_____ *St. and No.*_____
*City*_____ *State*_____

PROTECTION
THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.
Chicago Office: 59 W. Jackson Boul.
Post-Glover Electric Co., Cincinnati Agents.
W. G. Nagel Electric Co., Toledo (O.) Agents.

TEST INSTRUMENTS.
Portable Sets for Resistance, Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.
Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.
Send for Catalogue No. 507 10c in stamps.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent or manager of an electric-light or power plant on the Pacific coast by thoroughly experienced man. Have been in the business since 1880 and have owned own plant for 10 years; also experienced in electro deposition and electro chlorination, and own patents on the latter process. Address H. B. SLATER, care General Electric Co , Los Angeles, Cal.

POSITION WANTED.

By young electrical engineer; graduate of Swiss Polytechnicum; four years' experience in calculation of light and high tension power stations, in design of generators, motors and transformers; best references. Address BOX 140, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent and electrician of an electric light and power plant in city of population up to 10,000 inhabitants, or would lease a plant in West or Middle West; 14 year's experience; references A 1; married. Address "N," 2003 Pine St., Murphysboro, Ill.

WANTED.

Competent electrician and engineer to operate steam and electrical end of one of the most economicably constructed as well as good paying plants in the state of Illinois; one who can take an interest in the company. The right party can buy a controlling interest. Address BOX 144, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Engineer to take charge of 1,000 H. P. electric plant, compound condensing engines. Write stating salary expected and give references. KEOKUK ELECTRIC RAILWAY & POWER COMPANY, Keokuk, Iowa.

WANTED.

Competent electricians in every city to sell and install on liberal commissions, our Adams Secondary Generators. Write THE ELECTRICAL SPECIALTY CO., 301 S. 7th St., St. Louis.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,

140 S. Clinton St., Chicago.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings), Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

FOR SALE.

Electric-light Plant. Direct System. 750 lights on. City Contract. Address N. H. CROWELL, Sioux Rapids, Iowa.

FOR SALE.

About 90—110-volt enclosed arc lamps in good condition and now in use. Address BOX 143, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

35 h. p. Gasoline Engine.

"Olds" 35 h. p. engine, been used about four months; in best running order; for sale at a bargain. Address at once THE MORSE CEDAR CO., Saginaw, Mich.

BUSINESS OPPORTUNITY.

A good opening exists for a hard working electrical machinery salesman with a few thousand dollars. Must have unquestionable record and standing. Principals only need apply. Address BOX 145, care Western Electrician, 510 Marquette Bldg., Chicago.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each. Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x16 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

60-K. W. EDISON, 500-VOLT.

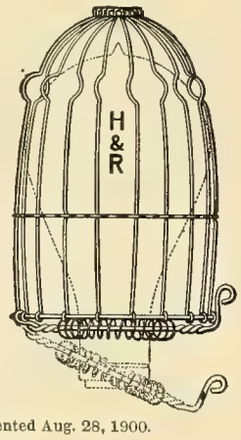
For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450

ROSE ELECTRIC CO., ST. LOUIS.

"NEVER BREAK"

ELECTRIC LIGHT GUARD.

SILVER LUSTER.

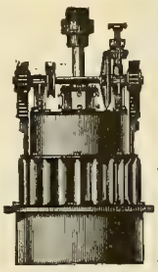


Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely,

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.



M'CORMICK TURBINE.

On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.

Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

S. MORGAN SMITH CO., York, Pa.

Electrical Machinery Bought, Sold and Exchanged. **REPAIRS** Switchboards Built to meet specifications.

ILLINOIS ELECTRICAL MFG. CO.,

Lowest Prices. **PEORIA, ILL.** Write Us.

IMMEDIATE SHIPMENT

TEN 72-inch by 18-foot

TUBULAR BOILERS

125 Pounds Pressure.

Full Fronts, Fine Condition, All Accessories. Located in Lindell Railway Co.'s Power House No. 1, Compton and Papin Streets, St. Louis, Mo.

ENGINES.

34x60 International Power Corliss.
26x48 Dickson Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
13x18 Frost Center Crank Automatic.
11½x 14 Taylor-Beck Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

One Geary Water Tube Boiler. 175 H. P. for 150 pounds pressure, almost new.
Two 150 Babcock & Wilcox Water Tube Boilers, 135 pounds pressure.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 6x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
200 H. P. Baragwanath Heater.
150 H. P. Kroeschell Heater.
500 H P. Excelsior Heater.
6x4x6 and 5½x3½x5 Worthington Pumps,
Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY, DAVENPORT, IA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 18 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric. A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37 inch face. As good as new. Immediate delivery.

375 H P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.
High speed automatics, from 250 H. P. down.
Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1.100-light, 60 K.W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric. 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE VICTOR TURBINE WATER WHEEL.

PARTICULARLY ADAPTED FOR DRIVING ELECTRIC PLANTS.

Its high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion will particularly commend it to all contemplating developing plants of this kind.

OUR OTHER SPECIALTIES ARE:

STEAM and POWER PUMPING MACHINERY for all purposes, AIR COMPRESSORS for the Air Lift system and general use, JET and SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS, STILWELL'S FEED WATER HEATERS, FILTER PRESSES and OIL MILL MACHINERY.

IF INTERESTED, WRITE

The STILWELL-BIERCE & SMITH-VAILE CO.

DAYTON, OHIO.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver Street.
NEW ORLEANS, 304 Hennen Building.
BALTIMORE, 1507 Continental Trust Building.
PHILADELPHIA, 612 Arch Street.
CHICAGO, 311 Dearborn Street.
LONDON, 97 Queen Victoria Street.
CLEVELAND, 1116 New England Building.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

INCANDESCENT LAMPS

A BARGAIN PROPOSITION.

We bought at sale 150,000 new, perfect incandescent lamps of standard make. They are clean, regular goods, put up in barrels each containing 250 lamps. Our stock consists as follows:

Candle Power: 8, 10, 16, 20, 24, 25.

Voltage: 100, 102, 104, 105, 106, 107, 108, 110, 115, 120.

Bases: Edison, T. H. and Westinghouse.

Note Our Prices: In lots less than a barrel, 15 cents; in lots of 250, 13 cents; in lots of 1,000, 12 cents; in lots of 5,000 or over, 10 cents.

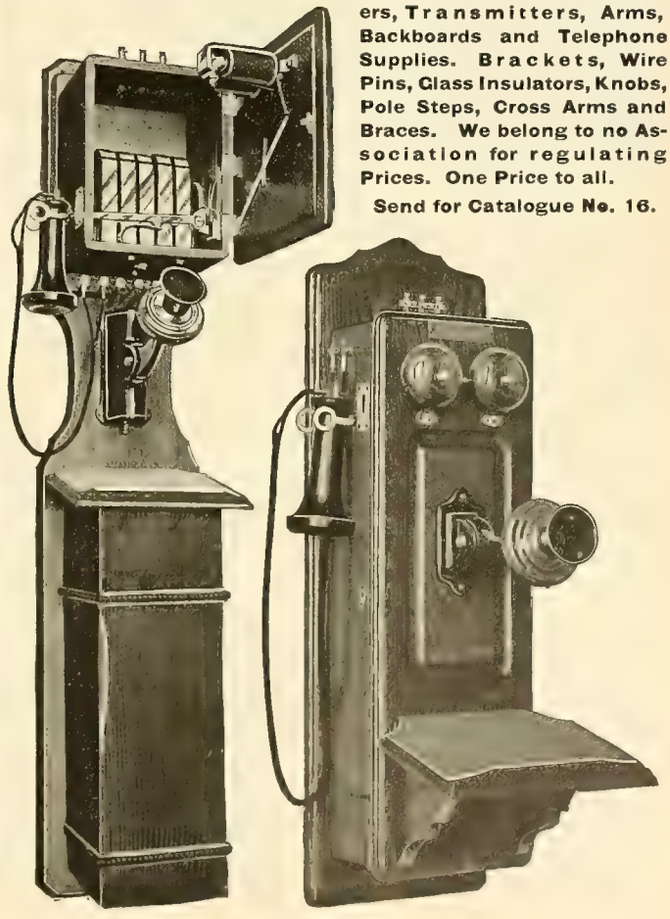
The above prices are for any candlepower or voltage, and for Edison or Westinghouse bases. Extra for lamps with T. H. base, each 3-4 cent. We handle electrical apparatus of any kind, also machinery of any description. Write for Catalogue 156.

CHICAGO HOUSE-WRECKING CO., W. 35th and Iron Sts., CHICAGO.

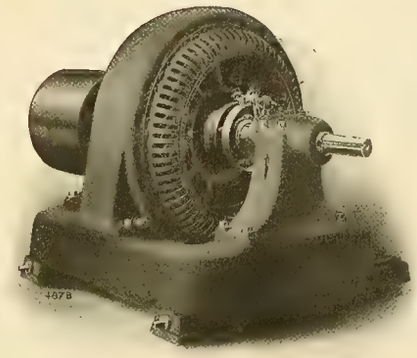
FARR TELEPHONE AND CONSTRUCTION SUPPLY CO. CHICAGO.

Manufacturers and Dealers in All Kinds of Telephones, Magneto Bells, Extension Bells, Receivers, Transmitters, Arms, Backboards and Telephone Supplies. Brackets, Wire Pins, Glass Insulators, Knobs, Pole Steps, Cross Arms and Braces. We belong to no Association for regulating Prices. One Price to all.

Send for Catalogue No. 16.

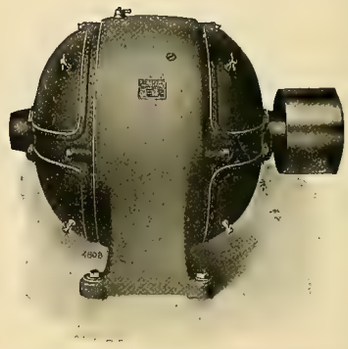


"Ceco." Electrical Machinery.



250 K. W. 3-Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.



Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

THE CHICAGO TELEPHONE HOLDER

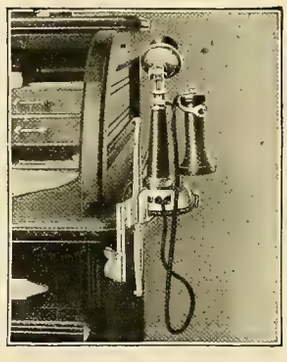
Holds the 'phone wherever wanted—out of the way or ready for use. Can be fastened to any desk, wall or partition. Leaves the desk slide free. Adjustable to any size base. The holder saves handling and avoids breaking. Retail price, $2 50. Write for our liberal inducements to the trade.

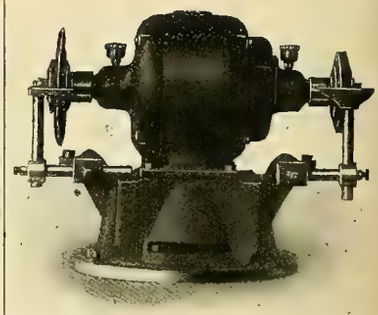
MANUFACTURED BY THE

CHICAGO WRITING MACHINE CO.

Room 424, 119 La Salle Street,

F. W. PARDEE, General Sales Agent. CHICAGO.





STEAM ENGINEERS' LICENSES

Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

Theo. Audel & Co., Publishers, 63 Fifth Avenue, New York City.

Bug-Proof Bell. Segerdahl Patent.

Sample, 3-in Nickel, 50c Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

HYLO

TURN-DOWN LAMP

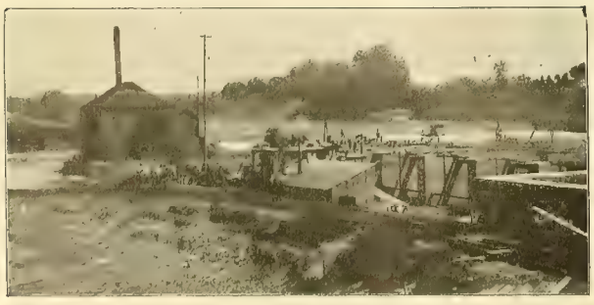
Teaches people to use more current by turning lamps down instead of out. Write for detailed information.

PHELPS CO., 50 State St., Detroit, U. S. A.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.



DAM!

That is what every user of water-power wants and very few have. Most dams leak. "The Gravity Dam" is the name of a 78 page book on dam construction. It describes all kinds of dams that leak and break and tells why they leak and break. It also describes a dam that will neither leak, break nor wash out.

THIS BOOK SENT FREE OF CHARGE

To every present or prospective user of water-power who sends his address and five cents in stamps to pay postage.

BEARDSLEY GRAVITY DAM & CONSTRUCTION CO.,
Dam Builders and Hydraulic Engineers, Etc. ELKHART, INDIANA.

WATSON MOTOR BENCH GRINDER.

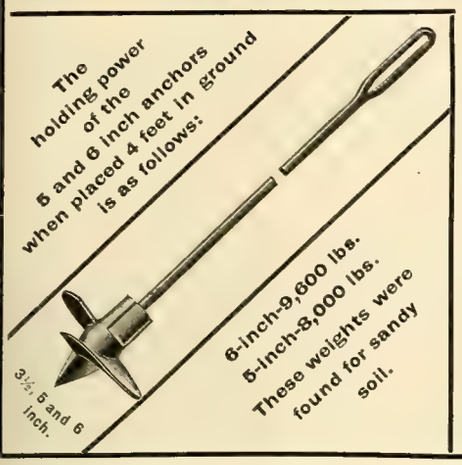
A PORTABLE DUST-PROOF ELECTRIC GRINDER. A BENCH TOOL WHICH EVERY MACHINE SHOP IN THE COUNTRY SHOULD BE EQUIPPED WITH. A TIME SAVER AND A MONEY MAKER YOU CANNOT AFFORD TO BE WITHOUT. ASK WHY? BUILT FOR 110 AND 220 VOLTS.

THE MECHANICAL APPLIANCE COMPANY,

MILWAUKEE.

Ask for Bulletin No. 55.

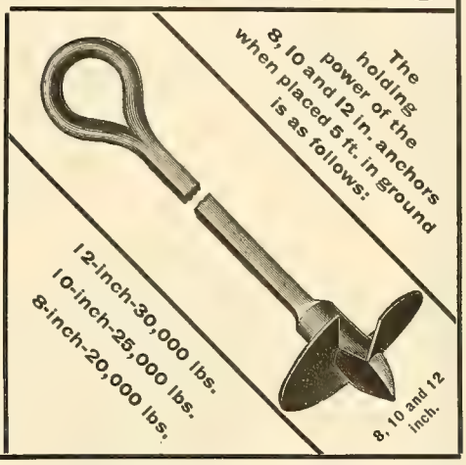
STOMBAUGH GUY ANCHORS



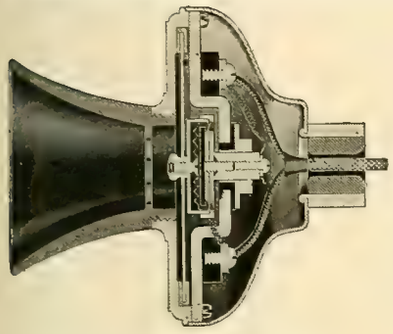
THIS IS THE WRENCH
that must be used to install the 3¼, 5 and 6 inch anchors.

W. N. MATTHEWS & BRO.,
DISTRIBUTERS,
603 Carleton Bldg., - - ST. LOUIS.

HGUABMOTS GUY ANCHORS



INTERNATIONAL TRANSMITTER



PATENT ALLOWED.

STANDS UNEQUALLED IN
Workmanship, Efficiency and Durability.

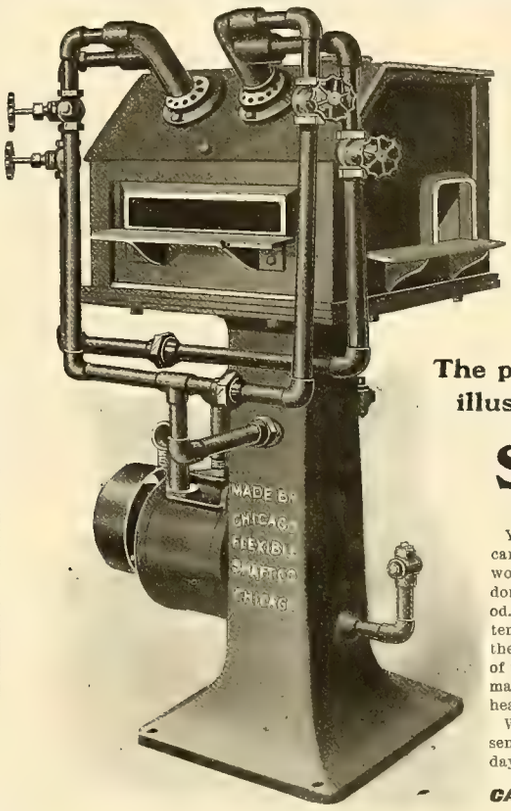
It is Clear, Distinct and Powerful.

IMPOSSIBLE
to become packed or deadened.

We manufacture a full line of public exchange central energy and generator call Telephones and multiple and trunking switchboards. Correspondence solicited.

INTERNATIONAL TELEPHONE MFG. CO.,
HARRISON AND CLINTON STREETS, - - - CHICAGO, U. S. A.

HEAT YOUR MAGNETS RIGHT.



ONE THOUSAND MAGNETS

10x½x¾ can be heated for hardening in this furnace in ten hours; every one perfect.—Thousands of magnets are ruined by the old method.

The price of furnace illustrated here is

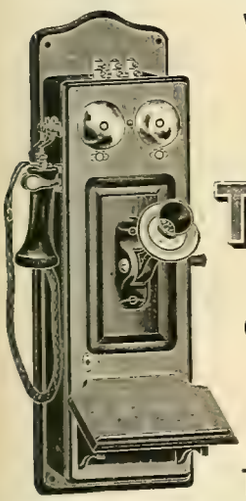
$100.

You take no chances, you cannot go wrong, you do more work in one day than can be done in three by the old method. If your magnets are not tempered right don't blame the steel man, it's the fault of the heating. Thousands of magnets are ruined by being heated in the open fire.

We make several sizes, and send our furnaces on thirty days' trial.

CATALOGUE FOR THE ASKING.

Chicago Flexible Shaft Co.,
Cor. La Salle Ave. and Ontario St., *CHICAGO, ILL.*



WE ALSO MAKE
FIRST-CLASS
BRIDGING AND SERIES
TELEPHONES
COMBINING
QUALITY AND SIMPLICITY.

WRITE US AND WE WILL TELL YOU ALL ABOUT IT.

THE U. S. ELECTRIC MFG. CO., - Butler, Pa

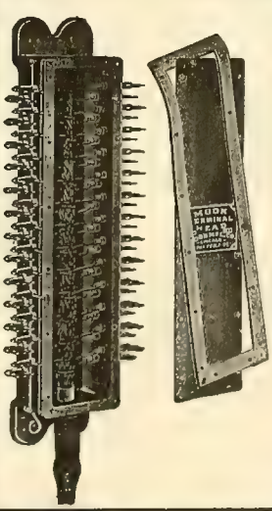
It's No Secret...

That the proper illustration in an **Ad.** pays for itself and the entire space of the ad.

WE MAKE THE PROPER KIND ...
— TRY THEM AND SEE

Real order fetchers
Full of force...

Franklin Engraving and Electrotyping Co.
341-351 DEARBORN ST., CHICAGO.



MOON TERMINALS
WITH
METALLIC OUTER CASE...

Protect the Telephone Cables. The Metal Case slides either up or down and is more durable and convenient than a wooden box.

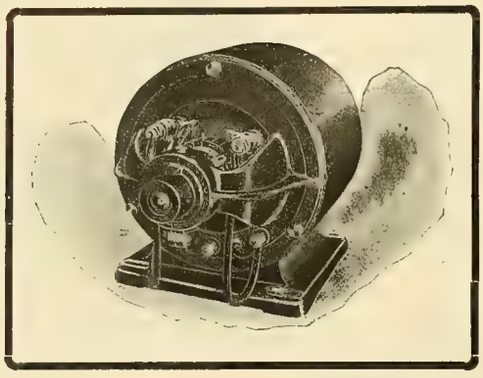
The Moon Terminal has a record. It has never lost a cable.

Write for Catalogue and Prices.

MOON MFG. CO.,
43-49 S. Canal Street,
CHICAGO.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

Sterling Direct Current Generators and Motors



This apparatus embodies some new and advanced ideas. Our factory makes nothing but small motors and generators in large quantities, which enables us to quote extremely low and attractive prices.

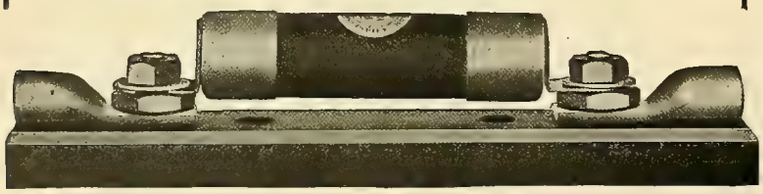
WE CAN INTEREST YOU IF IN THE MARKET.

WESTERN ELECTRICAL SUPPLY CO.

ST. LOUIS, U. S. A.

WRITE TO-DAY FOR CATALOGUE AND PRICES.

"SHAWMUT" ENCLOSED FUSES



RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

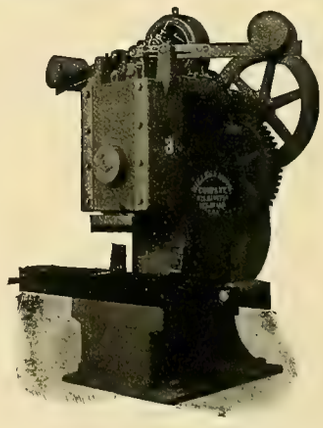
New York Representative:
WM. S. BROWN, 39 Cortlandt St.,
New York City.

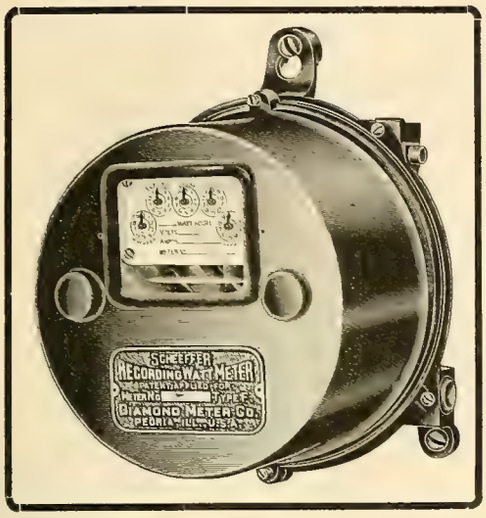
Western Representative:
THOMAS G. GRIER CO., 128 W. Jackson Blvd.,
Chicago, Illinois.

CROCKER-WHEELER COMPANY
AMPERE, N.J. U.S.A.

Manufacturers and Electrical Engineers for Systems of Electric Drive.

The Economical Method of Machine Tool Operation.





SCHEEFFER INTEGRATING WATTMETERS

FOR

DIRECT AND ALTERNATING CURRENT

DUST AND BUG PROOF

Not affected by alternations or lag in alternating current.

A highly sensitive and accurate meter.

Special prices on yearly contracts.

WESTERN ELECTRICAL SUPPLY CO.

WRITE TO-DAY FOR CATALOG AND PRICES.

ST. LOUIS, U. S. A.

HABIRSHAW

WIRES AND CABLES

WERE USED THROUGHOUT MARSHALL FIELD & CO.'S STORES, CHICAGO.

WIRED BY THE CHICAGO EDISON CO., OUR CHICAGO AGENT.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY.

SALES OFFICE:

15 Cortlandt Street, NEW YORK.

OFFICE AND FACTORY:

Glenwood Works, YONKERS.

THE

Western Electrician

OF DECEMBER 13TH, 1902

Will contain the report of the Interstate Independent Telephone Convention which will be held in Chicago December 9th-11th. This meeting promises to be the largest ever held among telephone men and consequently the above number of the Western Electrician will prove of special interest to everyone engaged in telephone work.

Manufacturers and dealers desiring to increase their trade with the telephone exchanges of the world should be largely represented in the advertising columns of this important issue.

Orders and copy should reach us by December 10th.

Western Electrician,

510 MARQUETTE BUILDING, CHICAGO.

BOOKS

Make your friend or yourself a Christmas present of an electrical book chosen from the following list which we recommend:

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Trevert's Electrical Measurements for Amateurs, cloth binding	1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	$1.25
Allsop's Bell Construction, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

Any of the above books sent prepaid on receipt of price. Write for free book catalogue.

ELECTRICIAN PUBLISHING CO.,

SUITE 510, MARQUETTE BLDG., CHICAGO.

Where are you going my pretty maid?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

WHY?

Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,

130 La Salle Ave., Chicago, Ill.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

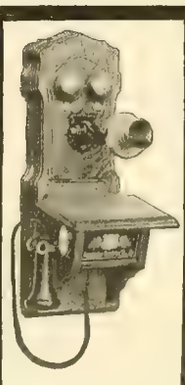
This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN

CENTRAL ENERGY **TELEPHONES** GENERATOR CALL

ARE A SUCCESS

AMERICAN ELECTRIC TELEPHONE CO.

39 JACKSON BLVD., CHICAGO

POWER INCREASED

AND BOILERS PROTECTED BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS.
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

RESISTANCE rods of Dixon's Graphite give high resistance in contracted space. Any size, any resistance. Ask for sample and booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

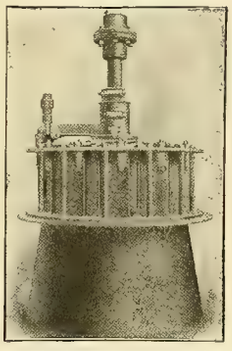
No. 4.

"Two Balls"

ASK YOUR SUPPLY HOUSE.

Sole Manufacturers
THE VOUGHT-BERGER COMPANY,
LA CROSSE, WIS., U. S. A.

GARRIGUS MECHANICAL BOILER CLEANER
THE ONLY KNOWN METHOD OF KEEPING BOILERS CLEAN AND FREE OF SCALE.
INSTALLED OUR EXPENSE ON 60 DAYS TRIAL
MECHANICAL BOILER CLEANER CO.
W. R. MASON Manager. 413 Western Union Building, CHICAGO.



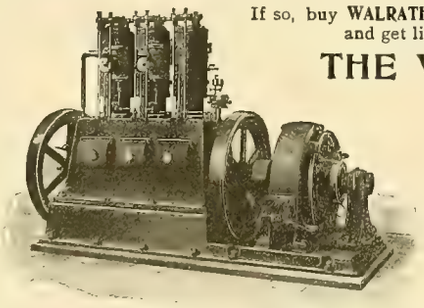
SAMSON TURBINE UPRIGHT AND HORIZONTAL
ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.
These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.
Write Dept. "D" for Catalog.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing.
Protection Guaranteed.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

The Inspector and Trouble Man.
A dialogue between the telephone trouble man and his assistant, showing how to overcome difficulties which arise in conducting a telephone exchange. A valuable and instructive book, 106 pages, $1.
THE INLAND PRINTER CO.,
214 MONROE ST., - - - - CHICAGO.

NEW CATALOGUE ELEVATING = CONVEYING — MACHINERY —
NOW READY SEND FOR COPY
"JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.
THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.
MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.
AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

THE TELEPHONE HAND-BOOK
BY HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

TO THE GREAT NORTHWEST
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.
JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

REG. TRADE MARKS
"Phosphor Bronze"
DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

THE STERRETT OIL PUMP
Has been improved so that it is better now than ever for handling heavy valve oils.
OUR NEW PATTERNS
will be out in a short time. You should send in your order at once for early delivery.
SENT ON 30 DAYS' TRIAL.
STERRETT PUMP CO.
67 EAST SIXTH ST., ST. PAUL, MINN.

ELECTRICAL BOOKS

FOR THE

HOLIDAYS

WE CARRY THE MOST COMPLETE STOCK

SEND FOR CATALOGUE

Electrician Publishing Co.

510 Marquette Building, CHICAGO.

New and Revised Edition JUST ISSUED.

American Telephone Practice

By KEMPSTER B. MILLER, M. E.

CONTENTS.

CHAPTER I — History and Principles of the Magneto Telephone. II.—History and Principles of the Battery Transmitter. III.—The Telephone Receiver. IV.—Carbon Transmitters. V. — Induction Coils. VI.—Batteries. VII.—Calling Apparatus. VIII.—The Automatic Shunt. IX.—The Hook Switch, and Circuits of a Telephone. X.—Commercial Calling Apparatus. XI.—The Telephone Relay or Repeater. XII.—Self-Induction and Capacity. XIII.—Telephone Lines. XIV.—Simple Switchboards for Small Exchanges. XV.—Listening and Ringing Apparatus for Switchboards. XVI.—Self-Restoring Switchboard Drops. XVII.—Complete Switchboards for Small Exchanges. XVIII.—Lamp Signal Switchboards. XIX.—The Multiple Switchboard. XX.—Transfer Systems. XXI.—Common-Battery Systems. XXII.—House Systems. XXIII.—Protective Devices. XXIV.—Distributing Boards. XXV.—Party Lines Non-Selective. XXVI.—Party Lines. Step by Step Selective Signaling. XXVII.—Selective Signaling by Strength and Polarity. XXVIII.—Harmonic Systems of Selective Signaling. XXIX.—Wire for Telephone Use. XXX.—Pole Line Construction. XXXI.—Overhead Cable Construction. XXXII.—Underground Cable Construction. XXXIII.—Testing. XXXIV.—Automatic Exchanges. XXXV.—Storage Batteries. XXXVI.—Specifications.

518 large octavo pages, 379 Illus. Price, $3.00.

This is the first complete treatise on Telephony in the English language. The author was peculiarly qualified for the task, having been an examiner in the U. S. Patent Office in the telephonic class, and subsequently as a telephone engineer had a wide experience in every branch of telephonic work. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

Copies of this or any other electrical book published sent prepaid, to any address in the world, on receipt of price.

Electrician Publishing Co., 510 Marquette Building, CHICAGO, ILLINOIS.

RENEWALS

December is an important month for the renewal of subscriptions. If your subscription is expiring this month, or even if it is expiring in January, it is to your interest to send in your renewal now so that the subscription may be extended on our books in plenty of time to prevent your missing any copies.

To make a Christmas gift of the WESTERN ELECTRICIAN send us the name and address of the person to whom you wish to give the subscription, with the annual subscription price of $3, and the paper will be sent regularly for 52 weeks.

With January 1st will begin the thirty-second volume of the WESTERN ELECTRICIAN, and during 1903 it will complete its sixteenth and the first half of its seventeenth year, the paper having been founded July 2, 1887, and continued under the present management for this entire period. We offer the past as a guaranty of the future, and in addition pledge the best efforts of an experienced and competent staff to the constant improvement of the paper.

The WESTERN ELECTRICIAN is published for the purpose of assisting everyone interested in the art. It is a general electrical and scientific paper, and gives to its readers all the latest news and keeps them thoroughly informed of everything that is going on in all the different departments of the electrical and allied fields. Its technical and scientific articles cover all the latest inventions and improvements and keep the reader thoroughly informed of all that is new in the art. Its special articles, written by the most prominent authorities, as well as its general articles, are of the highest order, and no interested person can afford to be without the paper.

SUBSCRIPTION PRICE PER YEAR

Of Fifty-two Numbers

IN THE

United States	**$3.00**
Foreign Countries	**5.00**

SAMPLE COPY FREE.

Electrician Publishing Company, SUITE 510, MARQUETTE BUILDING, CHICAGO, U. S. A.

GET BUSY WITH YOUR THINKER.

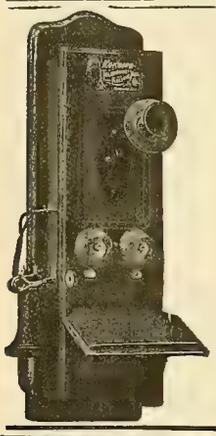
You spend a lot of time deciding where you will buy your telephone instruments. How much time do you devote to the question of where you buy your cross-arms? Of what use are your instruments when your cross-arms break and your wires are down?

We will send you Florida Heart Pine Cross-arms, direct from our mill in Brooksville, Fla.

The Standard Pole & Tie Co.,

BRANCH OFFICES: Wilmington, N. C.
Brooksville, Fla.

44 Broad St., New York City.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR

Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

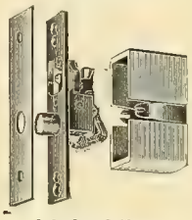
to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

EDWARDS and Co

DOOR SWITCH

(The Lungen).



Porcelain Insulation.
Wire Connections in Front.

Style A—Lights when door is open; out when door is closed.

Style B—Lights when door is closed; out when door is open.

THE ECO DOOR SWITCH OPERATES LIGHTS "EVERY OTHER TIME."

Approved by the National Board of Underwriters.

NEW YORK N.Y.

The Best of Everything

THE NORTH-WESTERN LINE

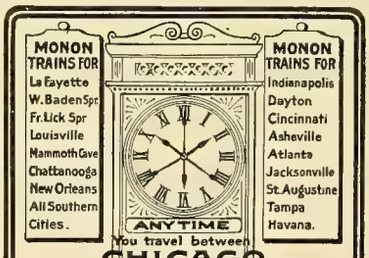
THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.



You travel between

CHICAGO LOUISVILLE INDIANAPOLIS AND CINCINNATI GO VIA

MONON ROUTE

AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W. H. McDOEL, PRES'T & GEN'L MGR. FRANK J. REED, GEN'L PASS'R AGT. CHAS. H. ROCKWELL, TRAFF. MGR.

CHICAGO.

ARE YOU LOOKING FOR TROUBLE?

IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM

—IN—

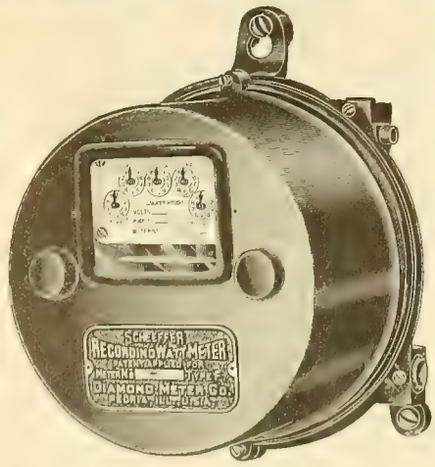
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

8th Edition Just Out. Price, 25c.

Electrician Publishing Co.,

510 Marquette Building,

CHICAGO.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

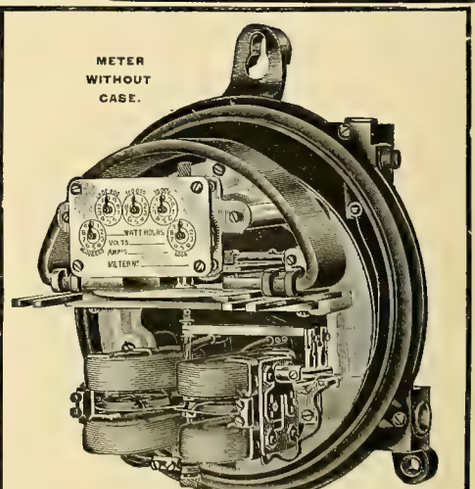
IMPROVED CONSTRUCTION.

Unaffected by Alternations or Lag in Alternating Currents.

A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.



METER WITHOUT CASE.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

WE WILL BE AMONG THE

Pole Men at the Convention.

We would like to meet you there. Our room is just opposite the elevator—Exhibit floor. No trouble to find us.

If you're not coming, write us anyway, and get a prompt reply, giving the lowest pole prices made this year.

TAKE DOWN THE NAME NOW

MALTBY LUMBER COMPANY,

BAY CITY, MICHIGAN.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705-7 FISHER BLDG. CHICAGO.

Central Manufacturing Co.

Chattanooga, Tenn.

Mfrs. and Dealers in

Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.

LARGE STOCKS ON HAND.

Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice. WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Western Cedar Poles.

LOW PRICES.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**

Eleven Pole Yards in Michigan. Wholesale Producers for 20 years.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand

M. KLEIN & SON

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,

229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.

Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.

Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES OF ALL LENGTHS AND SIZES.....

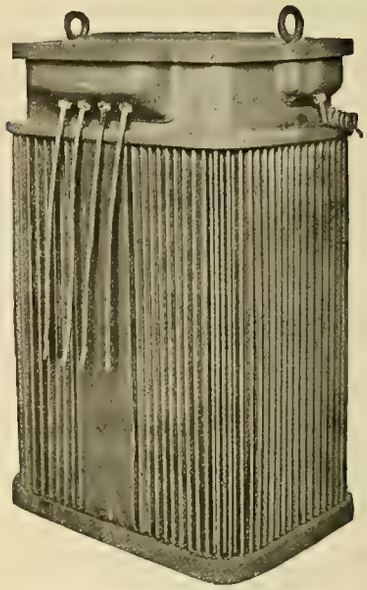
SPECIAL PRICES UPON APPLICATION.

PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Westinghouse Transformers

The larger sizes of Westinghouse Type N. and O. D. Transformers have corrugated cases, exceedingly light in weight and approximately 2½ times as large in radiating surface as a plain case of the same dimensions. Their value in maintaining low-running temperature is obvious.



Westinghouse 50 K.W., O. D. Transformer.

WRITE FOR ILLUSTRATED TRANSFORMER BOOKLET.

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities.

PITTSBURG, PA.

Nernst Lamps

EASILY RENEWED
REDUCE COST OF LIGHT ONE HALF
NO SHADOWS CAST
SOFT WHITE LIGHT
THE SAME AS DAYLIGHT

LOW MAINTENANCE COST
ALWAYS RELIABLE
MORE LIGHT FOR LESS MONEY
PERFECT DISTRIBUTION OF LIGHT.
SUPERIOR QUALITY OF LIGHT

WRITE FOR ILLUSTRATED BOOKLET No. 6.

Nernst Lamp Co.

Sales Offices: Pittsburgh, Pa.; New York, 120 Broadway; Boston, 131 State Street; Philadelphia, 710 Girard Trust Building.

Or address any Supply Dealer.

DUNCAN
Integrating Wattmeter

FOR DIRECT AND ALTERNATING CURRENTS.

BUILT STRICTLY IN ACCORDANCE WITH PRESENT DAY REQUIREMENTS.

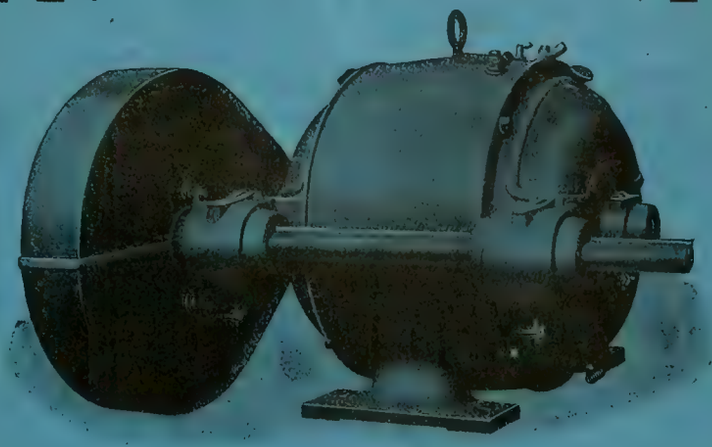
JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS

WRITE FOR PRICES

DUNCAN ELECTRIC MFG. CO.
MANUFACTURERS OF ELECTRICITY METERS
LAFAYETTE, IND.

BACK GEARED MOTORS

TYPE E
For direct current circuits.



A small-medium speed motor with reducing gears will do the work of a specially designed slow speed motor of greater size and cost. From 2 to 20 h.p. Type E back geared motors are standardized for 115, 230 and 500 volts, open, enclosed or semi-enclosed

Send for Bulletin 1036.

Fort Wayne Electric Works
MAIN OFFICE AND FACTORY
Fort Wayne, Indiana

THE "ELLIOTT" INSTRUMENTS.

All the Modern Styles.

EXCHANGE, TOLL and PARTY LINE WORK.

Strictly High Grade Throughout (H-C Gen. and Ringers.)

We fear no rival. We challenge comparison.

Seventeen Years Experience.

Try our phones. Prove our claims is all we ask. Write for catalogue and prices. You'll never regret it.

The Elliott Telephone Co.
518-520 Massachusetts Ave.
Indianapolis, Ind.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.

Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

CHARLES. H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
10 & 12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 190 PAGE ILL. CATALOGUE

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., Wilmington, Del.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

DON'T BUILD A CHIMNEY

USE MECHANICAL DRAFT

IT COSTS FAR LESS

Is independent of weather. The fan is positive in action. Responds instantly to sudden demands for more steam. Burns cheap fuel. Costs practically nothing for operation when exhaust steam is utilized

142

B. F. STURTEVANT Co BOSTON, MASS.
NEW YORK - PHILADELPHIA - CHICAGO - LONDON

MODERN HEAT
ELECTRICITY.
AMERICAN ELECTRICAL HEATER CO.
Manufacturers Electric Heating Appliances.
Write for catalogue. 198-197 River St. DETROIT MICH

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.
NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Black Diamond File Works
Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO DOWN DRAFT FORGES
NO SMOKE - NO OVERHEAD PIPES - NO REPAIRS
SEE NEW CATALOGUE

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
CHICAGO PITTSBURG

INTERSTATE TELEPHONE CONVENTION.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 13, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 24.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 70-81 Cornhill, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

MAXIMUM LIFE, EFFICIENCY AND LIGHT.
THE STERLING SPECIAL THAT'S ALL.
MINIMUM COST PER CANDLE-POWER.
STERLING ELECTRICAL MFG. CO., WARREN, OHIO.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. 101 Milk St., Boston.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

HYLO
TURN-DOWN LAMP
Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.
PHELPS CO., 50 State St., Detroit, U. S. A.

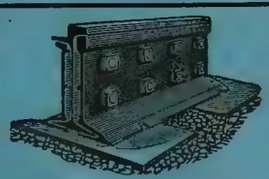
The Franklin Dynamo
50 Watts. 10 Volts, 5 Amperes.
3,000 to 4,000 revolutions. Sets of material, finished parts, complete machines. For amateur construction—very efficient Will drive a dental engine, sewing machine or small lathe; run as a generator, will furnish current for six 6 candle-power lamps. Parts $3.50, $6, $8.50. Complete $12.50. Write for circular 16.
PARSELL & WEED, 129-131 W. 31st Street, New York.
The FRANKLIN Model Shop

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg Co. Troy, Ohio

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburg. New York. Chicago.

CONTINUOUS RAIL JOINT CO. OF AM.
GENERAL OFFICES: CENTURY BUILDING,
NEWARK, N. J.
Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.



Platinum
In Sheet or Wire for all Purposes.
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS
Formerly C. F. Croselmire.
CHAS. ENGELHARD, Gen. Mgr.
251 to 255 New Jersey R. R. Ave., Newark, N. J.

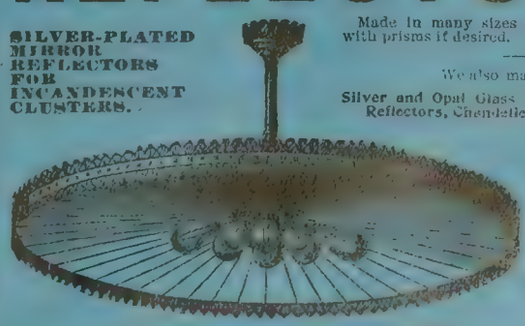
THE P-K ROSETTE
is smooth and don't hold dust, so looks neat for years. Isn't this worth a good bit?
Just specify "P-K"
H. T. PAISTE CO.,
Chicago - Philadelphia - New York

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Voltmeter.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., No. 101 St. Martins Lane.
Mention the WESTERN ELECTRICIAN when writing for catalogues.

REFLECTORS!
SILVER-PLATED MIRROR REFLECTORS FOR INCANDESCENT CLUSTERS.



Made in many sizes and styles. Trimmed with prisms if desired.
We also manufacture
Silver and Opal Glass Inverted Double Cone Reflectors, Chandeliers and Sun Burners
For lighting and ventilating Churches, Theatres, Halls and Public Buildings.
Street and Ornamental Lamps of every kind for Oil, Gas or Gasoline. Bridge Lights, Lunch Room, Pool Lights and Gas Stands for Theatres.
SEND FOR CATALOG.
AMERICAN REFLECTOR & LIGHTING COMPANY,
271-273 FRANKLIN STREET, CHICAGO, ILL., U. S. A.

R. W. [illegible], President.

B. S. BARNARD, Vice-President and Secretary.

STANDARD VITRIFIED CONDUIT CO.

VITRIFIED SALT GLAZED CONDUITS

39-41 Cortlandt Street, NEW YORK.

Baltimore—United Traction Co. awards us contract 200,000 feet of conduit.

Richmond, Va.—Richmond Telephone Co. awards us 200,000 feet of conduit.

Atlanta, Ga., New Castle, Pa., Perth Amboy, N. J., Trenton, N. J., many other cities.

LARGEST PLANT — BEST STOCK — SKILLED WORKMEN.

ANNUAL CAPACITY, 25,000,000 FEET.

HEADQUARTERS FOR TELEPHONE INSULATORS.

No. 9 PONY INSULATOR.

Weight per piece.....9½ oz.
Weight per 1,000 packed.....675 lbs.
Packed 400 in a barrel.

TRANSPOSITION INSULATOR.

Weight per piece.....30 oz. | Weight per 1,000 packed.....2,115 lbs.
Packed 125 in a barrel.

No. 11 DOUBLE GROOVE PONY INSULATOR.

Weight per piece.....10 oz.
Weight per 1,000 packed.....700 lbs.
Packed 400 in a barrel.

FACTORIES AT
[illegible]NGLE, IND.
OFFICE AT
[illegible]INGTON, KY.

HEMINGRAY GLASS CO.
Established 1848 MANUFACTURERS. Incorporated 1870.

R. G. HEMINGRAY, President.
BRADFORD SHINKLE, Vice-President.
D. C. HEMINGRAY, Sec'y and Treas.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

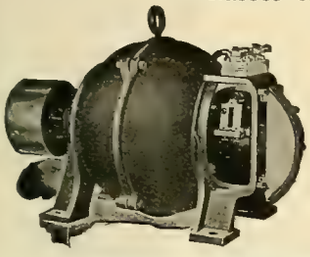
PHILADELPHIA, Allegheny Ave. and 19th St.
BOSTON, 60 State Street.
BALTIMORE, Continental Trust Building.
DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building.
NEW YORK, 100 Broadway.
CHICAGO, Marquette Building.
CLEVELAND, New England Building.
SAN FRANCISCO, Nevada Block.
HAVANA, CUBA, F. G. Greenwood, Mgr., 84 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

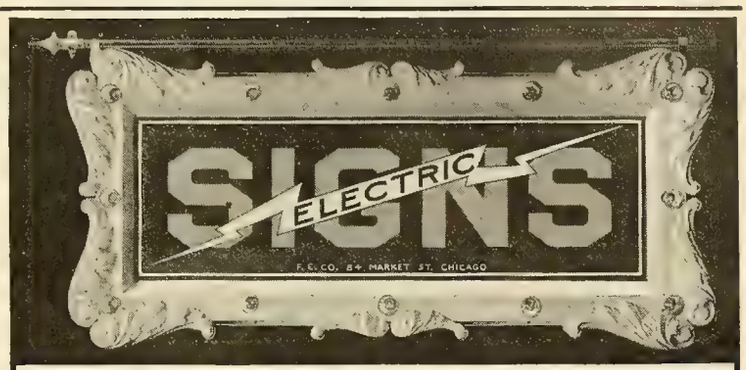
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

Western Manufacturers' Agent.

REPRESENTING:
THE ROBBINS & MEYERS CO., SPRINGFIELD, O.
INDIANA RUBBER & INSULATED WIRE CO., JONESBORO, IND.
PROCTOR-RAYMOND MFG. CO., BUFFALO, N. Y.
RENIM SPECIALTY CO., BOSTON, MASS.

ARTHUR F. STANLEY
BROADWAY AND MAIDEN LANE BLDG.
NEW YORK.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, it is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Smoking Pipe Co.....—
Allen Company, L. B..... 17
Allis-Chalmers Company....32
American Battery Co.....—
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....19
American Electrical Works..17
American Platinum Works.. 1
American Refl. & Lighting Co. 1
American School of Corresp .—
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....28
Audel & Company, Theo.... —

Baker & Company..... 3
Barnett Company, G. & H....32
Barron & Co., J. S.....—
Beardslee Chandelier Mfg. Co.16
Beardsley Gravity Dam & Construction Co..... ....—
Berthold & Jennings.....29
Besly & Co., Charles H.....32
Bonville, Edward 24
Bossert El. Construction Co..17
Brooks, Hall L..... 29
Brown & Leasure..... 16
Buffalo Forge Co..... 32

Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co...—
Central Telephone & El. Co..—
Century Glass Co.....—
Chase-Shawmut Company...22
Chicago & Alton Railroad....24
C. & N. W. R. R.....24
Chicago Die & Electric Co...17
Chicago Edison Company.4, 18
Chicago Flexible Shaft Co...21
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
C., M. & St. P. R. R.....24
Chicago Pay Station Co.....21
Christensen Engineering Co.20
Commercial Elec. Supply Co.11
Consumers Carbon Co.....17
Continuous Rail Joint Company of America..... 1
Cook, Frank B.....22
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .36
Cutler-Hammer Mfg. Co.....15
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..26
Diamond Meter Company....—
Dixon Crucible Co., Joseph..26
Duncan Electric Mfg. Co.... 31

Edison Decorative & Miniature Lamp Department..4, 16
Edison Mfg. Company.....25
Edwards & Company.....28
Electrical Engineer Institute.—
Electric Appliance Company.16
Electric Storage Battery Co.. 2
Electrician Pub. Company...27

Faries Manufacturing Co....—
Federal Electric Company... 3
Fisher Electric Company....32
"For Sale" Advertisements..18
Ft. Wayne Elec. Works., Inc.31
Fowler, John H.....29
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M. ...29

General Electric Company...14
General Incandescent Arc Light Company..... 5
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Great Western Smelting & Refining Company.... 18
Gregory Electric Company ..18
Guarantee Tel. & Equip Co.. 7

Hamblin & Russell Mfg. Co..24
Hartford Steam Boiler Inspection & Insurance Co...26
Hazard Manufacturing Co....32
Helios-Upton Company..... 4
Hemingray Glass Co..... 2
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....18
Holmes Fibre-Graph. Co.....26
Huebel Company, C. J.....28
Humphrey, Henry H.....16

Illinois Electrical Mfg. Co ..—
Illinois Maintenance Co.....18
Incandescent Electric Light Manipulator Company.....26
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....25
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..12
Iwan Bros.....16

Jeffrey Manufacturing Co....26
Johnston, Thomas J.....17
Kartavert Manufacturing Co.32
Kellogg Switchboard & Supply Company.....8, 29
Klein & Son, Mathias.....28
Kohler Brothers. 16
Kokomo Tel. & El. M. Co....24

Leather Preserv. M. Corp....—
Leffel & Co., James.....26
Lindsley Brothers Company..29
Lowell Model Co..... 26

Machado & Roller.....—
Maley, Martin.....26
Maltby Lumber Company.. .29
Manhattan Electrical Supply Co.....19
Marinette Iron Wks. Mfg. Co.26
Marshall-Sanders Co. 17
Matthews & Bros., W. N.....21
Mayer Engineering Co.....17
McLennan & Company, K....16
McNamara Brothers 26
Mechanical Appliance Co....25
Mechanical Boiler Cleaner Co.....26
Metropolitan Tel. & El Co...24
Mica Insulator Company.....—
Miscellaneous Advs.....18
Monarch Fire Appl. Co.....26
Monon Railroad.....—
Moon Mfg. Co., The.....21
Morse Cedar Company.....29
Mountain State Electrical Co.18
Munsell & Co., Eugene.....16
Murdock Parlor Grate Co....24

National India Rubber Co.... 1
Nernst Lamp Co.....30
New York Ins. Wire Co.....15
N. Y. Safety Steam Power Co.17
Norton Elec'l Instrument Co.—
Nungesser Elec. Battery Co..14

Okonite Company, The....1, 10
Osburn Flexible Conduit Co.23

Paishe Co., H. T..... 1
Paragon Fan & Motor Co.....—
Parsell & Weed..... 1
Perrizo & Sons.....29
Phelps Company..... 1
Phillips, Eugene F.....17
Phillips Insulated Wire Co..17
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co.....26
Pignolet, L. M.....16
Pittsburg & L. S. Iron Co....29
Porter Cedar Company.....29
Rauscher, John .....—
Reisinger, Hugo.....15
Replogle Governor Works.. .—
Reynolds Electric Company.—
Rice, Cyrus W 17
Roche, Wm.....15
Roebling's Sons Co., J. A.....32
Rooney-Westbury El. Lmp. Co.16
Rose Electric Company 18

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....18
Schott, W. H. 16
Schureman & Hayden.....18
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 16
Smith Co., S. Morgan.....26
Spies Electric Company.....24
Sprague Electric Company... 3
Standard Conduit Co..... 7
Standard Pole & Tie Co.... .28
Standard Underg. Cable Co.1, 6
Standard Varnish Works 17
Standard Vitrified Cond. Co. 2
Stanley, Arthur F..... 3
Stanley Instrument Co.....15
Station Equipment Co.....18
Sterling & Son, W. C.....29
Sterling Electrical Mfg. Co.. 1
Sterling Electric Company...20
Sterling Varnish Co., The....16
Stilwell-Bierce & Smith-Vaile Company.....25
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company..... 9
Sturtevant Company, B. F....32

Thompson Son & Co.....18
Toerring Company, C. J 16
Torrey Cedar Company..... .29
Triumph Electric Co.....16

U. S. Electric Mfg. Co.....21

Valentine-Clark Co., The....29
Vindex Electric Company....24
Vreeland, B. F. 29
Vulcanized Fiber Company..32

Wagner Electric Mfg. Co.....—
Wagor Mfg. Co., P. R.....32
Walsh's Sons & Company....18
Western Electric Company... 7
Western El. Supply Co.....—
Western Telephone Mfg. Co .13
Westinghouse Electric & Manufacturing Company ..30
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....18
Whitmore, A. E.....29
Wickes Bros.....18
Willyoung, Elmer G.....—
Wisconsin Central R. R..... 24
Worcester Company, C. H....29

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

EDISON TELEPHONE LAMPS

ARE THE

STANDARD FOR VISUAL SIGNALS.

They save the exchange time and money because every lamp is perfect—sure to fit—sure to burn. The life is extremely long—running into years.

Be sure to get the EDISON.

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY,

Harrison, N. J.

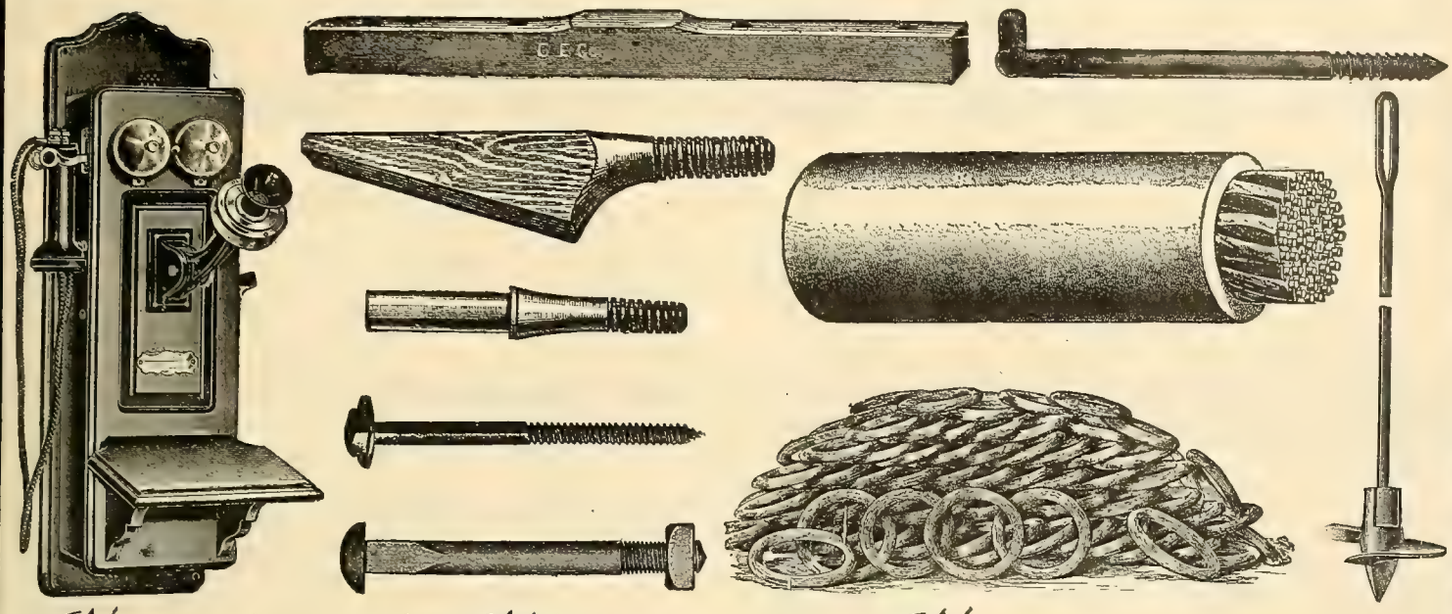
H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

EVERYTHING — FROM TELEPHONES TO GUY ANCHORS.



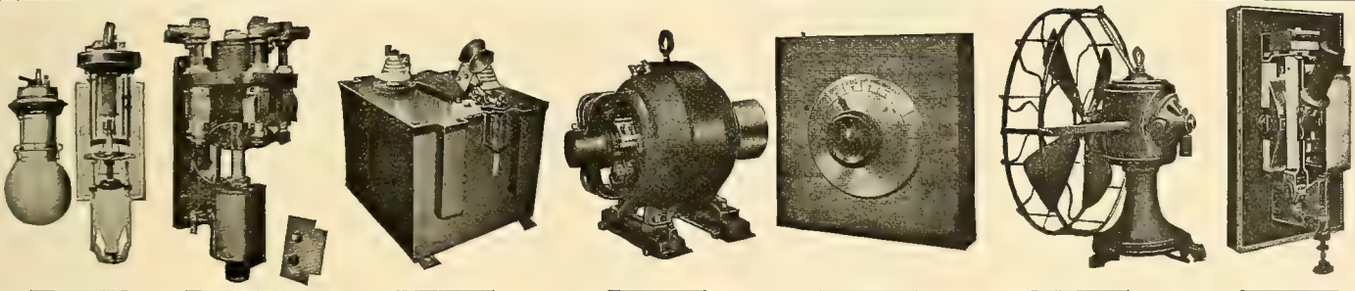
Central Electric Company,

264-266-268-270 FIFTH AVENUE

CHICAGO.

OKONITE IT NEVER DISAPPOINTS

OKONITE IT NEVER DISAPPOINTS



BULLETIN No. 172 | BULLETIN No. 54 | BULLETIN No. 53 | BULLETIN No. 164 | BULLETIN No. 155 | BULLETIN No. 162 | BULLETIN No. 152

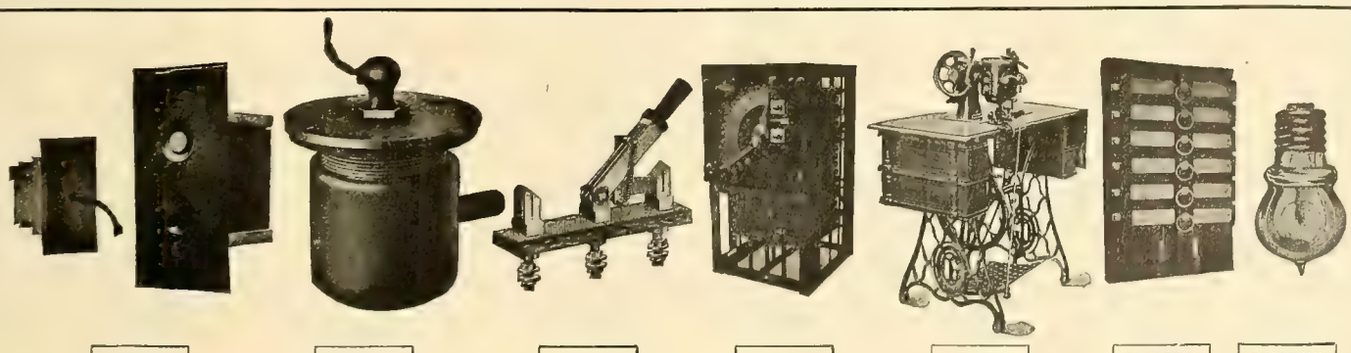
TRADE **G. I.** MARK

STANDS FOR ELECTRICAL AND MECHANICAL PERFECTION.

Bulletins, Blueprints, Photographs, Estimates, Etc., Mailed Upon Application.

GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK, N. Y.

220 Devonshire St., Boston, Mass.
48 West Jackson Blvd., Chicago, Ill.
638 Century Bldg., St. Louis, Mo.
1732 Champa St., Denver, Colo.
510 New England Bldg., Cleveland, Ohio.
319 Hayward Bldg., San Francisco, Cal.
57 Perin Bldg., Cincinnati, Ohio.
115-117 Cannon St., London, E. C. Eng.



BULLETIN No. 54 | BULLETIN No. 94 | BULLETIN No. 50 | BULLETIN No. 240 | BULLETIN No. 65 | BULLETIN No. 51 | BULLETIN No. 190

STANDARD UNDERGROUND CABLE CO.

Factories: PITTSBURGH, PA. PERTH AMBOY, N. J. OAKLAND, CAL.

WE MANUFACTURE AND SELL DIRECT

BARE COPPER WIRE AND CABLES,

Weatherproof Wire and Cables, Rubber Insulated Wire and Cables, Lead Covered Underground and Aerial Cables,

GALVANIZED STRAND, HANGERS, TERMINALS, ACCESSORIES.

WE HAVE COMPLETELY INSTALLED THE CABLE EQUIPMENT FOR TELEPHONE COMPANIES LARGE AND SMALL EVERYWHERE. ANY OF OUR OFFICES WILL GLADLY GIVE YOU INFORMATION AND PRICES. ADDRESS OUR NEAREST AGENT.

PITTSBURGH, PA., Westinghouse Building. NEW YORK, 56 Liberty St. BOSTON, 101 Milk St. PHILADELPHIA, Betz Building. CHICAGO, Rookery. SAN FRANCISCO, Mills Building.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Nungesser Elec. Battery Co.
Roche, Wm.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Cleaners.
Mechanical Boiler Cleaner Co.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Boxes.
Mountain State Elec. Co.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
Allen Co., L. B.
McLennan & Co., K.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Conduit Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Beardsley Gravity Dam & Construction Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Commercial Elec. Supply Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Hemingray Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Hemingray Glass Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Commercial Elec. Supply Co.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Heating Furnaces.
Chicago Flexible Shaft Co.

Magnet Wires.
(See Insulated Wires.)

Manufacturers' Agent.
Stanley, Arthur F.

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co., Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Post Hole Augers.
Iwan Bros.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Thompson, Son & Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Sockets & Receptacles.
Paiste Co., H. T.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
Cook, Frank B.
Guarantee Tel. & Equip. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Western Tel. Mfg. Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

SALES OFFICES

Room 85 Hartford Building, Chicago. 170 Broadway, New York.

YOU WILL SAVE MONEY

By investing in our line of

SECOND-HAND AND RECONSTRUCTED

Telephones, Switchboards and Appliances.

All Standard Makes Greatly Reduced Prices.

All apparatus thoroughly overhauled and placed in first-class operating condition.

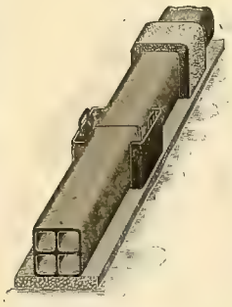
Exchange Owners requiring additional sections of switchboards will find it to their advantage to investigate our goods before purchasing new apparatus.

Guarantee Telephone & Equipment Co.,
71 W. Jackson Boulevard
CHICAGO, ILL.

J. O. THERIEN A. E. GREGORY C. F. WEISMANN

The Standard Conduit Co.

Manufacturers of



Mold Box Conduit Joint. Patented Feb. 26, 1901.

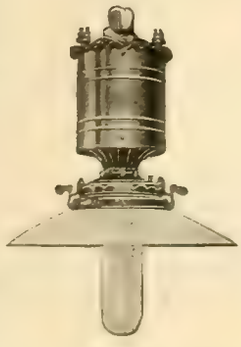
VITRIFIED CLAY CONDUIT

PROMPT SHIPMENTS.
Unequaled Shipping Facilities.

Also Patentees of the **"Mold Box Conduit Joint."** The only absolute water and gas proof joint on the market. Endorsed by the leading telephone and electric light companies. Furnished **FREE** to all purchasers of our conduit.

YOUR ORDERS SOLICITED.

General Office 525 Andrus Building,
MINNEAPOLIS, MINN.



Street and Factory Lighting

Series Enclosed Arc Lamps

FOR OPERATION ON

Direct or Alternating Current

INTERCHANGEABLE PARTS—DIRECT CARBON FEED.

Western Electric Company

Chicago. Saint Louis. Philadelphia. New York.

When Napoleon decided to advance on Russia, it was his intention to make a dash through Moscow to St. Petersburg and run the town wide open.

Now, everybody in Boston, and many people in Chicago, know that he didn't reach St. Petersburg, but went way back to the place he started from and there took a rest.

The trouble was the contract was faulty—the Russians hadn't signed it; and the only signature was that big Napoleonic "N." Very artistic, but inefficient. Since then the Russians have been called unfriendly, and so they are unless they need you.

So would you like to see a picture of the Factory that will build the big telephone plants for St. Petersburg and Odessa for the Russian Government?

THIS IS IT.

The newest of the five buildings of the Kellogg Telephone Plant.

The Largest, Most Modern and Best Equipped Independent Telephone Factory in the World.

The Kellogg Switchboard and Supply Company's factory is equipped to meet the heaviest demands for every detail of telephone and switchboard construction.—And is meeting them.

KELLOGG

SWITCHBOARD & SUPPLY CO. CHICAGO.

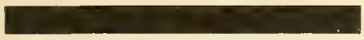
346 Broadway, New York. Electric Building, Cleveland. Keystone Telephone Building, Philadelphia.

GROWTH OF

Stromberg-Carlson Tel. Mfg. Co.,

Since 1895.

Represents [2] stenographers, number required in 1900 to handle correspondence.



Represents [17] stenographers, number required in 1902 to handle correspondence.

Represents [12], number of employes in 1895.

Represents [1595], number of employes in 1902.

Represents amount of business done in 1895.

Represents amount of business for 1902.

WHY ?

Such phenomenal Growth in this day of competition is the point that should interest prospective telephone buyers. It certainly couldn't have taken place had we furnished cheap and inefficient apparatus.

Its an easy question to answer.

The best apparatus and confidence of our customers. The word "best" is used carelessly in many advertisements; but there is no other way of saying "best" when we mean best.

FACTORIES at ROCHESTER, N. Y. and CHICAGO, ILL.

SALES DEPARTMENT—70 to 86 JACKSON BLVD., CHICAGO, ILL.

THE OKONITE COMPANY LTD.

253 BROADWAY, NEW YORK.

OKONITE INSULATED WIRES AND CABLES

Especially Adapted for Telephone Service

CANDEE PATENTED POTHEADS

Absolutely Watertight and Reliable

OKONITE AND MANSON TAPES

For Making Joints

THE STANDARD FOR RUBBER INSULATION.

$6.57

IS THE MONEY SAVED IN 100 DAYS BY A

NERNST LAMP

IN THE

COMPARISON between three 16 Candle-power Incandescents (48 C. P.) and one Single Glower Nernst 50 Candle-power Lamp, burning six hours per day, at 14 cents per 1000 watt hours——

EXAMPLE.

Three 16 Candle-power Incandescent Lamps = 165 watts x 6 hours, = 990 watt hours, at 14 cent rate	$0.13.96 cts. per day.
One 50 Candle-power Nernst Lamp = 88 watts x 6 hours, = 528 watt hours, at 14 cent rate	0.07.39 cts. per day.
Saving	$0.06.57 cts. per day.

THEREFORE, AS THE PRICE OF A ONE GLOWER NERNST LAMP FOR EITHER A 110 OR A 220-VOLT ALTERNATING CIRCUIT IS ONLY

$6.00

WE ASK YOU IF YOU ARE NOT STANDING IN YOUR OWN LIGHT BY NOT THOROUGHLY INVESTIGATING THIS SUBJECT. WE ARE HERE TO ASSIST YOU WITH THIS PROBLEM.

RENEWALS

- GLOWERS. — 25 cts. each; life as above. Allowance for burnt-out parts, 2 cts. each.
- HEATER TUBES. — 75 cts. each; life 2,500 hours. Allowance for burnt-out parts, 17 cts. each.

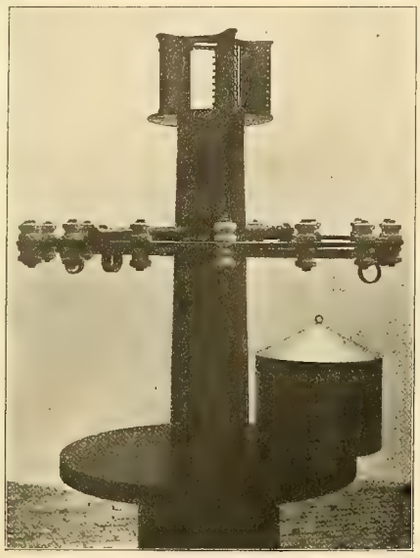
BIG STOCK ON HAND.

COMMERCIAL ELECTRICAL SUPPLY CO.,

1001 Market Street, ST. LOUIS, MO.

AGENTS FOR FOLLOWING STATES: Missouri, Iowa, Southern Illinois, Nebraska, Kansas, Arkansas, Texas, Louisiana, Mississippi, Tennessee, and the Territories.

For Underground and Aerial Cable Work



50 Pair Top Box
With Distributing Ring.

Use the HALL CABLE BOXES

The Neatest=The Most Convenient=The Most Substantial

Designed by FRANK B. HALL,

Used by

Home Telephone Co., Dayton, Ohio.
Federal Telephone Co., Pittsburg, Pa.
Standard Telephone Co., Waynesburg, Pa.
Belmont Telephone Co., (Four Exchanges) Bridgeport, Ohio.
Enterprise Telephone Co., New Martinsville, W. Va.
National Telephone Co., (Four Exchanges) Wheeling, W. Va.

Write us for ILLUSTRATED BOOK Showing Some Up-to-Date Cable Construction. With Descriptive Articles.

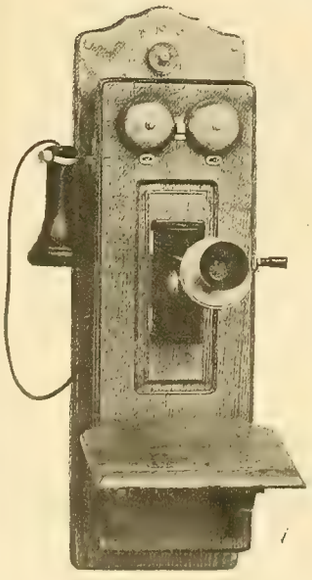
MANUFACTURED BY

THE MOUNTAIN STATE ELECTRICAL CO. WHEELING, WEST VIRGINIA.

Correspondence Solicited.

See Our ILLUSTRATED CATALOGUE For Special Hardware Designed for Cable Work.

TELEPHONES
THAT
CHALLENGE THE WORLD'S PAST CHAMPIONS
TO AN
"INTERNATIONAL" CONTEST.



TELEPHONES Central Energy Generator Call

That stand unequaled. Never fall down.

MULTIPLE TRUNKING SWITCHBOARDS

For any size exchange, where the best service is required.
Lamp Signal—Central Energy—Double Supervisory.

A FULL LINE OF APPARATUS

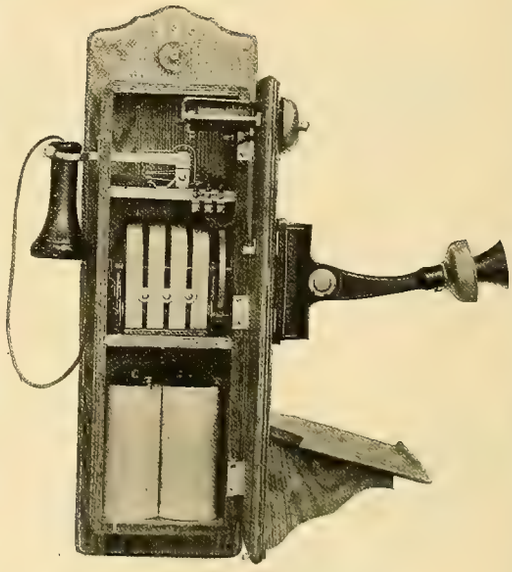
Embodying in the construction of the detail parts many

NEW FEATURES OF VITAL IMPORTANCE

To the efficiency and durability of a telephone plant.

Improvements Fully Protected by Patents Allowed.

CORRESPONDENCE SOLICITED.



INTERNATIONAL TELEPHONE M'F'G CO.,

Harrison and Clinton Streets. CHICAGO, U. S. A.

The Pioneer Western Telephone Construction Co.'s Business

Is Being Reorganized by the Best Talent Known to the Art of Telephony.

The Highest Mechanical Skill

AND **Most Scientific Electrical Engineering**

IS NOW BEING EMPLOYED TO **Create New Designs**

AND **Improve Upon Past Methods**

IT IS ANNOUNCED THAT THE

WESTERN TELEPHONE MFG. CO.

WILL MAKE ITS NAME A SYNONYM FOR

PERFECTION IN TELEPHONE APPARATUS

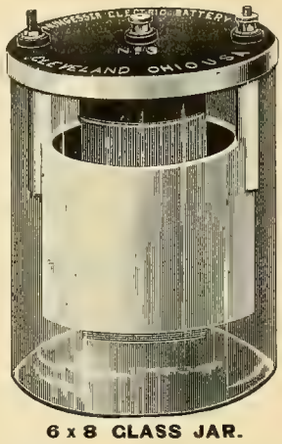
FACTORIES: Winthrop Harbor, Ill. **OFFICES:** Chicago, Ill.

NOTE: See our New Automatic Lamp Signal Clearing Out System!
The latest rapid improvement in the business!

THE NO. 3 NUNGESSER
CLOSED CIRCUIT BATTERY

GREAT REDUCTION IN THE COST OF BATTERY POWER IS EFFECTED BY THE USE OF THIS BATTERY.

33 per cent more Current than can be obtained from any other Battery of this type without any additional cost.



6 x 8 GLASS JAR.

Designed especially for Telephone Switchboard Service and Central Energy Systems, for which service it has no equal.

THOS. G. GRIER,
Western Manager,
128 West Jackson Boulevard,
CHICAGO, Ill.

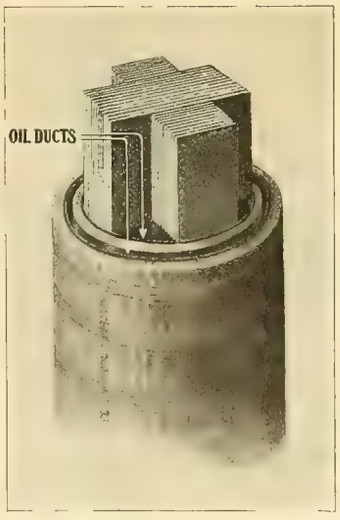
MANUFACTURED BY
THE NUNGESSER ELECTRIC BATTERY CO.
CLEVELAND - - - OHIO.

THIS BATTERY HAS A GUARANTEED CAPACITY OF 400 AMPERE HOURS. TEST THIS CELL IN YOUR SERVICE.

FOR SALE BY ALL FIRST-CLASS ELECTRICAL DEALERS AND TELEPHONE MANUFACTURERS.

GENERAL ELECTRIC COMPANY'S

TYPE "H" TRANSFORMERS—CORE TYPE.



Type "H" Transformers for high potentials, and of the largest sizes, are not only provided with ducts for circulation of cooling oil between the secondary winding and the core, but also between the secondary and primary windings, thus securing perfect insulation between primary and secondary and a low uniform temperature rise.

PRINCIPAL OFFICE: Schenectady, N. Y.

CHICAGO OFFICE, Monadnock Block. Sales Offices in all Large Cities.

The "Electra" Carbons are the recognized standard all the world over.

There are no Carbons better than the "Electra" and none "just as good."

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

New Standard Specialties.

DRY CELL.

If kept out of the sun, in a cool dry place, this cell will not run down on the shelf in two years, and at the end of that time will be as good as other makes fresh from the factory. To maintain its superiority to all others, no expense is spared, and only the best materials and chemicals are used in its manufacture.

This cell will save the consumer money, because a fewer number will perform a given amount of work four times as long as any other cell of equal size.

ELECTROMOTIVE FORCE, 1.52 VOLTS.
CURRENT, - 14 TO 18 AMPERES.

..CATALOGUE FOR THE ASKING..

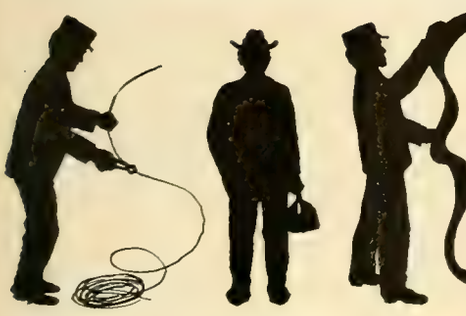
HOME SEARCHLIGHTS ALWAYS READY FOR INSTANT USE.

QUICK, SAFE, CHEAP.

By pushing button a steady, brilliant, strongly reflected electric light is obtained; illuminates the darkest corner instantly; handy at bedside, and in all cases of emergency. Takes the place of lamp or candle, without need of matches, or danger of fire. Will last for years. PRICE, PREPAID, $2.00. Extra batteries for recharging, 35c each. Send for booklet, with further information and illustrations of other electric household articles. Electric Cas Lighters, $1.50 each.

WM. ROCHE,

INVENTOR AND SOLE MANUFACTURER. 42 VESEY ST., NEW YORK, N.Y.



Only workmen of experience and proven ability are engaged in manufacturing our goods. When you buy, you get the best that money can buy and no trouble follows your bargain.

C & H RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

invite your investigation. Write to us for any desired information.

THE CUTLER-HAMMER MFG. CO.

AGENTS: Sturtevant Engineering Co. Ltd., London, Eng.
Edge & Edge, Sidney, Australia.
Kilbourne & Clark Co., Seattle, Wash.

MAIN OFFICES AND FACTORY—MILWAUKEE
BRANCH OFFICES—NEW YORK & CHICAGO

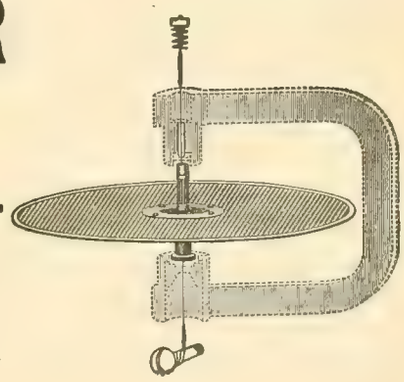
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,

GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. Los Angeles, Cal. Seattle, Wash.

EACO DRY BATTERIES

ARE UNIFORM AND OF LONG LIFE. THEY HAVE GREAT RECUPERATIVE POWER AND WILL STAND THE STRAIN.

ELECTRIC APPLIANCE COMPANY
ELECTRICAL SUPPLIES, CHICAGO.

A STOCK OF
EDISON MINIATURE LAMPS

Should be kept by every **Central Station** for rental to their customers. They popularize electric lighting and bring a profitable income from a small investment. Very desirable for **Christmas Tree** and **Holiday Decorations.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS ARC LAMPS

39 Cortlandt St. 19th & Allegheny Ave.

LONG LIFE

and a cheerful disposition are characteristics of
TOERRING ARC LAMPS
which will make all its users healthy, wealthy and wise.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

THE ROONEY-WESTBURY ELECTRIC LAMP COMPANY

154 E. 23d St., NEW YORK.

Manufacturers of all types of

MINIATURE AND CANDELABRA LAMPS
AND ACCESSORIES

PROMPT shipments in any quantities.
ACCURATE rating of all lamps.
PARTICULAR attention to specialties.

SEND FOR CATALOGUE

Showing New Ideas in Novelties and Decorative Work, also Xmas Tree Lighting from Circuit or Battery Outfit.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.
W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

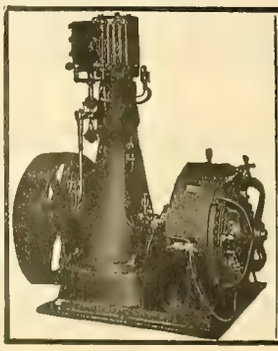
HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, 909-100 Washington Street. CHICAGO.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 5TH CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

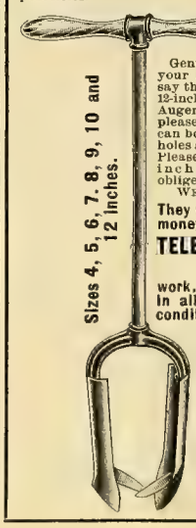


TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

Electric Heating Apparatus.

SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

IWAN'S PATENT IMPROVED
Post Hole AND Well Auger
THE BEST IN THE WORLD. The 10 and 12-inch are especially adapted for telephone and telegraph post holes.



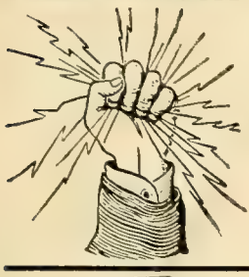
West Bend, Ia. June 19, 1902.
Gentlemen: — In reply to your letter of June 7th, will say that we have two of your 12-inch Patent Post Hole Augers, and we are well pleased with them. Two men can bore from 50 to 60 five-foot holes a day with each auger. Please ship us one more 12-inch auger at once, and oblige. Yours respectfully,
WEST BEND TELEPHONE CO.

They will save you time and money in your
TELEPHONE CONSTRUCTION
work, and give satisfaction in all kinds and under all conditions of soil.
For Sale by Hardware and Implement Jobbers and Dealers.
Write for prices and circular of our complete line of post hole augers and diggers.
Manufactured Exclusively by
IWAN BROS.
Box 105,
STRATOR, ILL.

FRANK N. PHILLIPS, President. C. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Sec

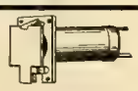
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.



THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

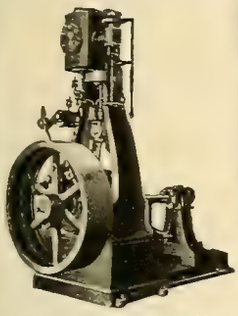
Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

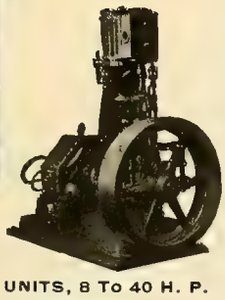
EVER SPILL YOUR ACID BOTTLE?
Full Size ALLEN Stick Free for Trial.

DODGE SUBSTITUTES (?) FOR THE ALLEN SOLDERING STICK MAKES SOLDER FLOW
WE PROTECT YOU
BY THIS on a pink Label
Beware of Imitations. L. B. Allen. None Genuine without Signature.
You Protect Yourself.

L. B. ALLEN CO., Inc. Sole Manufacturers, 1334 Columbia Ave. CHICAGO.



New York Safety Steam Power Company
60 SO. CANAL ST. CHICAGO



UNITS, 40 TO 125 H.P.
UNITS, 8 TO 40 H. P.

PISTON VALVE
CONTROLLED BY THE NICHOLS SHAFT GOVERNOR
SELF OILING

VERTICAL AUTOMATIC

15 N. SEVENTH ST. PHILADELPHIA.
NEW YORK: 113 LIBERTY ST.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents, 1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

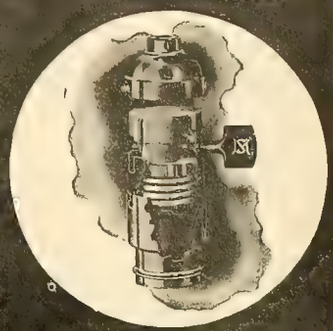
Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

"Things are not always what they seem"
—Phædrus

The M-S Key Socket for example, except for the finer finish of the shell, looks much like an ordinary product, but when you get beneath the "skin," the shrewd buyer will see the difference that comes of automatic production and exact steel gauges.

The porcelain body is as sharp and exact as a piece of tooled metal. The action shows the stuff the spring is made of. The copper screw shell makes a sure contact.

A sample shows other dividend paying qualities.



M.-S. KEY SOCKET.

MARSHALL-SANDERS COMPANY,
301 CONGRESS ST., - - - BOSTON MASS.,
MILLS BLDG., SAN FRANCISCO. STIMSON BLDG., LOS ANGELES.
STARR-BOYD BLDG., SEATTLE, WASH. MONADNOCK BLDG., CHICAGO.

THE CHICAGO DIE & ELECTRIC CO.
SOLE OWNERS OF THE MAXSTADT PATENT NO. 655,905.
We manufacture our joints under the patent we advertise.

PATENTED AUGUST 14, 1900, IN THE UNITED STATES AND FOREIGN COUNTRIES.

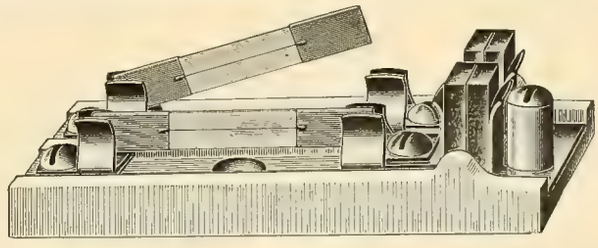
No. 882.

The illustration, No. 882, represents the Maxstadt patent improved American Joint, ready for use. Made in copper and tinned steel, for copper and galvanized iron wire. This joint is absolutely perfect and costs less money than any other joint on the market. Our Tinned Steel Joints are especially adapted for iron wire, and give entire satisfaction wherever used.

Prices and samples on application.

SOLE MANUFACTURERS OF THE
MAXSTADT PATENT IMPROVED FUSIBLE CUT-OUT CARBON LIGHTNING ARRESTERS.

No. 416 represents a full size Maxstadt Patent Improved Double Pole Porcelain Cut-Out and Carbon Lightning Arrester. The object of this Arrester is to economize space. Its compactness and efficiency has made it the most practical combination cut-out and lightning arrester on the market to-day, and it costs less money than any other arrester made.



Patented March 31, 1891. No. 416.

The above is one of the many different styles of Maxstadt Fuse Blocks we manufacture. We can also furnish fuses, paper sleeves, fuse wire and links.

Write for prices and samples.

Manufacturers of the Maxstadt Patent Improved American Joint:
CHICAGO DIE & ELECTRIC CO.,
87-91 W. LAKE STREET, CHICAGO, ILL.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent or manager of an electric-light or power plant on the Pacific coast by thoroughly experienced man. Have been in the business since 1880 and have owned own plant for 10 years; also experienced in electro deposition and electro chlorination, and own patents on the latter process. Address H. B. SLATER, care General Electric Co , Los Angeles, Cal.

POSITION WANTED.

By practical telephone construction man who has promoted and installed some of the best paying telephone plants in Wisconsin. He has been advised by his doctor to a change of climate and would represent some telephone manufacturing company on the road, or accept management of telephone plant in the South, or superintend construction of new plant. Address BOX 100, Mt. Horeb, Wis.

POSITION WANTED.

As electrician or engineer. Am capable of taking charge of A. C. or D. C.; can handle high speed or Corliss engines; can repair any kind of arc lamp, and rewind all coils of same; can do any kind of job of wiring; have had eleven years experience; best of references furnished. Address BOX 146, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

Young man of broad experience and ability energetic and ambitious, desires situation with electrical or telephone supply firm as sales manager, salesman or any position of responsibility. Good executive ability and thoroughly experienced in auditing, credits and correspondence. Have held position of general manager of corporation for several years. Address BOX 147, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Engineer to take charge of 1,000 H. P. electric plant, compound condensing engines. Write stating salary expected and give references. KEOKUK ELECTRIC RAILWAY & POWER COMPANY, Keokuk, Iowa.

FOR SALE.

One electric-light plant in town of 1,200 inhabitants. Everything in first-class condition and a good paying business. Plant only been in operation 2 years. All machinery new. Address BOX 343, Mt. Morris, Ill.

FOR SALE.

35 h. p. Gasoline Engine.

"Olds" 35 h. p. engine, been used about four months; in best running order: for sale at a bargain. Address at once THE MORSE CEDAR CO., Saginaw, Mich.

FOR SALE.

Two Royal Electric Company, Standard dynamos of 150 K. W. each. These machines are alternators, 133-cycle, new and of excellent design and make, connected for furnace work, but suitable for town lighting. Address D. M. HILLIS, 112 Hartford Building, Chicago.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work. Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., December 3, 1902. Sealed proposals will be received at this office until 2 o'clock P. M. on the 14th day of January, 1903, and then opened, for the installation of a conduit and electric wiring system for the U. S. Public Building at Helena, Montana, in accordance with the drawings and specifications, copies of which may be obtained at this office, or at the office of the Superintendent of Construction at Helena, Montana, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

Wanted Central Station Managers
And Users of Machinery
TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger, more improved or more modern.

We have the following Quick Shipment Bargains:—
1—20x18½ Harrisburg Ideal Engine,
1—16x16 Erie Ball Engine,
1—15x15 " " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine,
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps

A. G SCHOONMAKER CO.,
126 Liberty St., New York City, U. S. A.

SECOND-HAND
Dynamos and Motors.
We invite correspondence with those wishing to buy or sell.
SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

On receipt of
10 CENTS
.....We will send you a
Western Electrician Moonlight Schedule
FOR 1903.

Every Lighting man should have one.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Bldg., CHICAGO.

ENGINES.

3-18x30x16 Westinghouse.
2-13x24x18 Armington & Sims
2-15x23x17 Mc I. & Seymour.
1-16x27x16 Westinghouse.
1-8x14½x10½ Mc I. & Seymour
2-22x33 Buckeye (new).
1-18x42 Allis Corliss.
1-14x36 Hamilton Corliss.
1-15x15 Erie Ball.
2-13x12 Armington & Sims.
1-11x14 Straightline.
1-9x9 New York Safety.

BOILERS.

4-375 H. P. National watertube
2-136 H. P. Babcock & Wilcox.
1-250 H. P. Heine watertube.
2-114 H. P. Heine watertube.
2- 90 H. P. Horizontal tubular.
2- 60 H. P. Horizontal tubular.

110-VOLT DYNAMOS.

1-80 K. W. Thomson-Houston.
1-60 K. W. Westinghouse M. P.
2-60 K. W. Edison bi-polar.
1-55 K. W. Churchward M. P.
1-45 K. W. Edison bi-polar.
2-25 K W. Edison bi-polar.

DIRECT CONNECTED.

1-100 K. W. G. E. 250 volts, d. c. Mc Intosh & Seymour engine.
1-80 K. W. G. E. M. P. 115 volts, d. c. Russell 4-valve engine.
2-75 K. W. G. E. 125 volts, d. c. Ames tandem engines.
1-50 K W. Western Electric 110-volts, d. c. Ball & Wood engine
1-50 K. W. Walker 110-volts d. c. Russell engine (new).
1-43 K.W. Westinghouse 110-volts, d. c. Russell engine.
1-30 K W. C. & C. 110-volts, d. c. Atlas engine.
1-5 K.W. Perritt 110-volts, d. c. Sturtevant engine.

500 and 220 and 110-Volt Motors and Dynamos.

60 and 125 Cycle Alternators and Motors.

TRANSFORMERS,
ARC DYNAMOS,
ARC LAMPS.

THOMPSON SON & CO., 114 LIBERTY ST. NEW YORK.

MOTORS WANTED.
500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.
ROSE ELECTRIC CO., ST. LOUIS.

FOR SALE.—AMMETERS.
Old style Edison and U. S. Pattern.
$2 & $3 Each. Old Material and Machinery Purchased.
WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

60-K. W. EDISON, 500-VOLT.
For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.
ROSE ELECTRIC CO., ST. LOUIS.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.
Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

ENGINES.

34x60 International Power Corliss.
26x48 Dickson Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
13x18 Frost Center Crank Automatic.
11½x 14 Taylor-Beck Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

Ten 72x18 Horizontal Tubular, 125 pounds pressure.
One Geary Water Tube Boiler. 175 H. P. for 150 pounds pressure, almost new.
Two 150 Babcock & Wilcox Water Tube Boilers, 135 pounds pressure.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
200 H. P. Baragwanath Heater.
150 H. P. Kroeschell Heater.
500 H. P. Excelsior Heater.
6x4x6 and 5¼x3¼x5 Worthington Pumps, Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY, DAVENPORT, IA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE.
U.S. METAL POLISH GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric. A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.
375 H P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.
High sped automatics, from 250 H. P. down.
Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1,100-light, 60 K. W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric, 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

ALL Live men read the **WESTERN ELECTRICIAN** Each Week. Do You?

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUCHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

BOYCOTT

BOYCOTT

THE NEW
NET PRICE LIST
(Ready in a Few Days)
SPEAKS FOR ITSELF
SEND FOR IT.

We Manufacture a Large Percentage of the goods listed in our 600-page Catalog

We have sent the following Letter to the Local (Chicago) Members of the Electrical Supply Dealers' Association:

32 Courtlandt Street, NEW YORK. 188 Fifth Avenue, CHICAGO, ILL.

Office of

The Manhattan Electrical Supply Co.

CHICAGO, Dec. 4, 1902.

Gentlemen:—It is apparent that a well defined and systematic boycott against this Company exists among the local members of the Supply Dealers' Association; aided by some of the manufacturers. Against this we desire to protest. We believe it to be unjust, uncalled for and unbusiness like and calculated to force us to retaliatory measures.

We, therefore, desire to inform you that we cannot continue to work in harmony with you, in the matter of re-sale prices or Association rules, as to quantities or deliveries.

Respectfully.

MANHATTAN ELECTRICAL SUPPLY CO.

EVERYTHING IN TELEPHONES.

AMERICAN BEAUTY.

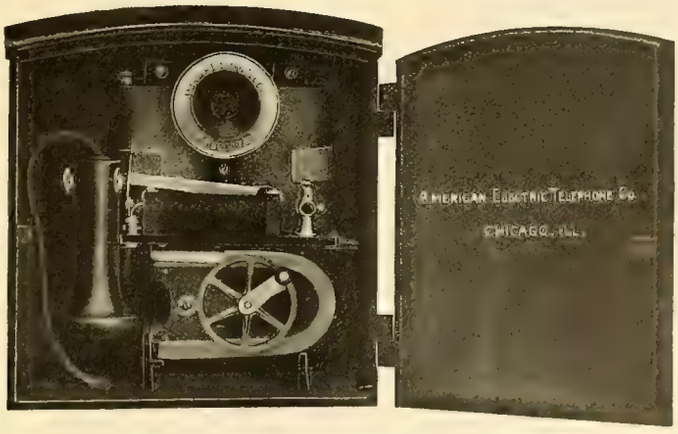
EVERYTHING IN SUPPLIES.

WITHOUT A PEER.

INDEPENDENT TELEPHONE

FINISHED PRODUCT GUARANTEED.

ENORMOUS OUTPUT.



TRACTION, MINE OR FIRE ALARM FOR OUTSIDE USE.

PRICES THAT ARE RIGHT.

COMPLETE STOCK.

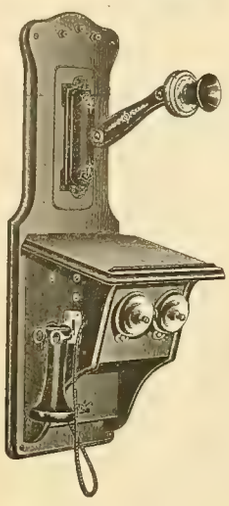
American Electric Telephone Company,

AMERICAN BUILDING, STATION U.

No. 25. Bell Style.

CHICAGO, ILLINOIS, U. S. A.

AS USUAL



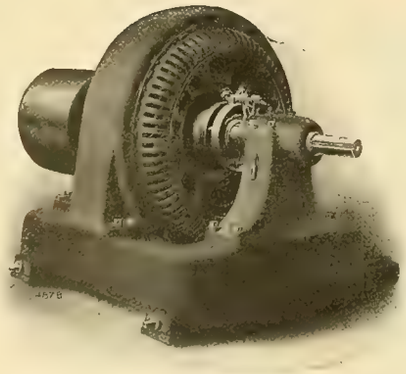
Sterling Electric Co. Led the Procession at the Convention.

IF YOU DIDN'T ATTEND SEND FOR CATALOGUES AND SOUVENIRS.

STERLING ELECTRIC CO.

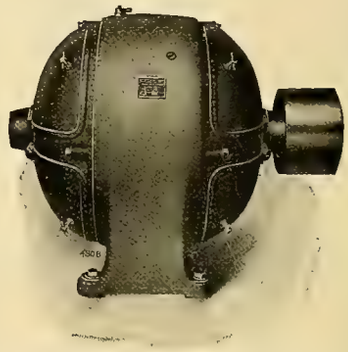
LAFAYETTE, - IND.

"Ceco." Electrical Machinery.



250 K. W. 3-Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.



Direct-Current Enclosed "Ceco" Motor.

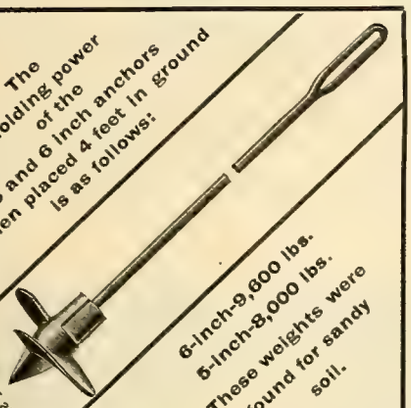
"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

STOMBAUCH GUY ANCHORS HGUABMOTS GUY

The holding power of the 5 and 6 inch anchors when placed 4 feet in ground is as follows:



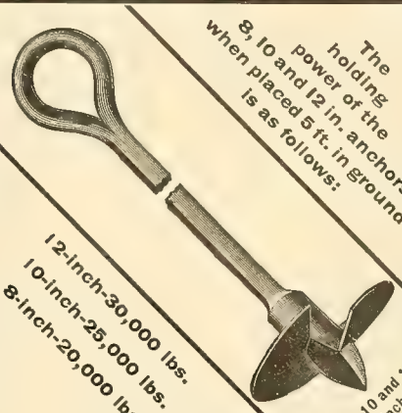
6-inch-9,600 lbs.
5-inch-8,000 lbs.
These weights were found for sandy soil.

3½, 5 and 6 inch.

THIS IS THE WRENCH
that must be used to install the
3½, 5 and 6 inch anchors.

W. N. MATTHEWS & BRO.,
DISTRIBUTERS,
603 Carleton Bldg., - - ST. LOUIS.

The holding power of the 8, 10 and 12 in. anchors when placed 5 ft. in ground is as follows:



12-inch-30,000 lbs.
10-inch-25,000 lbs.
8-inch-20,000 lbs.

8, 10 and 12 inch.

Where are you going my pretty maid?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

WHY?

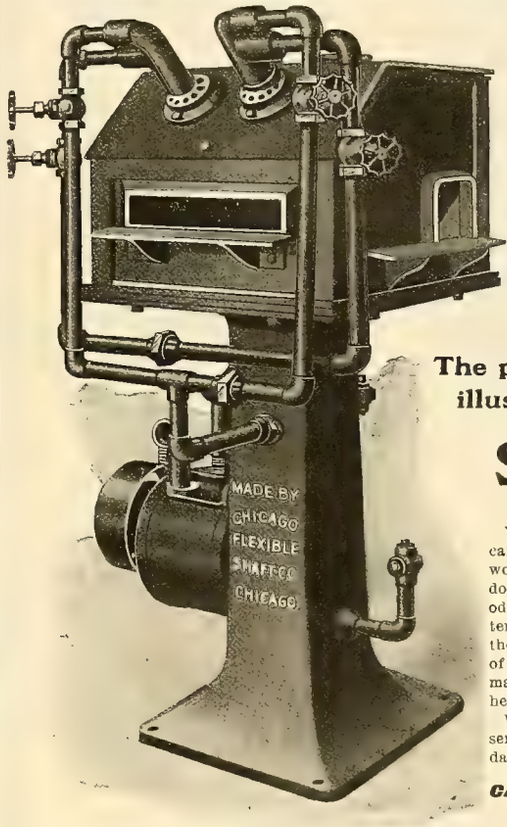
Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,
130 La Salle Ave., Chicago, Ill.

HEAT YOUR MAGNETS RIGHT.



ONE THOUSAND MAGNETS

10x½x¾ can be heated for hardening in this furnace in ten hours; every one perfect.—Thousands of magnets are ruined by the old method.

The price of furnace illustrated here is

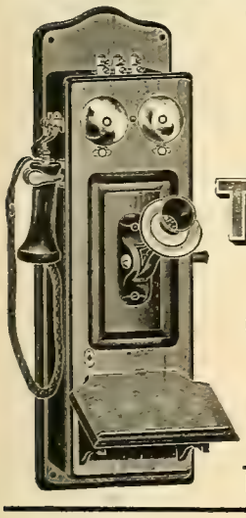
$100.

You take no chances, you cannot go wrong, you do more work in one day than can be done in three by the old method. If your magnets are not tempered right don't blame the steel man, it's the fault of the heating. Thousands of magnets are ruined by being heated in the open fire.

We make several sizes, and send our furnaces on thirty days' trial.

CATALOGUE FOR THE ASKING.

Chicago Flexible Shaft Co.,
Cor. La Salle Ave. and Ontario St., CHICAGO, ILL.



WE ALSO MAKE

FIRST-CLASS

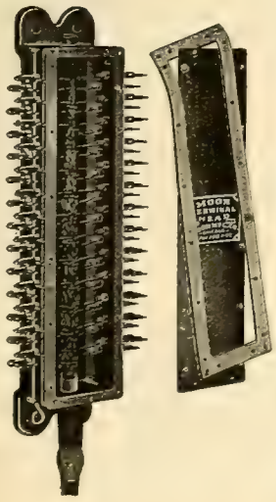
BRIDGING AND SERIES TELEPHONES

COMBINING

QUALITY AND SIMPLICITY.

WRITE US AND WE WILL TELL YOU ALL ABOUT IT.

THE U. S. ELECTRIC MFG. CO., - Butler, Pa



THE MOON TERMINAL HEAD FOR TELEPHONE CABLES,

AFFORDS COMPLETE PROTECTION.

THIS STATEMENT IS SUSTAINED BY ITS RECORD.

250,000 Line Wires Protected. **No Recorded Loss** From Moisture or High Potential Currents.

We desire to figure with you on the Cable Protection you will require. The reputation of this apparatus should secure your careful consideration. We furnish the Moon Fuse Pole Terminal with fuses and Metal Outer Case or Storm Box complete; or Terminals either with or without Fuse protection, as required, for the Exchange end of the Cable. They are simple in construction, easy to install and most economical to maintain.

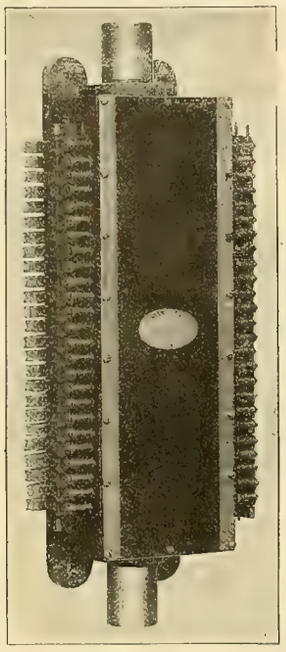
We are pleased to answer any questions regarding this equipment, and to furnish you with catalogue and price list.

MOON MFG. CO., **43-49 SO. CANAL STREET, CHICAGO.**

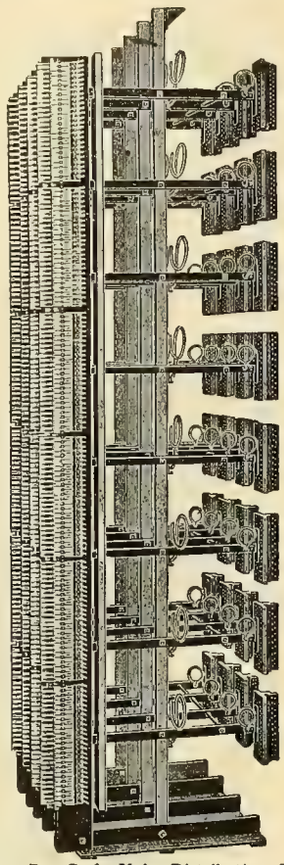
Cook Protectors STANDARD

All Apparatus broadly covered by United States Letters Patent.

Don't buy trouble. There is enough without buying more.



Type J.—Cook Combined Cable Terminal and Protectors, with heat coil and carbon plate arrester for strong and sneak current. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902. All sizes, 25 to 200 pairs.

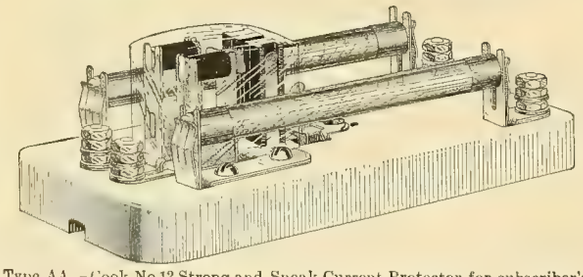


Type L.—Cook Main Distributing Iron Frame with Strong and Sneak Current Protectors. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902. Other patents pending. All sizes. Any capacity.

IMPORTANT.

Absolute Protection Guaranteed both as to Foreign currents and liability to patent infringement.

No exchange equipment modern and up-to-date without this line of apparatus.



Type AA.—Cook No 12 Strong and Sneak Current Protector for subscriber's station, with carbon plate, heat coil and tubular line fuse. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Oct. 21, 1902. Other patents pending.

FRANK B. COOK,

MANUFACTURER OF

Combined Cable Terminals and Protectors, Lock-nut Cable Terminals, Pole Top Cable Terminals, Guy Clamps, Cable Hangers, Lightning Arresters, Strong Current Protectors, Sneak Current Protectors, Heat Coils, Line Fuses, Copper Test Connectors, Terminal Strips, Distributing Boards, Main or Intermediate.

Any Combinations of above mounted on Iron or Wood.

240-244 West Lake Street, CHICAGO, U. S. A.

TELEPHONE MONROE 1117.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.

IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.

(SOLE MANUFACTURERS.)

BOSTON, MASS.

THOS. G. GRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.

WESTERN REPRESENTATIVE.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

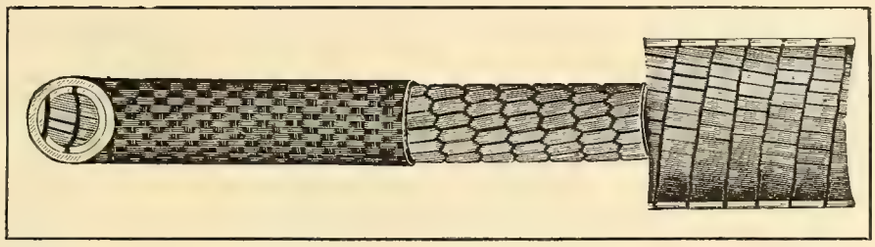
ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

FLEXDUCT

For Interior Wiring
The Superior Product

The interior of "Flexduct" remains intact under all circumstances because it is an inseparable part of the conduit.



Here are some of the advantages of "Flexduct."

The interior cannot be ripped out, because it is an inseparable part of the conduit—no possibility of ripping out the inside when installing wires too large for the conduit or when fishing wires through it.

With part of the interior of a conduit gone, and the insulating properties seriously impaired, the installation cannot possibly meet the requirements of first-class work.

When "Flexduct" is used, every foot is absolutely intact and uninjured.

"Flexduct" is positively moisture-proof—made so by closely weaving together a special fibre with a special warp and by treating the conduit with a special compound to fill up the pores.

Send for booklet—also a sample of "Flexduct," and carefully examine its smooth interior; its longitudinal interweaving; test its strength, and satisfy yourself that "Flexduct" is the best flexible conduit that has ever been manufactured for interior wiring.

Osburn Flexible Conduit Co.,

General Sales Offices, 21 Park Row, New York City.

Copyright, 1902 by C. & A. R'y.

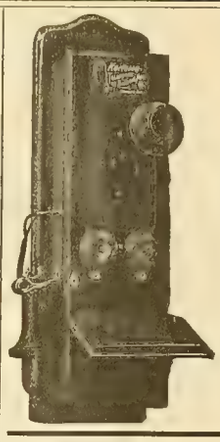
ART CALENDAR

Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.



KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. MCCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

A LONG-FELT WANT.

THE HANDY ELECTRICAL DICTIONARY

BY W. L. WEBER, M. E.

225 PAGES, SIZE 2½ x 6 INCHES.

Price: { Cloth Binding, - - - - 25c.
Flexible Leather Binding, 50c.

This is a practical book in a convenient vest pocket size; alike suitable for workman, student or anyone employed or interested in the electrical science. It contains clear, concise definitions of every used electrical term or phrase and is sold at a price within the reach of all.

Promptly Mailed on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of **Slates for Electrical Purposes**

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

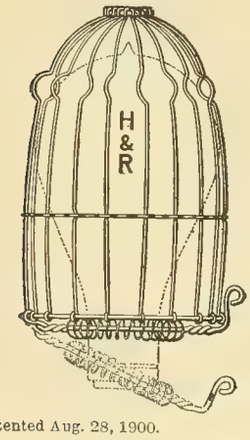
METROPOLITAN TELEPHONE & ELECTRIC CO.,

610 WILSON AVE., CHICAGO, ILL.

"NEVER BREAK"

ELECTRIC LIGHT GUARD.

SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely.

Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,

WORCESTER, MASS.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

TO THE GREAT NORTHWEST

The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.

JAS. C. POND,

Gen'l Pass. Agent, Milwaukee, Wis.

ELECTRICAL BOOKS

FOR THE

HOLIDAYS

WE CARRY THE MOST COMPLETE STOCK

SEND FOR CATALOGUE

Electrician Publishing Co.

510 Marquette Building, CHICAGO.

Bug-Proof Bell. Segerdahl Patent.

Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO.,

87-89 W. Van Buren Street, Chicago, Ill.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

NAME PLATES

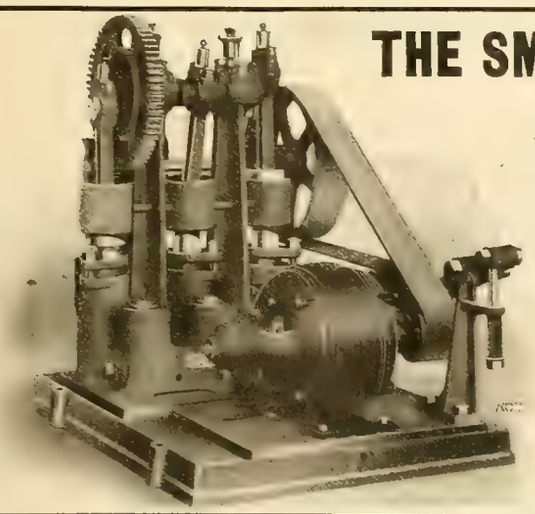
FOR MACHINERY.

We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.

No Plate Too Large or Too Small.

MURDOCK PARLOR GRATE CO.,

161 Boylston St., Boston, Mass., U. S. A.



THE SMITH-VAILE ELECTRIC TRIPLEX PUMPS

afford an excellent means for pumping water for House service, Hydraulic Elevator service Factories and Mills desiring an independent water supply, also for Mine Work and : : :

WATER WORKS SUPPLY.

Can be located wherever electric current is available, and require little or no attention after once installed. We make steam and power : : : : : : : : : : : : : : : : :

PUMPING MACHINERY FOR ALL PURPOSES.

Jet and Surface CONDENSERS, Feed Water Heaters and Victor Turbine Water Wheels

THE STILWELL-BIERCE & SMITH-VAILE CO.,

DAYTON, OHIO, U. S. A.

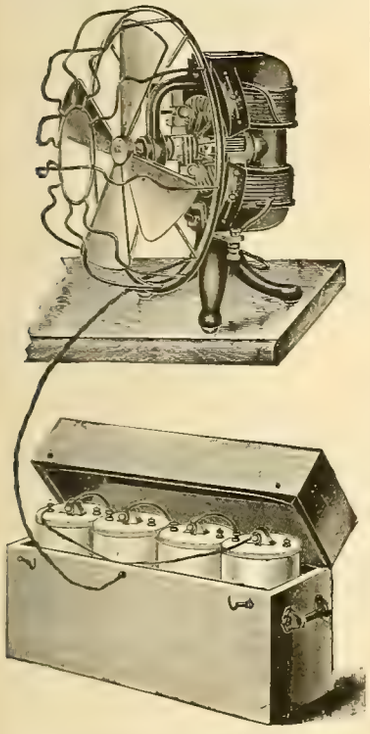
New York: 141 Broadway. Chicago: 311 Dearborn St. Boston: 73 Oliver St.
Philadelphia: 612 Arch St. Cleveland: 1116 New England Bldg. Baltimore: 1107 Continental Trust Bldg.
New Orleans: 304 Hennen Bldg.

Sales Agents: FREDERIC NELL, 97 Queen Victoria St., London, Eng. E. F. AUSTIN, Smith Blk., Pittsburg.

EDISON

BATTERY FAN OUTFITS ...WITH... EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.

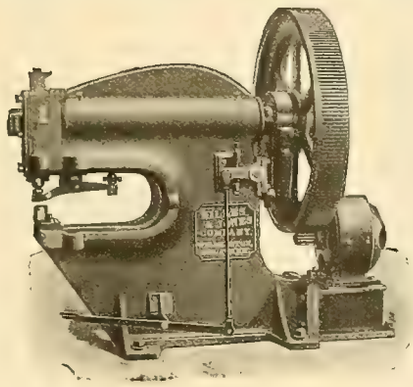


Write for Catalogue No. 4.

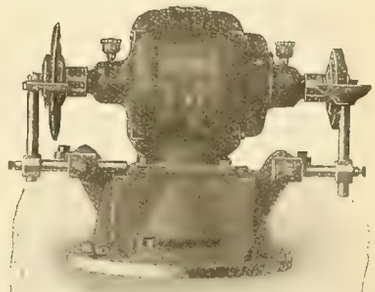
EDISON MFG. CO.,

FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.

CROCKER-WHEELER COMPANY AMPERE, N.J. U.S.A.



A wide experience in the attachment of motors to all sorts of machine tools, qualifies us to bid on your requirements.



WATSON

MOTOR BENCH GRINDER.

A PORTABLE DUST-PROOF ELECTRIC GRINDER. A BENCH TOOL WHICH EVERY MACHINE SHOP IN THE COUNTRY SHOULD BE EQUIPPED WITH. A TIME SAVER AND A MONEY MAKER YOU CANNOT AFFORD TO BE WITHOUT. ASK WHY? BUILT FOR 110 AND 220 VOLTS.

THE MECHANICAL APPLIANCE COMPANY,

MILWAUKEE.

Ask for Bulletin No. 55.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

Sales Office, 15 Cortlandt St., New York.

YONKERS, N. Y.

(10923)

POWER INCREASED

AND BOILERS PROTECTED
BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS.
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

CARBONS and lamp filaments baked with Dixon's No. 1365 Graphite do not lose their carbon. Furnished in any degree of fineness. Ask for booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

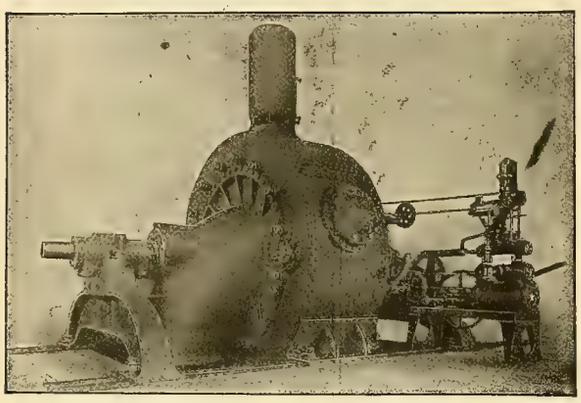
MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.

GARRIGUS MECHANICAL BOILER CLEANER
THE ONLY KNOWN METHOD OF KEEPING BOILERS CLEAN AND FREE OF SCALE.
INSTALLED OUR EXPENSE ON 60 DAYS TRIAL
MECHANICAL BOILER CLEANER CO.
W. R. MASON MANAGER. 413 WESTERN UNION BUILDING. CHICAGO.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.

J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President,
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Asst. Secretary.



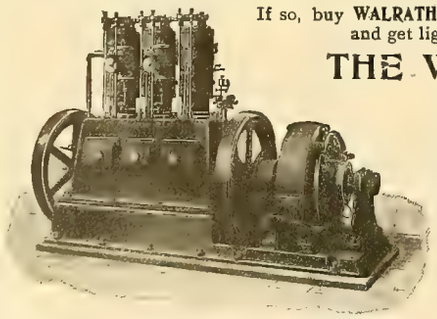
SAMSON TURBINE
UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.
Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.
We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.
WRITE DEPT. "D" FOR CATALOG.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

GASOLINE MOTORS
—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

MORSE AUTOMATIC LAMP ADJUSTER
For Mills, Factories and Offices
Incandescent Electric Light Manipulator Company,
116 Bedford Street, Boston, Mass.

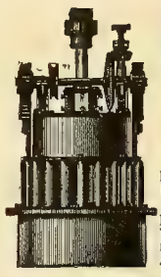
NEW CATALOGUE ELEVATING = CONVEYING MACHINERY
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.
THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.
MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.

AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.
Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.
Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.
S. MORGAN SMITH CO., York, Pa.

REG. TRADE MARKS
Phosphor Bronze DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
—DELTA METAL—
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

FIBRE-GRAPHITE COMMUTATOR BRUSH
SELF-LUBRICATING NOISELESS

There's No Friction
with the Fibre-Graphite Commutator Brush.
Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

Kilfyre DRY POWDER COMPOUND

IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

RENEWALS

December is an important month for the renewal of subscriptions. If your subscription is expiring this month, or even if it is expiring in January, it is to your interest to send in your renewal now so that the subscription may be extended on our books in plenty of time to prevent your missing any copies.

To make a Christmas gift of the WESTERN ELECTRICIAN send us the name and address of the person to whom you wish to give the subscription, with the annual subscription price of $3, and the paper will be sent regularly for 52 weeks.

With January 1st will begin the thirty-second volume of the WESTERN ELECTRICIAN, and during 1903 it will complete its sixteenth and the first half of its seventeenth year, the paper having been founded July 2, 1887, and continued under the present management for this entire period. We offer the past as a guaranty of the future, and in addition pledge the best efforts of an experienced and competent staff to the constant improvement of the paper.

The WESTERN ELECTRICIAN is published for the purpose of assisting everyone interested in the art. It is a general electrical and scientific paper, and gives to its readers all the latest news and keeps them thoroughly informed of everything that is going on in all the different departments of the electrical and allied fields. Its technical and scientific articles cover all the latest inventions and improvements and keep the reader thoroughly informed of all that is new in the art. Its special articles, written by the most prominent authorities, as well as its general articles, are of the highest order, and no interested person can afford to be without the paper.

SUBSCRIPTION PRICE PER YEAR

Of Fifty-two Numbers

IN THE

United States $3.00
Foreign Countries 5.00

SAMPLE COPY FREE.

Electrician Publishing Company, SUITE 510, MARQUETTE BUILDING,

CHICAGO, U. S. A.

BOOKS

Make your friend or yourself a Christmas present of an electrical book chosen from the following list which we recommend:

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Trevert's Electrical Measurements for Amateurs, cloth binding	1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	$1.25
Allsop's Bell Construction, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

Any of the above books sent prepaid on receipt of price. Write for free book catalogue.

ELECTRICIAN PUBLISHING CO.,

SUITE 510, MARQUETTE BLDG.,

CHICAGO.

S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO.

FLORIDA HEART PINE

This is what our Crossarms are to be made of. Our new plant at **Brooksville, Florida,** will be ready January 1st, 1903. It will have a capacity of three carloads of arms per day.

THE STANDARD POLE & TIE CO.

44 Broad Street, New York.

Branch Offices, Wilmington, N. C.; Brooksville, Fla.

S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO. — S P & T CO.

M. KLEIN & SON

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

Send list of requirements for quotations to

W. H. ANDERSON & SONS,

ST. AUBIN AVE., DETROIT,

Manufacturers Tools and Iron Work for Telephone and Railway Construction.

IT'LL PAY YOU WELL.

Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

THE COMING

NEW YEAR'S ISSUE

OF THE

Western Electrician

will be of exceptional interest and value to every electrical worker. As in previous New Years Numbers the carefully prepared statistics of electrical manufactures in the United States for the year 1902 will be a noteworthy feature of this number. To illustrate the correctness of the Western Electrician's estimates, it may be observed that the figures published in our New Year's issue of January 5, 1901, agreed substantially with the Government census statistics made public last August. This important issue will be an exceptionally choice one for advertisers. An attractive announcement would enable you to place the merits of your product before nearly every prospective buyer. To obtain a choice location and a striking advertisement we would urge you to send in your copy at the earliest possible moment.

WESTERN ELECTRICIAN, - 510 Marquette Bldg., CHICAGO.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

MAYBE YOU DIDN'T GET

Maltby's Pole Prices

at the convention. Maybe you didn't go. Anyway, if you are buying without them, it's your loss as well as ours. Don't let it occur again, will you?

We are cedar tie men also, and make the same attractive prices on both the "steam" and "trolley" sizes for either early or immediate shipment.

TAKE OUT YOUR PENCIL AND WRITE AS FOLLOWS:

MALTBY LUMBER COMPANY,
BAY CITY, MICHIGAN.

POLES TIES.

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

Western Cedar Poles.

LOW PRICES.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

CEDAR POLES STREET RY. TIES PERRIZO STOLES DAGGETT MICH.

THE SEASON IS GETTING LATE

AND IF YOU REQUIRE

CEDAR OR CHESTNUT POLES

For Fall construction work, we can supply you on short notice.
WRITE US FOR PRICES.

THE MORSE CEDAR CO., "Producers," Saginaw, Mich

WHITE CEDAR POLES.

HALL L. BROOKS,
TOMAHAWK, WIS.
Prompt Shipments from Large Stock.

POLES, TIES, POSTS.

THE PORTER CEDAR CO.,
SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

John H. Fowler CEDAR POLES POSTS, SHINGLES & TIES 1705 FISHER BLDG. CHICAGO.

IDAHO, WISCONSIN, MICHIGAN . . . . . **CEDAR POLES** FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT, TROLLEY.

POSTS, POLES, TIES AND EVERYTHING IN WHITE CEDAR

YARDS IN IDAHO AND AT WASHBURN, PLUMMER AND BRULE, WISCONSIN.

JOHN. H. FOWLER — GENERAL OFFICE: 1705 FISHER BLDG., CHICAGO. Branch Offices: Washburn, Wisconsin, and Spokane, Washington. — FOWLER-JACOBS CO.

FOWLER-JACOBS TIES POSTS POLES PILING COMPANY

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.
D. M. FULMER LUMBER CO., Florence, Wis.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.
A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

CEDAR POLES.

From 16 Feet to 70 Feet.
SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,
MARINETTE, WIS.,
Producers and Wholesalers of White Cedar Products.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

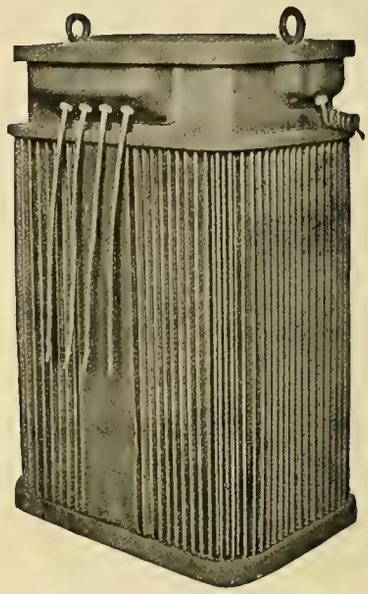
Large Stock Constantly on Hand

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES

THE VALENTINE-CLARK CO.,
— 234 LA SALLE ST, CHICAGO
YARDS: ANCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

Westinghouse Transformers



Westinghouse 50 K. W., O. D. Transformer.

The larger sizes of Westinghouse Type N. and O. D. Transformers have corrugated cases, exceedingly light in weight and approximately 2½ times as large in radiating surface as a plain case of the same dimensions. Their value in maintaining low-running temperature is obvious.

WRITE FOR ILLUSTRATED TRANSFORMER BOOKLET.

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities.

PITTSBURG, PA.

Nernst Lamps

EASILY RENEWED

REDUCE COST OF LIGHT ONE HALF

NO SHADOWS CAST

SOFT WHITE LIGHT

THE SAME AS DAYLIGHT

LOW MAINTENANCE COST

ALWAYS RELIABLE

MORE LIGHT FOR LESS MONEY

PERFECT DISTRIBUTION OF LIGHT.

SUPERIOR QUALITY OF LIGHT

WRITE FOR ILLUSTRATED BOOKLET No. 6.

Nernst Lamp Co.

Sales Offices: Pittsburgh, Pa.; New York, 120 Broadway; Boston, 131 State Street; Philadelphia, 710 Girard Trust Building.

Or address any Supply Dealer.

DUNCAN
Integrating Wattmeter

FOR DIRECT AND ALTERNATING CURRENTS.

BUILT STRICTLY IN ACCORDANCE WITH PRESENT DAY REQUIREMENTS.

JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS

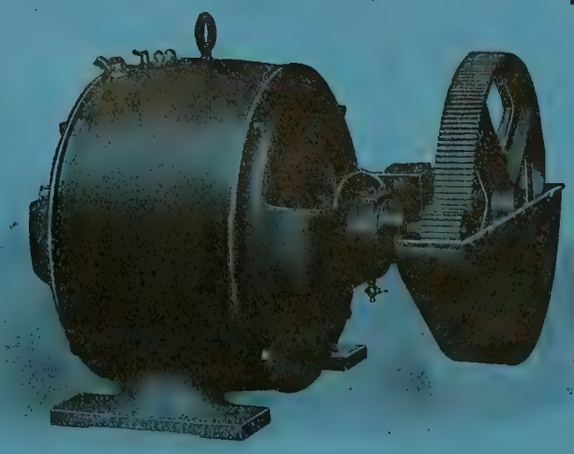
WRITE FOR PRICES

DUNCAN ELECTRIC MFG. CO.
MANUFACTURERS OF ELECTRICITY METERS
LAFAYETTE, IND.

AGENTS:
Goltz Engineering Co., 1504 Monadnock Bldg., Chicago.
C. H. Norwood, 1503 Fisher Bldg., Chicago.
Safety Electric Mfg. Co., 303 Magazine St., New Orleans.

Back Geared
TYPE E
MOTORS

For Direct-Current Circuits.



Where high torque and low speed are necessary, these motors are suitable for all conditions of operation. They give perfect satisfaction, running upside-down or right-side-up, enclosed, open or protected.

BULLETIN No. 1036

Fort Wayne Electric Works
MAIN OFFICE and FACTORY
FORT WAYNE - - INDIANA

[illegible]

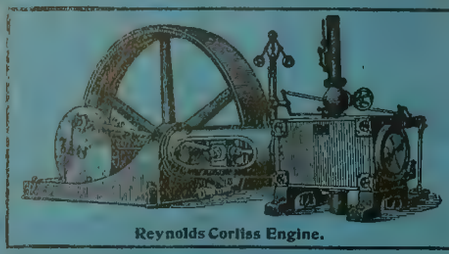
PROTECTION.

A GOOD INVESTMENT.

A Lamp Guard firmly fastened to socket protects completely.

THE P. R. WAGOR MFG. CO.,
SPRINGFIELD, MASS.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

MACHINE SCREWS SET SCREWS and CAP SCREWS in stock.

CHARLES H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
1012 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE

THE STURTEVANT FORGES

B. F. STURTEVANT COMPANY
BOSTON, MASS.
NEW YORK
PHILADELPHIA
CHICAGO
LONDON

253

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

HAZARD MANUFACTURING CO.

HIGH-GRADE RUBBER-COVERED, WEATHERPROOF WIRES AND CABLES

MAGNET, OFFICE, ANNUNCIATOR WIRE.

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa.
NEW YORK OFFICE, 50 Dey St.
CHICAGO OFFICE, 1201-2 Marquette Bldg.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK.

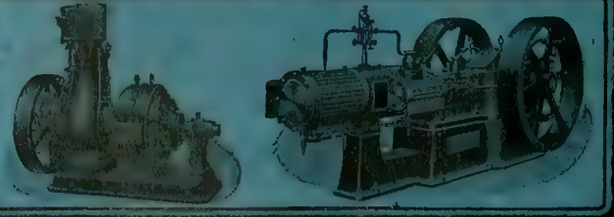
Special Prize Gold Medal at Atlanta, 1895.

[illegible] ARE ON SALE IN EVERY LEADING HARDWARE [illegible] IN THE UNITED STATES AND CANADA.

H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES

SIMPLE COMPOUND
FOR ELECTRIC LIGHT AND POWER SERVICE
VERTICAL HORIZONTAL
SEE NEW CATALOGUE



BUFFALO FORGE COMPANY
BUFFALO, N.Y.
NEW YORK PHILADELPHIA CHICAGO PITTSBURG

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 20, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 25.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 2137 Monadnock Block, CHICAGO.

The Simplex Electrical Co., 78-81 Cornhill, BOSTON, MASS.

AN IMPORTANT POINT.
HEADQUARTERS FOR
ELECTRIC LIGHT LINE WIRE.
Chicago Insulated Wire Co.

OKONITE
TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

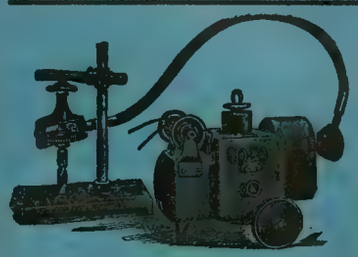
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

THE BEST VERMONT SLATE FOR Electrical Purposes.

It Pays to Get the Best from
EDWARD BONVILLE
P. O. Lock Box 24, FAIR HAVEN, VERMONT.
Manufacturer of all kinds of Slates for Electrical Purposes
All Sizes of Slate Switchboards.
Best Black Enameled and Marbleized Finishes in Vermont.

PARANITE

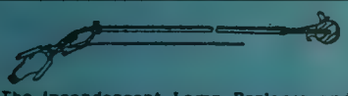
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.



ESTABLISHED 1870.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR.
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 65 Queen Victoria Street, London, England.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 50 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg Co. Troy, Ohio



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

For Porcelain or Clay Insulating Specialties, such as Bushings, Knobs or Cleats, Address,
THE AKRON SMOKING PIPE CO.,
MOGADORE, OHIO

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book,
"Can I Become an Electrical Engineer."
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute,
Dept. K. 240-242 W. 23d St., New York.

LIGHT
If you want light to see objects below the lamp
USE SHELBY LAMPS.
16 C. P. Horizontal are 14 C. P. Vertical. Other makes are 7 C. P. Vertical.
THE COIL DOES IT—IT'S FLATTENED.

LIFE
The Longest Life at Best Efficiency.
SHELBY USEFUL LIGHT LAMPS.
Pat. Oct. 20, 1900.
A TRIAL WILL PROVE OUR CLAIMS.
THE SHELBY ELECTRIC CO., SHELBY, O.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters,
Ground Detectors and Circuit Testers,
Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Bil-Ammeter.

Our portable instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.

Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., No. 101 St. Martins Lane.

Mention the WESTERN ELECTRICIAN when writing for catalogues.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 25 Colmore Row, Birmingham, England.

THE P-K ROSETTE
is smooth and don't hold dust so looks neat for years. Isn't that worth a good bit?
Just specify "P-K."
H. T. PAIste CO.,
Chicago - Philadelphia - New York

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street - - - - New York

THE COMING

NEW YEAR'S ISSUE

OF THE

Western Electrician

will be of exceptional interest and value to every electrical worker. As in previous New Years Numbers the carefully prepared statistics of electrical manufactures in the United States for the year 1902 will be a noteworthy feature of this number. To illustrate the correctness of the Western Electrician's estimates, it may be observed that the figures published in our New Year's issue of January 5, 1901, agreed substantially with the Government census statistics made public last August. This important issue will be an exceptionally choice one for advertisers. An attractive announcement would enable you to place the merits of your product before nearly every prospective buyer. To obtain a choice location and a striking advertisement we would urge you to send in your copy at the earliest possible moment.

WESTERN ELECTRICIAN, - 510 Marquette Bldg., CHICAGO.

Type C indicating fuse before blowing.

D. & W.

Type C indicating fuse after blowing.

BULL'S-EYE INDICATOR

An absolutely FLASHLESS device indicating the blown fuse instantly.

Watch the "TARGET" on the label of the fuse.

D. & W. FUSE COMPANY, PROVIDENCE, R. I.

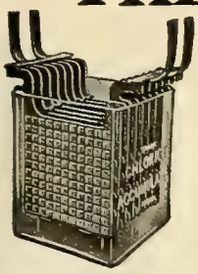
A. HALL BERRY, New York Representative, 100 Williams Street.

OFFICES

BOSTON: [illegible] | NEW YORK: Western Electric Co. | PHILADELPHIA: Western Electric Co. | CHICAGO: Central Electric Co. | ST. LOUIS: Western Electric Co. | SAN FRANCISCO: California Electrical Works.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.



MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

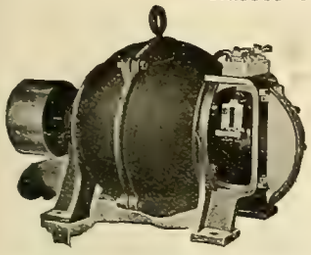
PHILADELPHIA, Allegheny Ave. and 19th St. | BOSTON, 60 State Street. | BALTIMORE, Continental Trust Building. | DETROIT, Michigan Electric Company.
ST. LOUIS, Wainright Building. | NEW YORK, 100 Broadway. | CHICAGO, Marquette Building. | CLEVELAND, New England Building. | SAN FRANCISCO, Nevada Block. | HAVANA, CUBA, F. G. Greenwood, Mgr., 34 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

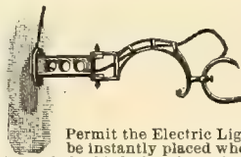
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



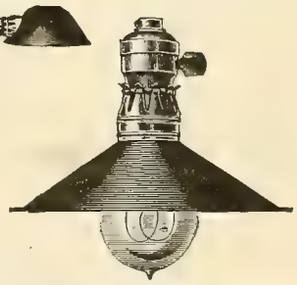
GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



FARIES ADJUSTABLE LAMP HOLDERS

Permit the Electric Light to be instantly placed where it is needed. Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.



WE MANUFACTURE:
Portables, Chandeliers, Brackets, Desk Lamps, Clusters, Canopies and All Sizes and Styles of Shades and Reflectors.

Goods carried by all principal jobbers. | Send for Catalogue No. 10, just issued.

FARIES MFG. CO., DECATUR ILL.

Western Manufacturers' Agent.

REPRESENTING:
THE ROBBINS & MEYERS CO., SPRINGFIELD, O.
INDIANA RUBBER & INSULATED WIRE CO., JONESBORO, IND.
PROCTOR-RAYMOND MFG. CO., BUFFALO, N. Y.
RENIM SPECIALTY CO., BOSTON, MASS.

ARTHUR F. STANLEY
BROADWAY AND MAIDEN LANE BLDG.
NEW YORK.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO.

PLATINUM

FOR INCANDESCENT LAMPS AND EVERYTHING ELSE.

PLATINUM FOR CONTACT POINTS IN ELECTRICAL INSTRUMENTS.
PLATINUM FOR TELEPHONES. PLATINUM FOR ELECTRICAL INSTRUMENTS.
We sell PLATINUM in any quantity, either large or small. We buy PLATINUM or anything containing PLATINUM, in any quantity.

BAKER & CO.,
MANUFACTURERS OF PLATINUM IN ALL SHAPES.
Newark, N. J. New York Office, 120 Liberty Street.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...— 8
Akron Smoking Pipe Co..... 1
Allen Company, L. B..... 13
Allis-Chalmers Company.... 22
American Battery Co..... 8
Amer. Electrical Heater Co..22
Amer. El. Telephone Co.....17
American Electrical Works..13
American Platinum Works. —
American Refl. & Lighting Co.13
American School of Corresp . 7
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....13
Audel & Company, Theo.... 14

Baker & Company..... 3
Barnett Company, G. & H....22
Barron & Co., J. S.....—
Beardslee Chandelier Mfg. Co.—
Berthold & Jennings.....19
Besly & Co., Charles H.....22
Bonville, Edward 1
Bossert El. Construction Co..22
Brooks, Hall L..... 19
Brown & Leasure..... 12
Buffalo Forge Co.....22

Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co...19
Central Telephone & El. Co..17
Century Glass Co.....—
Chase-Shawmut Company...13
Chicago & Alton Railroad....18
C. & N. W. R. R..... 8
Chicago Edison Company.4, 14
Chic. Fuse Wire & Mfg. Co...22
Chicago Insulated Wire Co.. 1
C., M. & St. P. R. R..... 8
Chicago Pay Station Co.....17
Christensen Engineering Co. 4
Commercial Elec. Supply Co.—
Consumers Carbon Co.....12
Continuous Rail Joint Company of America.....18
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company . 5
Cutler-Hammer Mfg. Co.....11
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company 2
Dearborn Drug & Chem. Co..18
Diamond Meter Company.... 5
Dixon Crucible Co., Joseph..18
Duncan Electric Mfg. Co.... 21

Edison Decorative & Miniature Lamp Department.... 12
Edison Mfg. Company..... 5
Edwards & Company..... 7
Electrical Engineer Institute. 1
Electric Appliance Company.12
Electric Storage Battery Co.. 3
Electrician Pub. Company... 8

Faries Manufacturing Co.... 3
Federal Electric Company...—
Fisher Electric Company.... 7
"For Sale" Advertisements..14
Ft. Wayne Elec. Works., Inc.21
Fowler, John H.....19
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....19

General Electric Company... 9
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Great Western Smelting & Refining Company.... ....—
Gregory Electric Company...14

Hamblin & Russell Mfg. Co..12
Hartford Steam Boiler Inspection & Insurance Co...—
Hazard Manufacturing Co....—
Helios-Upton Company..... 4
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Huebel Company, C. J.....19
Humphrey, Henry H.....12

Illinois Electrical Mfg. Co...14
Illinois Maintenance Co.....14
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company.....—
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..17

Jeffrey Manufacturing Co....18
Johnston, Thomas J.....13

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....17, 19
Klein & Son, Mathias.....19
Kohler Brothers. 12
Kokomo Tel. & El. M. Co....16

Leather Preserv. M. Corp....14
Leffel & Co., James.....18
Lindsley Brothers Company..19
Lowell Model Co..... .....—

Machado & Roller..... 7
Maley, Martin.....—
Maltby Lumber Company.. .19
Marinette Iron Wks. Mfg. Co.18
Marshall-Sanders Co. 10
Matthews & Bros., W. N.....17
Mayer Engineering Co.....13
McLennan & Company, K....12
McNamara Brothers 1
Mechanical Appliance Co.... 5
Mechanical Boiler Cleaner Co.....18
Metropolitan Tel. & El Co...16
Mica Insulator Company.....—
Miscellaneous Advs.....14
Monarch Fire Appl. Co.....—
Monon Railroad..... 8
Moon Mfg. Co., The.....—
Morse Cedar Company.....19
Munsell & Co., Eugene.....12
Murdock Parlor Grate Co....—

National India Rubber Co....—
Nernst Lamp Co.....20
New York Ins. Wire Co.....11
N. Y. Safety Steam Power Co.18
Norton Elec'l Instrument Co.10

Okonite Company, The..... 1
Osburn Flexible Conduit Co.—

Paiste Co., H. T..... 1
Paragon Fan & Motor Co.....—
Parsell & Weed..... 7
Perrizo & Sons.....19
Phelps Company..... 7
Phillips, Eugene F.....13
Phillips Insulated Wire Co..13
Phœnix Glass Company.....—
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....19
Porter Cedar Company.....19

Rauscher, John .....—
Reisinger, Hugo.....11
Replogle Governor Works.. .18
Reynolds Electric Company.—
Rice, Cyrus W 13
Roche, Wm.....—
Roebling's Sons Co., J. A.....22
Rooney-Westbury El. Lmp. Co.12
Rose Electric Company 14

Sargent & Lundy..... 7
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G.....—
Schott, W. H. 12
Schureman & Hayden.....14
Shelby Electric Company.... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 12
Smith Co., S. Morgan.....18
Spies Electric Company..... 8
Sprague Electric Company... 3
Standard Pole & Tie Co.... .19
Standard Underg. Cable Co..—
Standard Varnish Works 13
Standard Vitrified Cond. Co. 2
Stanley, Arthur F..... 3
Stanley Instrument Co.....11
Station Equipment Co.....14
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co..10
Sterling Electric Company...—
Sterling Varnish Co., The.... 1
Stilwell-Bierce & Smith-Vaile Company.....15
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company 16
Sturtevant Company, B. F...22

Thompson Son & Co.....14
Toerring Company, C. J 12
Torrey Cedar Company.....19
Triumph Electric Co.....12

U. S. Electric Mfg. Co.....17

Valentine-Clark Co., The....—
Vindex Electric Company....—
Vreeland, B. F. 19
Vulcanized Fiber Company..22

Wagner Electric Mfg. Co.....11
Wagor Mfg. Co., P. R.....—
Walsh's Sons & Company....14
Western Electric Company... 7
Western El. Supply Co..... 8, 9
Westinghouse Electric & Manufacturing Company ..20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co....14
Whitmore, A. E.....19
Wickes Bros.....14
Willyoung, Elmer G.....14
Wisconsin Central R. R.....18
Worcester Company, C. H....19

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

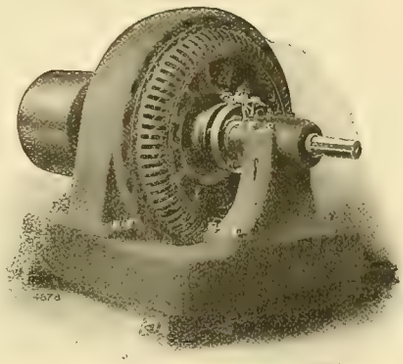
ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

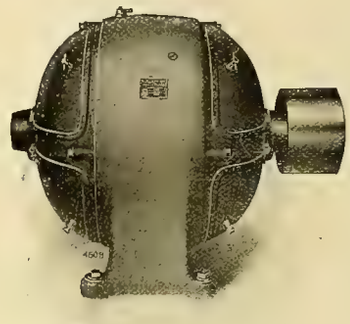
CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

"Ceco." Electrical Machinery.



250 K. W. 3-Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.



Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

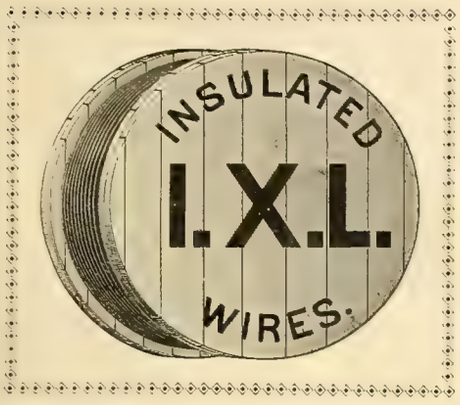
MILWAUKEE.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.



There Are Two Ways

OF CONVINCING YOURSELF AS TO ITS QUALITY.

ONE IS— **SEND FOR A SAMPLE**

THE OTHER IS— **SEND US AN ORDER.**

TRIPLE BRAID WEATHER-PROOF—SLOW-BURNING WEATHER-PROOF—
SLOW-BURNING OR UNDERWRITERS.

Central Electric Company,

GENERAL SALES AGENTS.

264-266-268-270 FIFTH AVENUE :: :: CHICAGO.

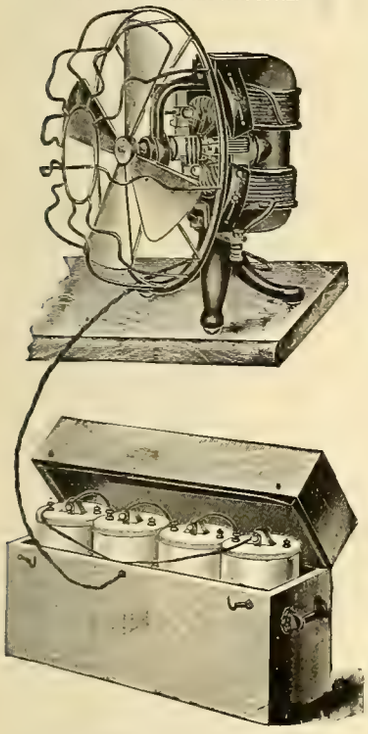
EDISON

BATTERY FAN OUTFITS

...WITH...

EDISON PRIMARY CELLS

Are the only efficient battery fan outfits on the market. Invaluable for the sick room.



Write for Catalogue No. 4.

EDISON MFG. CO.,

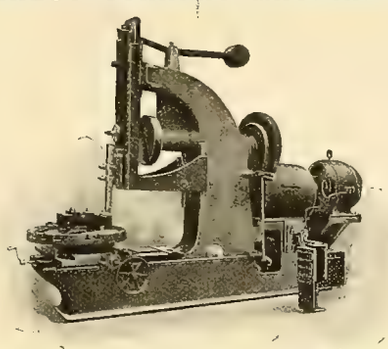
FACTORY, Orange, New Jersey, U. S. A.

NEW YORK OFFICE, 83 Chambers Street.

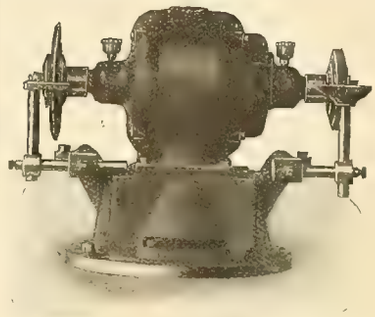
CHICAGO OFFICE, 144 Wabash Avenue.

CROCKER-WHEELER COMPANY
AMPERE, N.J., U.S.A.

DIRECT CURRENT MACHINERY



FOR THE ECONOMICAL OPERATION OF SHOPS AND FACTORIES



WATSON

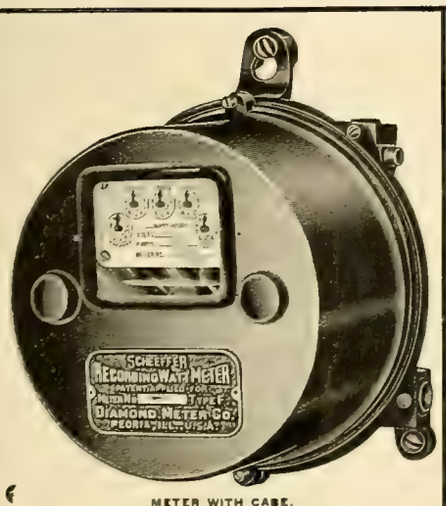
MOTOR BENCH GRINDER.

A PORTABLE DUST-PROOF ELECTRIC GRINDER. A BENCH TOOL WHICH EVERY MACHINE SHOP IN THE COUNTRY SHOULD BE EQUIPPED WITH. A TIME SAVER AND A MONEY MAKER YOU CANNOT AFFORD TO BE WITHOUT. ASK WHY? BUILT FOR 110 AND 220 VOLTS.

THE MECHANICAL APPLIANCE COMPANY,

MILWAUKEE.

Ask for Bulletin No. 55.



METER WITH CASE.

SCHEEFFER INTEGRATING WATT-METER.

For Direct or Alternating Currents.

DUST AND BUG PROOF.

IMPROVED CONSTRUCTION.

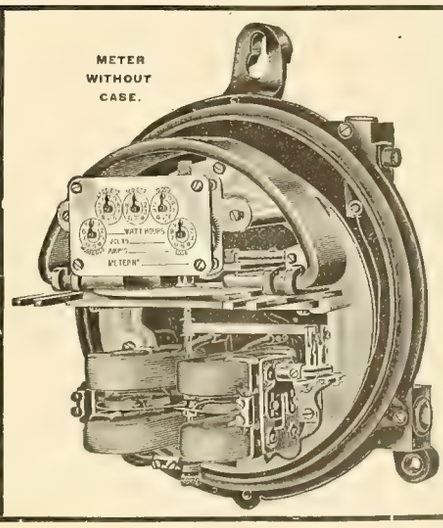
Unaffected by Alternations or Lag in Alternating Currents.

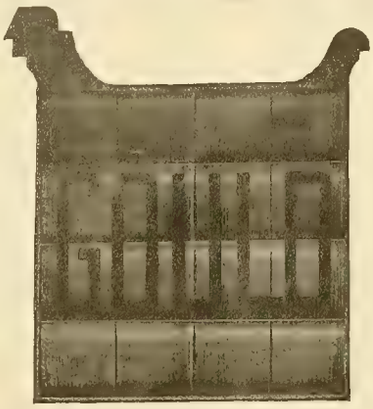
A Highly Sensitive and Accurate Meter.

DIAMOND METER CO.,

PEORIA, ILL., U. S. A.

METER WITHOUT CASE.





TRADE MARK.

STORAGE BATTERY INSTALLATIONS

FOR

RAILROAD REGULATING, LIGHTING, POWER AND ISOLATED PLANTS.

COULD C, E-M-F BOOSTER SYSTEMS.

COULD STORAGE BATTERY CO.

SALES OFFICES:

Boston, 53 State Street, Chicago, Rookery Building, New York, 25 West 33rd Street,
Century Electric Company, San Francisco, Cal. Pittsburg Engineering Company, Pittsburg, Pa.

WORKS: DEPEW. N. Y.

Bulletin No. 2, describing "GOULD BOOSTER SYSTEMS," on application.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Roche, Wm.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Cleaners.
Mechanical BoilerCleaner Co.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
Allen Co., L. B.
McLennan & Co., K.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Commercial Elec. Supply Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Hemingray Glass Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Hamblin & Russell Mfg. Co.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Commercial Elec. Supply Co.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Manufacturers' Agent.
Stanley, Arthur F.

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co., Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co.
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Thompson, Son & Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Sockets & Receptacles.
Paiste Co., H. T.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

X-Ray Outfits.
Willyoung, Elmer G.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

SALES OFFICES

Room 85 Hartford Building, Chicago. 170 Broadway, New York.

HYLO

TURN-DOWN LAMP

Teaches people to use more current by turning lamps down instead of out.
Write for detailed information.

PHELPS CO., 50 State St., Detroit, U. S. A.

AN INSTRUMENT FOR ISOLATED PLANT WORK.

Diameter of Base Flange, 7½ Inches.

LIST PRICE $16.50.

This popular type of WHITNEY instrument has a polished all brass case and a permanent magnet movement giving equally divided scales and dead beat indications. The ammeters of large capacity are supplied with separate shunts.

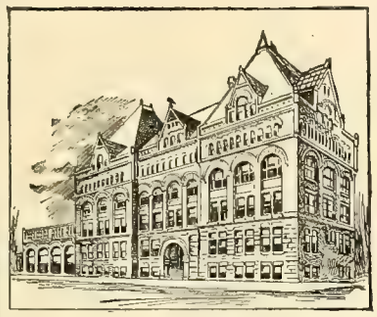
Send for complete price list and our attractive discounts to

ELECTRIC APPLIANCE CO., Chicago, Ill.
WESTERN ELEC'L SUPPLY CO., St. Louis, Mo.
ELECTRICAL ENGINEERING CO., Minneapolis.
STANDARD ELECTRIC CO., Cincinnati, O.

OR

MACHADO & ROLLER, New York, N.Y.

FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.



MAIN BUILDING, ARMOUR INSTITUTE OF TECHNOLOGY.

ENGINEERING EDUCATION

BY CORRESPONDENCE

UNDER DIRECTION OF COLLEGE PROFESSORS.

The American School of Correspondence offers the following courses in

ENGINEERING.

Electrical, Mechanical, Stationary, Locomotive, Navigation, Architectural, Marine, Mechanical Drawing, Heating, Ventilating and Plumbing, Perspective Drawing, Sheet Metal Work, Cotton Spinning, Woolen and Worsted Spinning, Textile Design and Fabric Structure.

ALSO 49 SHORT SPECIAL ENGINEERING COURSES.

INSTRUCTION UNDER MEMBERS OF THE FACULTY OF ARMOUR INSTITUTE OF TECHNOLOGY.

Textile Manufacturing Under the Foremost Authorities.

All work in Engineering will receive full credit toward resident work at Armour Institute, should the student at any time continue his studies there.

FOR EXAMPLE: Parts 1 to 6 of the work on Mechanical Drawing, mastered under these auspices, will be accepted as entrance preparation on that subject to the College of Engineering.

As a help in their studies, students in full engineering courses are furnished a Technical Reference Library (in 10 volumes) in addition to the regular instruction papers.

AMERICAN SCHOOL OF CORRESPONDENCE,

at

Armour Institute of Technology,

CHICAGO, ILL.

Mention Western Electrician.

The Franklin Gas Engine

One-Half Horsepower.

Worth $100 complete. We sell all necessary castings, materials and detail drawings for $16.50. For real work—not a toy. 450 revolutions per minute. Upright or horizontal form. Finished parts sold separately. Runs by gas or gasoline. For boys and men with a mechanical turn. Write for circular 16.

PARSELL & WEED,
129-131 W. 31st Street, New York.

SARGENT & LUNDY,

Engineers,

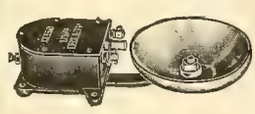
1000, 46 E. VAN BUREN ST., CHICAGO.

FREDERICK SARGENT. A. D. LUNDY

EDWARDS AND CO.

THE "RECTI" BELL

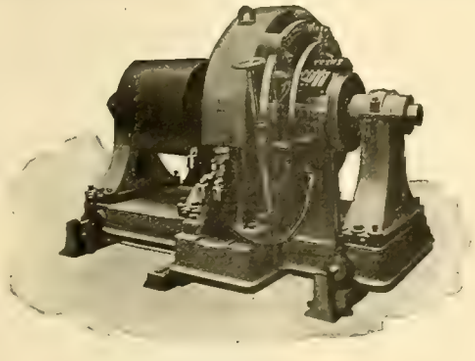
FOR AUTOMOBILES AND ELECTROMOBILES.



No. 100.

This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.

NEW YORK N.Y.



Catalogues and Bulletins Sent on Request.

Motors—Generators
Arc Lamps—Switchboards
Automatic Circuit Breakers

and

Electrical Supplies.

Western Electric Company,

Chicago. Saint Louis. Philadelphia. New York.

INCANDESCENT LAMPS

NEW TYPE

PEERLESS

A strictly high grade lamp that we are prepared to guarantee fully. In order to temporarily take care of the largely increased output of our factory, we are making some very attractive prices.

WRITE US TO-DAY.

WESTERN ELECTRICAL SUPPLY CO., ST. LOUIS, U. S. A.

SUPPLIES AND CONSTRUCTION MATERIAL OF EVERY DESCRIPTION.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

MONON TRAINS FOR
La Fayette
W. Baden Spr
Fr. Lick Spr
Louisville
Mammoth Cave
Chattanooga
New Orleans
All Southern Cities.

MONON TRAINS FOR
Indianapolis
Dayton
Cincinnati
Asheville
Atlanta
Jacksonville
St. Augustine
Tampa
Havana.

ANY TIME

You travel between

CHICAGO
LOUISVILLE
INDIANAPOLIS
AND
CINCINNATI
GO VIA

MONON ROUTE

AND C.H.&D Rwy.

LUXURIOUS PARLOR AND DINING CARS BY DAY.
PALACE SLEEPING AND COMPARTMENT CARS BY NIGHT.
6 TRAINS DAILY BETWEEN CHICAGO AND THE OHIO RIVER

W. H. McDOEL, PRES. & GEN'L MGR. FRANK J. REED, GEN'L PASS. AGT. CHAS. H. ROCKWELL, TRAFF. MGR.
CHICAGO.

ELECTRICAL BOOKS

FOR THE

HOLIDAYS

WE CARRY THE MOST COMPLETE STOCK

SEND FOR CATALOGUE

Electrician Publishing Co.

510 Marquette Building, CHICAGO.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in. Nickel, 50c. Enameled, 45c.

By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.

SPIES ELECTRIC CO.,
87-89 W. Van Buren Street, Chicago, Ill.

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

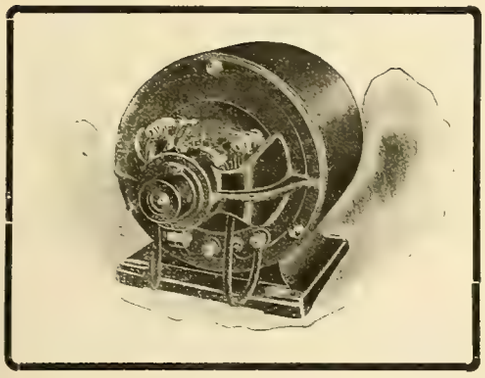
H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt.
CHICAGO, ILL.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.

AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago, Ill.

Sterling Direct Current Generators and Motors



This apparatus embodies some new and advanced ideas. Our factory makes nothing but small motors and generators in large quantities, which enables us to quote extremely low and attractive prices.

WE CAN INTEREST YOU IF IN THE MARKET.

WESTERN ELECTRICAL SUPPLY CO.,

ST. LOUIS, U. S. A.

WRITE TO-DAY FOR CATALOGUE AND PRICES.

GENERAL ELECTRIC COMPANY'S

Type "H" Transformers

OIL COOLED.

INITIAL AND ULTIMATE ECONOMY OF OPERATION—because of low core loss, non-aging of iron, and long life due to uniform temperature and expansions—MAKE TYPE "H" TRANSFORMERS A GOOD INVESTMENT.

GENERAL OFFICES: SCHENECTADY, N. Y.

CHICAGO OFFICE: Monadnock Block. Sales Offices, all large cities.

BOOKS

Make your friend or yourself a Christmas present of an electrical book chosen from the following list which we recommend:

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Trevert's Electrical Measurements for Amateurs, cloth binding	1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	$1.25
Allsop's Bell Construction, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

Any of the above books sent prepaid on receipt of price. Write for free book catalogue.

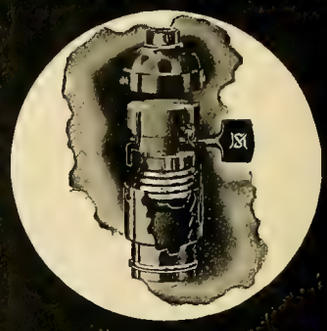
ELECTRICIAN PUBLISHING CO.,

SUITE 510, MARQUETTE BLDG.,

CHICAGO.

SOCKET VALUES.

The elastic fibre lining of the M-S Socket is one of its many items of added value not found in other makes. Lining never drops out, when the wireman is at the top of a ladder. Can be easily removed for refinishing the shells. Automatically made sockets are absolutely uniform.



M.-S. KEY SOCKET.

MARSHALL-SANDERS COMPANY.

301 CONGRESS ST., - - - - BOSTON, MASS.

MILLS BUILDING, SAN FRANCISCO. STIMSON BLDG., LOS ANGELES.
STARR-BOYD BLDG., SEATTLE, WASH. MONADNOCK BLDG., CHICAGO.

BEFORE CONTRACTING FOR

INCANDESCENT LAMPS

GET THE STERLING SPECIAL LITERATURE.

STERLING ELECTRICAL MFG. CO. - - WARREN, OHIO.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.

The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.

Agents.—Kohler Bros., Chicago, Ill.; Newman-Spranley Co., New Orleans, La.

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,

510 Marquette Bldg., Chicago.

"ELECTRA" FLAME LIGHT CARBONS

MARVELOUS EFFECT

"ELECTRA" Flame Light Carbons are suitable for all types of Open Arc Lamps, either direct or alternating current, with slight change in regulation of lamp.

HIGHEST INTENSITY

The intensity and brilliancy of light is three times that of regular "ELECTRA," and five times that of other carbons, making them eminently suitable for all special lighting purposes.

HUGO REISINGER, SOLE IMPORTER, 11 BROADWAY, NEW YORK.

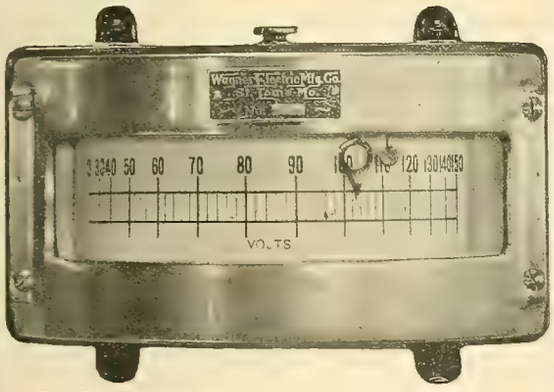
Grimshaw. Raven White Core. Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

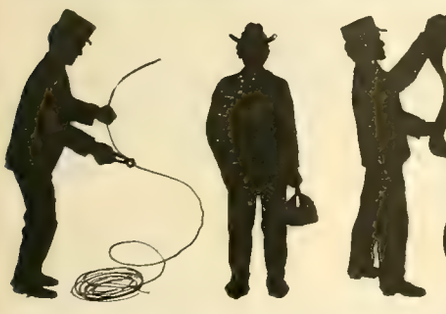
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.



Type F Voltmeter, Back Connection, One-Third Actual Size.

STATIC GROUND DETECTORS, SYNCHRONIZERS, POWER FACTOR INDICATORS, GALVANOMETERS, switchboard and portable types of **VOLTMETERS, AMMETERS** and **INDICATING WATTMETERS** are as **ACCURATE, DEADBEAT** and **PERMANENT** as it is possible to build them and withstand ordinary commercial usage.

WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO., U. S. A.



Only workmen of experience and proven ability are engaged in manufacturing our goods. When you buy, you get the best that money can buy and no trouble follows your bargain.

C & H RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

invite your investigation. Write to us for any desired information.

THE CUTLER-HAMMER MFG. CO.

AGENTS: Sturtevant Engineering Co. Ltd., London, Eng. Edge & Edge, Sidney, Australia. Kilbourne & Clark Co., Seattle, Wash.

MAIN OFFICES AND FACTORY--MILWAUKEE
BRANCH OFFICES--NEW YORK & CHICAGO

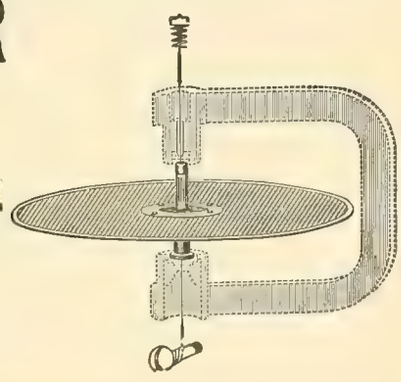
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR **ALTERNATING CURRENT**
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO FRICTION. NO LOST REVENUE. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., SAN FRANCISCO, CAL. LOS ANGELES, CAL. SEATTLE, WASH.

EACO DRY BATTERIES

The days of testing and trying Eaco Dry Batteries are over. They have proven to excell anything on the market for a low-priced battery.

ELECTRIC APPLIANCE COMPANY,
ELECTRICAL SUPPLIES, CHICAGO.

A STOCK OF
EDISON MINIATURE LAMPS

Should be kept by every **Central Station** for rental to their customers. They popularize electric lighting and bring a profitable income from a small investment. Very desirable for **Christmas Tree** and **Holiday Decorations.**

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RICHT
EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 Cortlandt St.

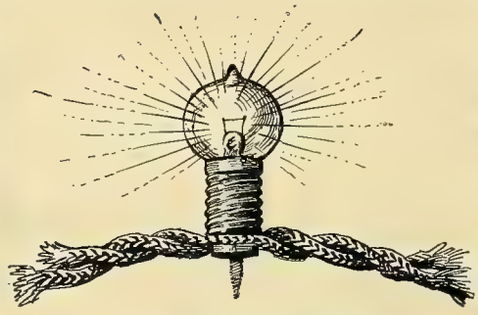
SOME GROW RICH

on what others waste. If you are using old-fashioned 100-hour Arc Lamps it will pay you to scrap them and buy modern 200-hour Arc Lamps.

It is not what you make but what you save that counts.

19th & Allegheny Ave.

NEW YORK CITY. C. J. TOERRING Co. PHILADELPHIA.



THIS IS OF INTEREST!

A NEW DEPARTURE IN XMAS TREE LIGHTING AND DECORATIVE WORK. :: A CHILD CAN PUT IT UP.

FOR STORAGE BATTERY OR DRY BATTERY CELL WORK ESPECIALLY SEND FOR PRICES TO

THE ROONEY-WESTBURY ELECTRIC LAMP CO.,
154 EAST 23RD STREET, :: NEW YORK CITY.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET.
78-80 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS, ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

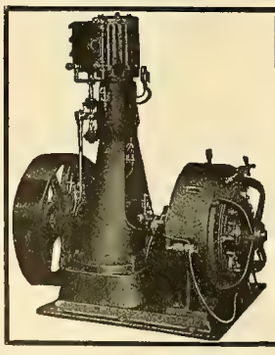
The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
909 Title and Trust Bldg., CHICAGO, ILL.

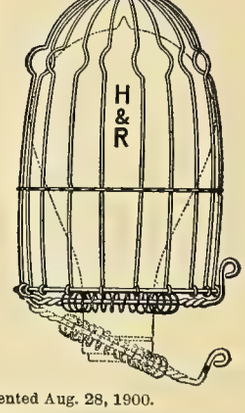


TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

"NEVER BREAK"
ELECTRIC LIGHT GUARD.
SILVER LUSTER.



Patented Aug. 28, 1900.

A Perfect Guard. Adjustable Clamp Socket. Holds All Sizes Securely.

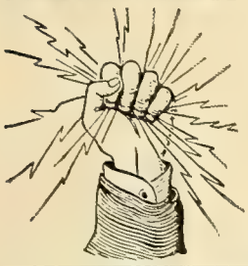
Neat and attractive. All objectionable features overcome. Made of Steel Wire, Silver Luster-Finish. The corrugation prevents all possible chance of breaking. No screws to loosen and fall out. Send for Illustrated Catalogue.

HAMBLIN & RUSSELL MFG. CO.,
WORCESTER, MASS.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

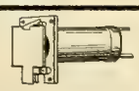
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.



THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

EVER SPILL YOUR ACID BOTTLE?
Full Size ALLEN Stick Free for Trial.

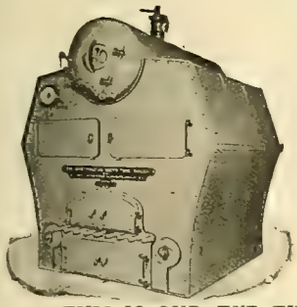
DODGE SUBSTITUTES (?) FOR THE ALLEN SOLDERING STICK MAKES SOLDER FLOW
WE PROTECT YOU
BY THIS on a pink Label
Beware of Imitations. L. B. Allen. None Genuine without Signature.
You Protect Yourse'f.

L. B. ALLEN CO., Inc. Sole Manufacturers, 1334 Columbia Ave. CHICAGO.

Send us your specifications and space available.

WORTHINGTON

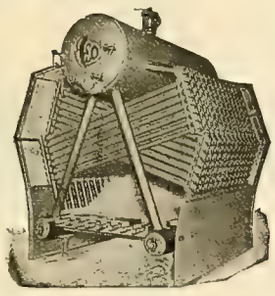
Our Book with Details on Application.



Water-Tube Sectional

BOILER

No brickwork, no bent tubes, no screw joints, no gaskets. Nothing to get out of order. Made in units of from 20 to 360 H.P.



THIS IS OUR END FIRED TYPE—FROM 20 TO 125 H. P.

NOTICE—Our larger units are all side fire, and are set in battery—Mechanical stoked or hand fired.

NEW YORK SAFETY STEAM POWER CO., 60 S. Canal Street,
New York Philadelphia Boston San Francisco CHICAGO, ILL.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office: Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

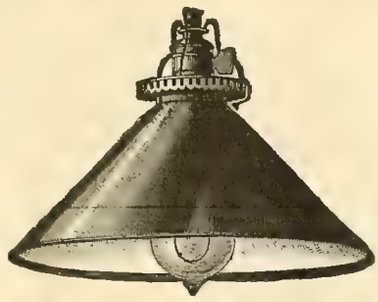
NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

REFLECTORS!



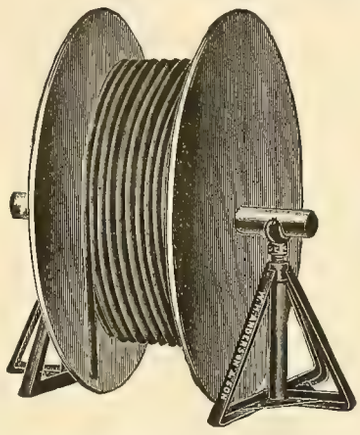
Light is useless if you can't have it where you want it.

Paragon Reflectors throw the light **just where you want it.**

Our Incandescent Reflectors are neat and are superior to all others. They are green outside, glossy enamel white inside. Reflecting surface. Made in various styles and sizes. Get our catalog.

American Reflector & Lighting Co.,
271-273 FRANKLIN ST., CHICAGO.

CABLE REEL JACK.



Made in Two Styles.

No. 1. With Heavy Angle Iron Frame and Steel Screw, capable of handling the heaviest underground cables.

No. 2. Body made of steel castings, with the Machine Steel Screw, capable of handling reels up to 4 feet 6 inches in diameter.

Correspondence solicited. Catalogue on request.

W. H. ANDERSON & SONS,
Tool Manufacturers.
Established 1871.
St. Aubin Ave., DETROIT, MICH.

"SHAWMUT" ENCLOSED FUSES

RE-STANDARDIZED TO DATE TO MEET THE LATEST REQUIREMENTS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

ABSOLUTE RELIABILITY.

THE NEW SHAWMUT INDICATING FUSE.

Indicating Type P Fuse, intact.

Fuse blown, showing auxiliary indicating patch white.

CHASE-SHAWMUT CO., Boston,
MANUFACTURERS.

New York Representative:
WM. S. BROWN, 39 Cortlandt St.,
New York City.

Western Representative:
THOMAS G. GRIER CO., 128 W. Jackson Blvd.,
Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

FOR SALE.

Two Royal Electric Company, Standard dynamos of 150 K. W. each. These machines are alternators, 133-cycle, new and of excellent design and make, connected for furnace work, but suitable for town lighting. Address D. M. HILLIS, 112 Hartford Building, Chicago.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each. Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450.

ROSE ELECTRIC CO., ST. LOUIS.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., December 3, 1902. Sealed proposals will be received at this office until 2 o'clock P. M. on the 14th day of January, 1903, and then opened, for the installation of a conduit and electric wiring system for the U. S. Public Building at Helena, Montana, in accordance with the drawings and specifications, copies of which may be obtained at this office, or at the office of the Superintendent of Construction at Helena, Montana, at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

When in search of a position advertise in the WESTERN ELECTRICIAN.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,

140 S. Clinton St., Chicago.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings), Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1— 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines. Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18½x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

STEAM ENGINEERS' LICENSES

Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

Theo. Audel & Co., Publishers, 63 Fifth Avenue, New York City.

FREE Christmas Dinners For 10,000 Chicago's POOR

will be supplied by **The Salvation Army.** You are invited to contribute either cash or provisions Address

CHICAGO Headquarters
84 Adams St. Dexter Bldg.

On receipt of

10 CENTS

.....We will send you a

Western Electrician Moonlight Schedule

FOR 1903.

Every Lighting man should have one.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Bldg., CHICAGO.

ENGINES.

3-18x30x16 Westinghouse.
2-13x24x18 Armington & Sims
2-15x23x17 Mc I. & Seymour.
1-16x27x16 Westinghouse.
1-8x14½x10½ Mc I. & Seymour
2-22x33 Buckeye (new).
1-18x42 Allis Corliss.
1-14x36 Hamilton Corliss.
1-15x15 Erie Ball.
2-13x12 Armington & Sims.
1-11x14 Straightline.
1-9x9 New York Safety.

BOILERS.

4-375 H. P. National watertube
2-136 H. P. Babcock & Wilcox.
1-250 H. P. Heine watertube.
2-114 H. P. Heine watertube.
2- 90 H. P. Horizontal tubular.
2- 60 H. P. Horizontal tubular.

110-VOLT DYNAMOS.

1-80 K.W. Thomson-Houston.
1-60 K.W. Westinghouse M. P.
2-60 K.W. Edison bi-polar.
1-55 K.W. Churchward M. P.
1-45 K.W. Edison bi-polar.
2-25 K W. Edison bi-polar.

DIRECT CONNECTED.

1-100 K.W. G. E. 250 volts, d. c. Mc Intosh & Seymour engine.
1-80 K.W. G. E. M. P. 115 volts, d. c. Russell 4-valve engine.
2-75 K.W. G. E. 125 volts, d. c. Ames tandem engines.
1-50 K W. Western Electric 110-volts, d. c. Ball & Wood engine
1-50 K. W. Walker 110-volts d. c. Russell engine (new).
1-43 K.W. Westinghouse 110-volts, d. c. Russell engine.
1-30 K. W. C. & C. 110-volts, d. c. Atlas engine.
1-5 K.W. Perritt 110-volts, d. c. Sturtevant engine.

500 and 220 and 110-Volt Motors and Dynamos.

60 and 125 Cycle Alternators and Motors.

TRANSFORMERS, ARC DYNAMOS, ARC LAMPS.

THOMPSON SON & CO., 114 LIBERTY ST. NEW YORK.

REPAIRS AND SECOND-HAND MACHINERY.

STREET RAILWAY, LIGHTING AND POWER.
Write for List of Machines.
ILLINOIS ELECTRICAL MFG. CO., PEORIA, ILL.

ENGINES.

84x60 International Power Corliss.
26x48 Dickson Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
13x18 Frost Center Crank Automatic.
11½x 14 Taylor-Beck Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

Ten 72x18 Horizontal Tubular, 125 pounds pressure.
One Geary Water Tube Boiler. 175 H. P. for 150 pounds pressure, almost new.
Two 150 Babcock & Wilcox Water Tube Boilers, 185 pounds pressure.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
200 H. P. Baragwanath Heater.
150 H. P. Kroeschell Heater.
500 H. P. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps, Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY, DAVENPORT, IA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric, A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi-polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1—30 K. W. Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.

375 H. P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.

High speed automatics, from 250 H. P. down.

Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1,100-light, 60 K. W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1,100 volt.
1—60 K. W. General Electric, 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

TEST INSTRUMENTS.

Portable Sets for Resistance, Faults, Etc.
Portable Sets for Insulation and Capacity.
Galvanometers, Bridges, Condensers, Photometers, Etc., Etc.
11 Catalogues in print, 4c in stamps.

X-RAY APPARATUS.

Coils and X-Ray Machines for Battery and Power Circuits—Direct or Alternating — Permanent or Portable—4 inches to 18 inches.
We control patents and are sole makers of the
Caldwell Liquid Interrupter.
Cunningham Mercury Jet Interrupter.
Caldwell Stereoscopic Fluoroscope.

ELMER G. WILLYOUNG, 97-99 Frankfort St., NEW YORK, N. Y.

Send for Catalogue No. 507 10c in stamps.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE VICTOR TURBINE WATER WHEEL.

PARTICULARLY ADAPTED FOR DRIVING ELECTRIC PLANTS.

Its high speed, close regulation, great capacity, high efficiency, perfect cylinder gate and steady motion will particularly commend it to all contemplating developing plants of this kind.

OUR OTHER SPECIALTIES ARE:

STEAM and POWER PUMPING MACHINERY for all purposes, AIR COMPRESSORS for the Air Lift system and general use, JET and SURFACE CONDENSERS, AIR PUMPS, VACUUM PUMPS, STILWELL'S FEED WATER HEATERS, FILTER PRESSES and OIL MILL MACHINERY.

IF INTERESTED, WRITE

The STILWELL-BIERCE & SMITH-VAILE CO.

DAYTON, OHIO.

NEW YORK, 141 Broadway.
BOSTON, 73 Oliver Street.
NEW ORLEANS, 304 Hennen Building.
BALTIMORE, 1507 Continental Trust Building.
PHILADELPHIA, 612 Arch Street.
CHICAGO, 311 Dearborn Street.
LONDON, 97 Queen Victoria Street.
CLEVELAND, 1116 New England Building.
E. F. AUSTIN, Sales Agent, Smith Block, PITTSBURG, PA.

NOW READY!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1903.

TEN CENTS A COPY.

Electrician Publishing Co.,

510 MARQUETTE BUILDING,

CHICAGO.

"The Recognized Authority on Wiring and Construction."

The universally adopted National Electrical Code explained and illustrated in this year's edition of the hand-book.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University, Stanford University and other Technical Colleges and Schools.
By over 27,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover (pocket size), $1.00.

Sent post paid upon receipt of price, by

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - - CHICAGO, ILL.

ELECTRICITY MADE SIMPLE.

233 Pages. 108 Illustrations. **By CLARK CARYL HASKINS.** Cloth $1.00. Paper .50.

A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.

This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.

Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.

The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.

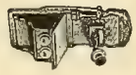
FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

"CENTRAL ENERGY."

THE ONLY SYSTEM.
WE ARE THE LEADERS.

STROMBERG-
CARLSON
TELEPHONE
MFG. CO.



ROCHESTER, N. Y. CHICAGO, ILL.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM
CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.
METROPOLITAN TELEPHONE & ELECTRIC CO.,
610 WILSON AVE., CHICAGO, ILL.

A LONG-FELT WANT.

THE HANDY ELECTRICAL DICTIONARY
BY W. L. WEBER, M. E.
225 PAGES, SIZE 2½ x 6 INCHES.
Price: { Cloth Binding, - - - - 25c.
Flexible Leather Binding, 50c.

This is a practical book in a convenient vest pocket size; alike suitable for workman, student or anyone employed or interested in the electrical science. It contains clear, concise definitions of every used electrical term or phrase and is sold at a price within the reach of all.

Promptly Mailed on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

KOKOMO TELEPHONES
Always Up-to-Date.
WE MANUFACTURE
SWITCHBOARDS, TELEPHONES
AND EVERYTHING FOR
COMPLETE EXCHANGE.
Write for Catalog and Prices.
KOKOMO
TELEPHONE AND ELECTRIC
MFG. CO.,
KOKOMO, IND.

RENEWALS

December is an important month for the renewal of subscriptions. If your subscription is expiring this month, or even if it is expiring in January, it is to your interest to send in your renewal now so that the subscription may be extended on our books in plenty of time to prevent your missing any copies.

To make a Christmas gift of the WESTERN ELECTRICIAN send us the name and address of the person to whom you wish to give the subscription, with the annual subscription price of $3, and the paper will be sent regularly for 52 weeks.

With January 1st will begin the thirty-second volume of the WESTERN ELECTRICIAN, and during 1903 it will complete its sixteenth and the first half of its seventeenth year, the paper having been founded July 2, 1887, and continued under the present management for this entire period. We offer the past as a guaranty of the future, and in addition pledge the best efforts of an experienced and competent staff to the constant improvement of the paper.

The WESTERN ELECTRICIAN is published for the purpose of assisting everyone interested in the art. It is a general electrical and scientific paper, and gives to its readers all the latest news and keeps them thoroughly informed of everything that is going on in all the different departments of the electrical and allied fields. Its technical and scientific articles cover all the latest inventions and improvements and keep the reader thoroughly informed of all that is new in the art. Its special articles, written by the most prominent authorities, as well as its general articles, are of the highest order, and no interested person can afford to be without the paper.

SUBSCRIPTION PRICE PER YEAR
Of Fifty-two Numbers

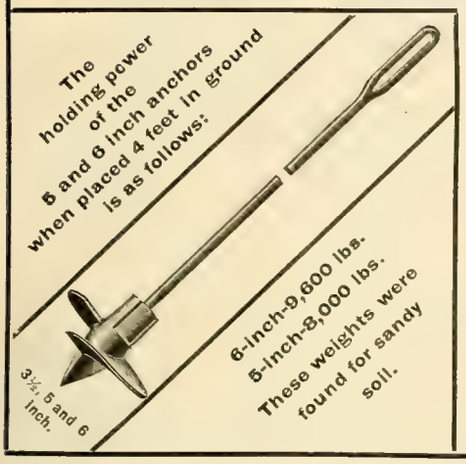
IN THE

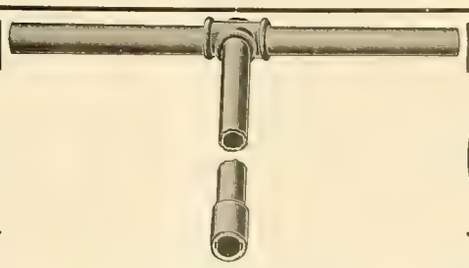
United States	$3.00
Foreign Countries	5.00

SAMPLE COPY FREE.

Electrician Publishing Company, SUITE 510, MARQUETTE BUILDING, CHICAGO, U. S. A.

STOMBAUCH GUY ANCHORS

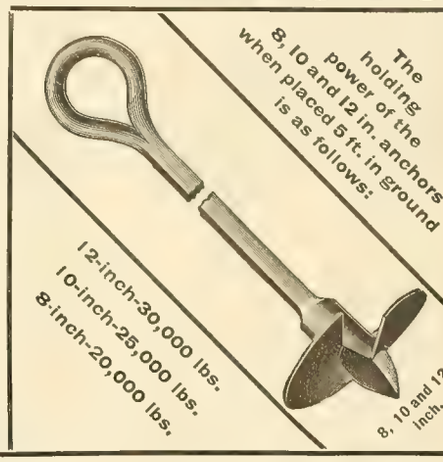




THIS IS THE WRENCH
that must be used to install the
3½, 5 and 6 inch anchors.

W. N. MATTHEWS & BRO.,
DISTRIBUTERS,
603 Carleton Bldg., - - ST. LOUIS.

HGUABMOTS GUY ANCHORS



Where are you going my pretty maid ?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

WHY?

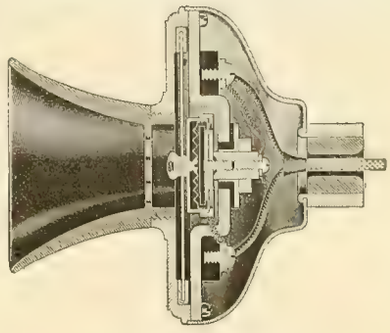
Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,
130 La Salle Ave., Chicago, Ill.

INTERNATIONAL TRANSMITTER



PATENT ALLOWED.

STANDS UNEQUALLED IN
Workmanship, Efficiency and Durability.

It is Clear, Distinct and Powerful.

IMPOSSIBLE
to become packed or deadened.

We manufacture a full line of public exchange central energy and generator call Telephones and multiple and trunking switchboards. Correspondence solicited.

INTERNATIONAL TELEPHONE MFG. CO.,
HARRISON AND CLINTON STREETS, - - - CHICAGO, U. S. A.

It Doesn't Pay!

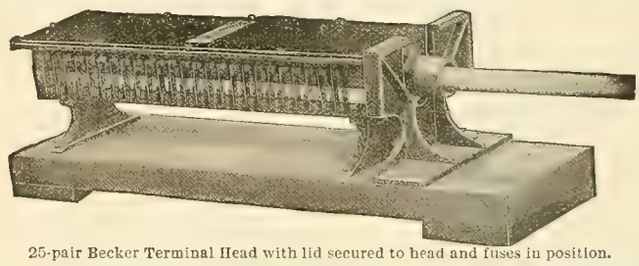
To start in with a short-lived Telephone.
Kellogg Telephones are Centenarians!

It Doesn't Pay!

To go near a short-winded Telephone.
Kellogg Telephones are as wonderfully distinct for a thousand miles distance, as they are for a mile!
Send for our Catalogue.

KELLOGG SWITCHBOARD AND SUPPLY CO.
Green and Congress Streets, CHICAGO.
NEW YORK *PHILADELPHIA* *CLEVELAND*

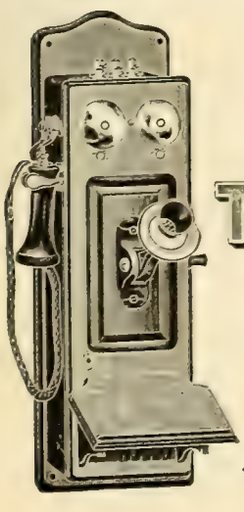
PROTECTION
THE BECKER TERMINAL HEAD.



25-pair Becker Terminal Head with lid secured to head and fuses in position.

A practical, absolute protection against lightning, sneak currents or high potential currents from any source. No expense has been spared to make this Terminal Head the best on the market. We can supply anything in the telephone line. Prices reasonable.

CENTRAL TELEPHONE AND ELECTRIC CO., 909 Market Street, ST. LOUIS.
Chicago Office: 59 W. Jackson Boul.
Post-Glover Electric Co., Cincinnati Agents.
W. G. Nagel Electric Co., Toledo (O.) Agents.



WE ALSO MAKE
FIRST-CLASS
BRIDGING AND SERIES
TELEPHONES
COMBINING
QUALITY AND SIMPLICITY.

WRITE US AND WE WILL TELL YOU ALL ABOUT IT.

THE U. S. ELECTRIC MFG. CO., - Butler, Pa.

LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

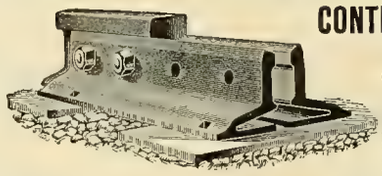
AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO

POWER INCREASED

AND BOILERS PROTECTED BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

DEARBORN DRUG & CHEMICAL WORKS.
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H. EDGAR, President Telephone: Harrison 3930 and 3931.

CARBONS and lamp filaments baked in Dixon's No. 1365 Graphite do not lose their carbon. Furnished in any degree of fineness. Ask for booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

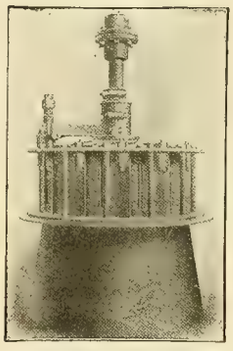


CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER TEN THOUSAND (10,000) MILES IN USE.
Highest Award in its Class at Paris Exposition, 1900, and Pan-American Exposition, Buffalo 1901.

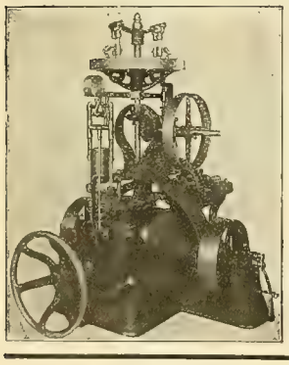
GARRIGUS MECHANICAL BOILER CLEANER
THE ONLY KNOWN METHOD OF KEEPING BOILERS CLEAN AND FREE OF SCALE.
INSTALLED OUR EXPENSE ON 60 DAYS TRIAL
MECHANICAL BOILER CLEANER CO.
W. R. MASON MANAGER. 413 WESTERN UNION BUILDING. CHICAGO.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR
Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.
"THE ONLY WAY"
to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.
The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.



SAMSON TURBINE UPRIGHT AND HORIZONTAL
ESPECIALLY ADAPTED FOR DRIVING
ELECTRIC LIGHTING AND POWER PLANTS,
On account of its HIGH SPEED and EFFICIENCY, also BALANCED GATES.
These qualities, maintained to such a High Degree of Perfection, assure exceedingly close regulation and economical use of water. Copy of "Official Holyoke Tests" furnished on application.
Write Dept. "D" for Catalog.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

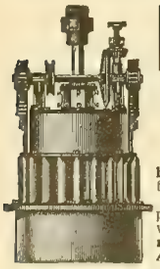


Water Wheel **Governors**
For Electric Light, Power and Railway Stations, Also Paper and Textile Mills.
We are now prepared to
GUARANTEE ABSOLUTE SATISFACTION
Write for References in your Locality.
The Replogle Governor Works,
HIGH & CHESTNUT STS., AKRON, OHIO.

NEW CATALOGUE ELEVATING = CONVEYING MACHINERY
NOW READY SEND FOR COPY
JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

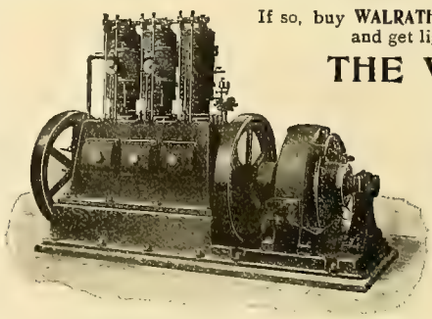
THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

TO THE GREAT NORTHWEST
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.
JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.
Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.
Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.
S. MORGAN SMITH CO., York, Pa.

ARE YOU LOOKING FOR MONEY?
If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.
MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.
AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

REG. TRADE MARKS
THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

PRICES YOU CAN'T MISS.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

CEDAR AND CHESTNUT POLES

Cedar Ties, Posts, Shingles, Etc.

Get Our Prices Before You Buy Elsewhere.

THE MORSE CEDAR COMPANY - Saginaw, Mich.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.
Producers and Wholesalers. Escanaba, Mich.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

WHITE CEDAR POLES.

HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

EMPTY SHELLS.

Compared with Juniper Poles, the Northern Cedar Poles are Empty Shells.
Better Investigate. Write for More Information.

THE STANDARD POLE & TIE COMPANY,
44 Broad Street, New York City.
WILMINGTON, N. C. BROOKSVILLE, FLA.

CEDAR POLES STREET RY. TIES PERRIZO STOKES DAGGETT MICH.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

POLES

W. C. STERLING & SON, MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

TIES.

John H. Fowler CEDAR POLES POSTS SHINGLES TIES CHICAGO

IDAHO, WISCONSIN, MICHIGAN . . . . . CEDAR POLES FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT, TROLLEY.

POSTS, POLES, TIES AND EVERYTHING IN WHITE CEDAR

YARDS IN IDAHO AND AT WASHBURN, PLUMMER AND BRULE, WISCONSIN.

JOHN. H. FOWLER — GENERAL OFFICE: 1705 FISHER BLDG., CHICAGO. Branch Offices: Washburn, Wisconsin, and Spokane, Washington. — FOWLER-JACOBS CO.

FOWLER-JACOBS TIES POSTS POLES PILING COMPANY

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.
Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

Central Manufacturing Co.

Chattanooga, Tenn.

Mfrs. and Dealers in

Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.

LARGE STOCKS ON HAND.

Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

M. KLEIN & SON

LINE BUILDERS' TOOLS.

Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.

Headquarters for Linemen's Tools.

MATHIAS KLEIN & SONS, 87-89 W. Van Buren St. CHICAGO, ILL.

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.,

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS.
Chemical Building.

CROSS ARMS.

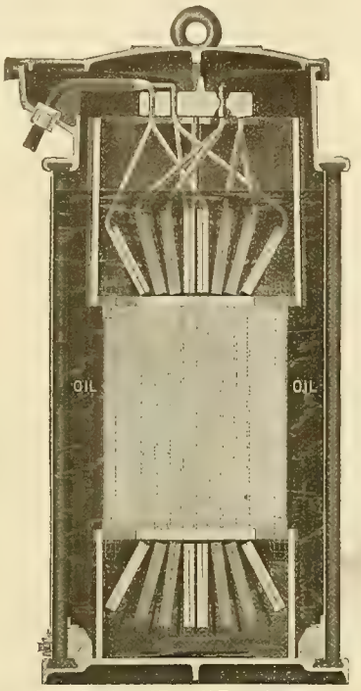
LONG LEAF PINE AND FIR.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .

SPECIAL PRICES UPON APPLICATION.
PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Westinghouse



Cross Section of Type N Transformer.

Transformers

Westinghouse Type N and O. D. Transformers show practically no difference of Temperature as measured by a thermometer placed between the coils, or as measured in the copper by the resistance method.

This is actual proof of Uniform Temperature.

For illustrated Transformer Booklet address nearest sales office of the

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities. Pittsburg, Pa.

Nernst Lamps

Operative on all Alternating Circuits

This illustration was reproduced from a photograph of a Men's Furnishing Goods Store, taken while illuminated by two 6-Glower Nernst Lamps.

The Light is the same as Daylight.
Shows the True Color of Fabrics.
Fifty per cent more economical than Incandescents.

Ask your nearest Supply Dealer, or write for Booklet No. 6 to nearest office of

Nernst Lamp Co.

General Office, Pittsburgh, Pa.

Sales Offices: New York—120 Broadway. Boston—131 State St. Philadelphia—710 Girard Trust Bldg.

DUNCAN
Integrating Wattmeter

FOR DIRECT AND ALTERNATING CURRENTS.

BUILT STRICTLY IN ACCORDANCE WITH PRESENT DAY REQUIREMENTS.

JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS

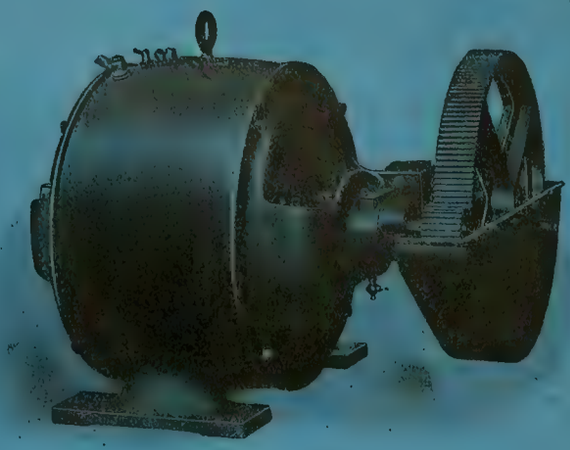
WRITE FOR PRICES

DUNCAN ELECTRIC MFG. CO.
MANUFACTURERS OF ELECTRICITY METERS
LAFAYETTE, IND.

AGENTS:
Goltz Engineering Co., 1504 Monadnock Bldg., Chicago.
C. H. Norwood, 1503 Fisher Bldg., Chicago.
Safety Electric Mfg. Co., 303 Magazine St., New Orleans.

Back Geared
TYPE E
MOTORS

For Direct-Current Circuits.



Where high torque and low speed are necessary, these motors are suitable for all conditions of operation. They give perfect satisfaction, running upside-down or right-side-up, enclosed, open or protected.

BULLETIN No. 1036

Fort Wayne Electric Works

MAIN OFFICE and FACTORY
FORT WAYNE - - INDIANA

Chicago Fuse Wire & Mfg. Co.

Manufacturers,

Fuse Wire,
Fuse Links,
Telephone Fuses
and Supplies.

ANNOUNCEMENT.

Owing to the steady growth of our business, and to enable us to supply our Eastern customers more promptly,

We have equipped a complete factory for the manufacture of our goods at

187 PRATT STREET. - BUFFALO, N. Y.

We are now manufacturing and shipping at this address under the supervision of competent and experienced men, who are thoroughly trained in the details of the business.

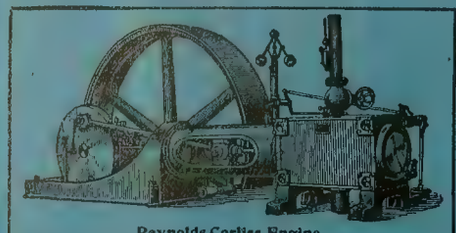
New York Office, - 853 Broadway.

MAIN OFFICE:

358 Dearborn Street, - Chicago, Ill.

ALLIS-CHALMERS CO.,

CHICAGO, U. S. A.



Reynolds Corliss Engine.

Sole Builders of

REYNOLDS CORLISS ENGINES

For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.

RIEDLER PUMPS AND AIR COMPRESSORS.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

MODERN HEAT

ELECTRICITY.

AMERICAN ELECTRICAL HEATER CO.

Manufacturers Electric Heating Appliances,

Write for catalogue. 195-197 River St. DETROIT MICH

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.

NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND, SAN FRANCISCO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR [illegible] ARE ON SALE IN EVERY LEADING HARDWARE [illegible] IN THE UNITED STATES AND CANADA.

H. BARNETT COMPANY

PHILADELPHIA, PA.

Western Electrician

Vol. XXXI. $3.00 Per Annum. Copyright, 1901, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 27, 1902. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 26.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1137 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 28-81 Cornhill, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt, W. H. Hodgins, Secy.

TRADE MARK — CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

BEFORE CONTRACTING FOR INCANDESCENT LAMPS
GET THE STERLING SPECIAL LITERATURE.
STERLING ELECTRICAL MFG. CO. WARREN, OHIO.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
Standard Underground Cable Co.
822 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. Mills Bldg., San Francisco. 56 Liberty St., New York City. 101 Milk St., Boston. 1225 Betz Bldg., Philadelphia, Pa.
Electric Cables, Conduits, Wires and Accessories.
Also High Grade Rubber Covered Wires and Cables.

Bug-Proof Bell. Segerdahl Patent.
Sample, 3-in Nickel, 50c Enameled, 45c.
By mail, prepaid. Made in sizes 2 to 8-inch. Dealers send for prices. We also make Inventors' Models and Special Electrical Devices. Write us for prices.
SPIES ELECTRIC CO., 87-89 W. Van Buren Street, Chicago, Ill.

BARE AND INSULATED
ELECTRICAL WIRES
OF EVERY DESCRIPTION.
CROWN RAIL BONDS.
American Steel & Wire Co.
CHICAGO. NEW YORK. WORCESTER. DENVER. SAN FRANCISCO.

2,000 IN USE.
Bipolar and Multipolar Motors from ½ to 60 horsepower. Dynamos from 10 lights to 700. We sell or rent. Good profits for agents.
The Hobart Elec. Mfg Co. Troy, Ohio

HYLO
TURN-DOWN LAMP
Teaches people to use more current by turning lamps down instead of out. Write for detailed information.
PHELPS CO., 50 State St., Detroit, U. S. A.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
SEND FOR COPY OF OUR NEW AND LATEST CATALOGUE.
Pittsburg. New York. Chicago.

TRIUMPH
SMALL GENERATING SETS FOR MARINE WORK OR SMALL ISOLATED PLANTS.
WE MANUFACTURE
GENERATORS AND MOTORS
OF ALL KINDS AND FOR ALL PURPOSES.
TRIUMPH ELECTRIC CO.,
SEND FOR BULLETIN "W E" CINCINNATI, O.

Kilfyre DRY POWDER COMPOUND
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.
Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

CONTINUOUS RAIL JOINT CO. OF AM.
GENERAL OFFICES, CENTURY BUILDING,
NEWARK, N. J.
Over ten thousand (10,000) miles in use. Received the highest award in its class at Paris Exposition, 1900, and Pan-American, Buffalo, 1901.

WESTON Electrical Instrument Co.,
Waverly Park, ESSEX CO., N. J.

Weston Portable Galvanometer for Bridge Work.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milliammeters,
Ground Detectors and Circuit Testers,
Ohmmeters, Portable Galvanometers.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., No. 101 St. Martins Lane.
Mention the WESTERN ELECTRICIAN when writing for catalogues.

PARAGON REFLECTORS

Silver-Plated Mirror Reflectors.
A deep cone, for use with any system of incandescent electric light where it is desired to concentrate a very powerful light on a small space. Lined with silver-plated mirror glass. Increases the light from every fifteen times. Most valuable in show windows and for machine work, also for type-writing, etc.
Thousands of this style used in show windows. Get our Catalogue and Prices.
American Reflector & Lighting Co.,
271-273 FRANKLIN ST., CHICAGO.

"Ceco." Electrical Machinery.

250 K. W 3 Phase "Ceco" Alternator.

For Lighting, Power and Railway Service.

Direct-Current Enclosed "Ceco" Motor.

"Ceco" apparatus is modern in design, accurate in construction, and superior in performance. Write for Catalogue 27.

Christensen Engineering Company,

MILWAUKEE.

THE COMING

NEW YEAR'S ISSUE

OF THE

Western Electrician

will be of exceptional interest and value to every electrical worker. As in previous New Years Numbers the carefully prepared statistics of electrical manufactures in the United States for the year 1902 will be a noteworthy feature of this number. To illustrate the correctness of the Western Electrician's estimates, it may be observed that the figures published in our New Year's issue of January 5, 1901, agreed substantially with the Government census statistics made public last August. This important issue will be an exceptionally choice one for advertisers. An attractive announcement would enable you to place the merits of your product before nearly every prospective buyer. To obtain a choice location and a striking advertisement we would urge you to send in your copy at the earliest possible moment.

WESTERN ELECTRICIAN, - 510 Marquette Bldg., CHICAGO.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA.

MANUFACTURER OF THE "Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

Price Lists and Descriptive Bulletins forwarded upon request

SALES OFFICES:

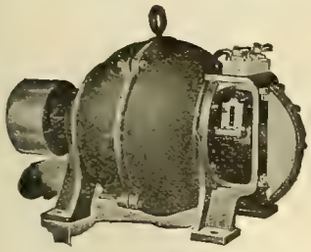
PHILADELPHIA, Allegheny Ave. and 19th St. — BOSTON, 60 State Street. — BALTIMORE, Continental Trust Building. — DETROIT, Michigan Electric Company. — ST. LOUIS, Wainright Building. — NEW YORK, 100 Broadway. — CHICAGO, Marquette Building. — CLEVELAND, New England Building. — SAN FRANCISCO, Nevada Block. — HAVANA, CUBA, F. G. Greenwood, Mgr., 84 Empedrado St.

SPRAGUE ELECTRIC COMPANY'S

DIRECT CURRENT MOTORS

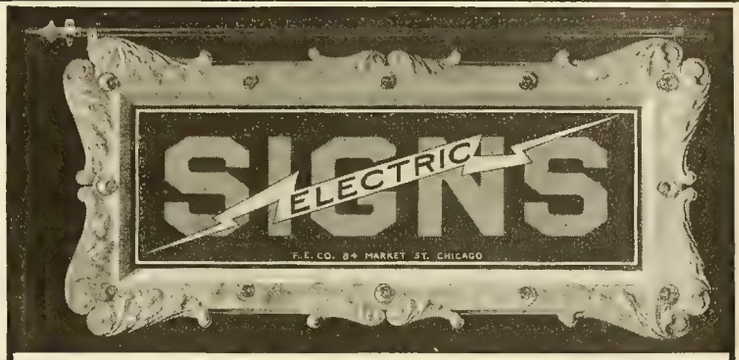
are unequaled for driving all classes of machine tools.

Write for Descriptive Bulletin No. 206.



GENERAL OFFICES:
527 W. 34th St., New York.

CHICAGO OFFICE:
Fisher Building.



$100,000 YEARLY INCOME

to fifty central stations now using Federal All-Metal Electric Signs. Will average $200 to $300 per year per Kw. of station capacity. Engraving shows our new No. 108 ornamental sign. Write for Bulletins descriptive of Federal Signs. Mailed free to central stations.

FEDERAL ELECTRIC COMPANY,
84 MARKET ST., CHICAGO, ILL., U. S. A.

Western Manufacturers' Agent.

REPRESENTING:
THE ROBBINS & MYERS CO., SPRINGFIELD, O.
INDIANA RUBBER & INSULATED WIRE CO., JONESBORO, IND.
PROCTOR-RAYMOND MFG. CO., BUFFALO, N. Y.
RENIM SPECIALTY CO., BOSTON, MASS.

ARTHUR F. STANLEY
BROADWAY AND MAIDEN LANE BLDG.
NEW YORK.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO.

An INCANDESCENT LAMP represents a large investment of capital, ingenuity and skilled workmanship, It is sold at a price so low as to necessitate eternal vigilance in cutting costs to a minimum. A successful lamp manufacturer can not afford to experiment with poor materials. This explains the popularity of

BAKER & CO.'S PLATINUM

408 N. J. R. R. Ave., NEWARK, N. J. 120 LIBERTY ST., NEW YORK.

We buy and Refine Platinum Scrap also.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Smoking Pipe Co.....—
Allen Company, L. B..... 13
Allis-Chalmers Company....22
American Battery Co.....—
Amer. Electrical Heater Co...—
Amer. El. Telephone Co.....17
American Electrical Works..13
American Platinum Works. —
American Refl. & Lighting Co. 1
American School of Corresp .—
Amer. Steel & Wire Company 1
Anderson & Sons, W. H.....18
Audel & Company, Theo.... —

Baker & Company..... 3
Barnett Company, G. & H....22
Barron & Co., J. S.....—
Beardslee Chandelier Mfg. Co.12
Berthold & Jennings.....19
Besly & Co., Charles H.....22
Bonville, Edward 14
Bossert El. Construction Co.. 7
Brooks, Hall L..... 19
Brown & Leasure..... 12
Buffalo Forge Co.....22

Camp Company, H. B..... 7
Central Electric Co..... 5
Central Manufacturing Co ..—
Central Telephone & El. Co..—
Century Glass Co..... 7
Chase-Shawmut Company...13
Chicago & Alton Railroad....15
C. & N. W. R. R.....14
Chicago Edison Company.4, 14
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
C., M. & St. P. R. R.....15
Chicago Pay Station Co.....17
Christensen Engineering Co. 2
Commercial Elec. Supply Co.—
Consumers Carbon Co..... 9
Continuous Rail Joint Company of America..... 1
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company .10
Cutler-Hammer Mfg. Co.....11
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company .....—
Dearborn Drug & Chem. Co..18
Diamond Meter Company ...—
Dixon Crucible Co., Joseph..18
Duncan Electric Mfg. Co.... 21

Edison Decorative & Miniature Lamp Department.... 12
Edison Mfg. Company.....13
Edwards & Company.....15
Electrical Engineer Institute.—
Electric Appliance Company.12
Electric Storage Battery Co.. 3
Electrician Pub. Company...15

Faries Manufacturing Co....—
Federal Electric Company... 3
Fisher Electric Company.... 9
"For Sale" Advertisements..14
Ft. Wayne Elec. Works., Inc.21
Fowler, John H.....19
Franklin Eng. & Elec. Co....—
Fulmer Lumber Co., D. M....19

General Electric Company... 9
General Incandescent Arc Light Company..... 5
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Great Western Smelting & Refining Company.... 14
Gregory Electric Company...14

Hartford Steam Boiler Inspection & Insurance Co...18
Hazard Manufacturing Co....22
Helios-Upton Company..... 4
Hobart Elec. Mfg. Company.. 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co..... 7
Huebel Company, C. J.....19
Humphrey, Henry H.....12

Illinois Electrical Mfg. Co...—
Illinois Maintenance Co.....14
Incandescent Electric Light Manipulator Company..... 9
Indiana Rub. & Ins. W. Co... 1
India Rubber & Gutta Percha Insulating Company..... 5
Inland Printer Co.....—
Internat'l Corres. Schools....—
International Tel. Mfg. Co. ..17

Jeffrey Manufacturing Co....18
Johnston, Thomas J.....13

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....17, 19
Klein & Son, Mathias.....18
Kohler Brothers. 12
Kokomo Tel. & El. M. Co....16

Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lindsley Brothers Company..19
Lowell Model Co..... 9

Machado & Roller.....—
Maley, Martin..... 9
Maltby Lumber Company.. .19
Manhattan Elec. Supply Co.. 4
Marinette Iron Wks. Mfg. Co.18
Marshall-Sanders Co. 10
Matthews & Bros., W. N.....17
Mayer Engineering Co.....13
McLennan & Company, K....12
McNamara Brothers 9
Mechanical Appliance Co....13
Mechanical Boiler Cleaner Co.....18
Metropolitan Tel. & El Co...16
Mica Insulator Company.....—
Miscellaneous Advs.....14
Monarch Fire Appl. Co..... 1
Monon Railroad.....—
Moon Mfg. Co., The.....17
Morse Cedar Company.....19
Munsell & Co., Eugene.....12
Murdock Parlor Grate Co....12

National Conduit & Cable Co.12
National India Rubber Co.... 1
Nernst Lamp Co.....20
New York Ins. Wire Co.....11
N. Y. Safety Steam Power Co.13
Norton Elec'l Instrument Co.—

Okonite Company, The..... 1
Osburn Flexible Conduit Co.—

Paiste Co., H. T.....12
Paragon Fan & Motor Co.....—
Parsell & Weed.....22
Perrizo & Sons.....19
Phelps Company..... 1
Phillips, Eugene F.....13
Phillips Insulated Wire Co..13
Phœnix Glass Company..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....19
Porter Cedar Company.....19

Rauscher, John .....—
Reisinger, Hugo.....11
Replogle Governor Works.. .—
Reynolds Electric Company.—
Rice, Cyrus W 13
Roche, Wm.....—
Roebling's Sons Co., J. A.....22
Rooney-Westbury El. Lmp. Co.12
Rose Electric Company 14

Sargent & Lundy.....—
Sawyer-Man Elec. Company.—
Schoonmaker Co., A. G 14
Schott, W. H. 12
Schureman & Hayden.....14
Shelby Electric Company....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co... 12
Smith Co., S. Morgan.....18
Spies Electric Company..... 1
Sprague Electric Company... 3
Standard Pole & Tie Co.... .19
Standard Underg. Cable Co.. 1
Standard Varnish Works 13
Standard Vitrified Cond. Co. 6
Stanley, Arthur F..... 3
Stanley Instrument Co.....11
Station Equipment Co.....14
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co.. 1
Sterling Electric Company...16
Sterling Varnish Co., The.... 9
Stewart Electric Co., John A.15
Stilwell-Bierce & Smith-Vaile Company..... 9
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company 16
Sturtevant Company, B. F...22

Thompson Son & Co.....14
Toerring Company, C. J 12
Torrey Cedar Company.....19
Triumph Electric Co..... 1

U. S. Electric Mfg. Co.....16

Valentine-Clark Co., The....19
Vindex Electric Company....10
Vreeland, B. F. 19
Vulcanized Fiber Company..22

Wagner Electric Mfg. Co.....—
Wagor Mfg. Co., P. R.....22
Walsh's Sons & Company....14
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Company ..—
Weston Electrical Inst. Co. 1, 8
Whitehead Machinery Co....14
Whitmore, A. E.....19
Wickes Bros.....14
Wisconcin Central R. R.....18
Worcester Company, C. H....19

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

NEW YORK. CHICAGO.

Manhattan Electrical Supply Co.

BOYCOTT

DEAR READER:

In Chicago and vicinity this company is experiencing some inconvenience in filling orders promptly, owing to the boycott against us, for withdrawing from the Supply Dealers' Association.

Two concerns in particular are taking advantage of the situation. One, the *Bryant-Perkins Co.*, which makes a specialty of electric light supplies, will only sell us at "retail prices" from their Chicago stock.

The other concern, which is owned by the *Bell Telephone Co.*, operating under the name of *Western Electric Co.*, also turns us down, and will sell to us at "retail prices" only. *Rather a small game on their part, don't you think?*

We expect to be doing business at the old stand for some time to come, and ask users of electrical apparatus if a little independence, and our refusal to be squeezed by that OCTOPUS OF A CORPORATION which has been squeezing everybody in their telephone business, doesn't merit approval and support?

In order to keep up the interest, we are revising our prices, and our 560-page Catalogue and discount sheet will interest you both as to goods and prices.

We would like to hear from you.

MANHATTAN ELECTRICAL SUPPLY CO.

H-U. ACCUMULATORS.

For ELECTRIC LIGHTING and RAILWAY CENTRAL and SUB-STATIONS, POWER STATIONS, TELEPHONE, TELEGRAPH, RAILWAY CAR LIGHTING and all other purposes to which Storage Batteries are applicable.

We guarantee LOWEST FIRST COST, HIGHEST EFFICIENCY, MOST CONSERVATIVE RATING and CHEAPEST MAINTENANCE.

HELIOS-UPTON CO., 222 Fullerton Ave., CHICAGO.

PITTSBURG TYPE K

TYPE K TRANSFORMERS

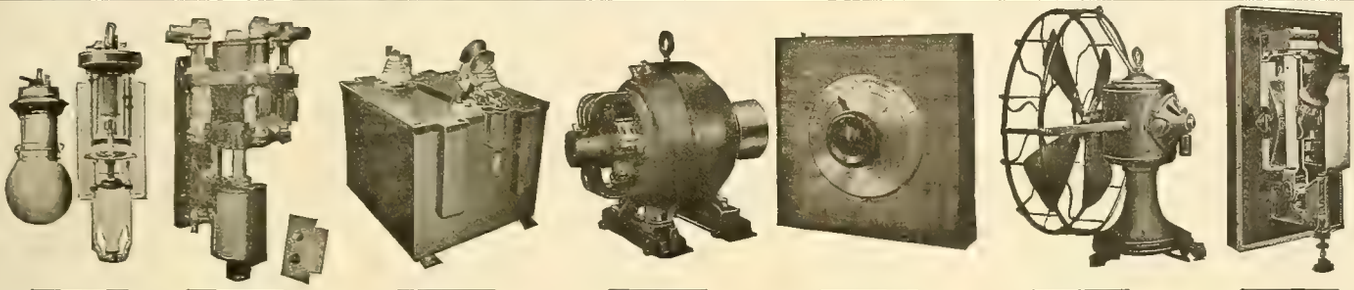
HIGHEST ELECTRICAL EFFICIENCY

PERFECT MECHANICAL CONSTRUCTION

SEND FOR DESCRIPTIVE BULLETINS AND PRICE-LISTS

Central Electric Company, GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO.



BULLETIN No. 172 | BULLETIN No. 54 | BULLETIN No. 53 | BULLETIN No. 164 | BULLETIN No. 155 | BULLETIN No. 162 | BULLETIN No. 152

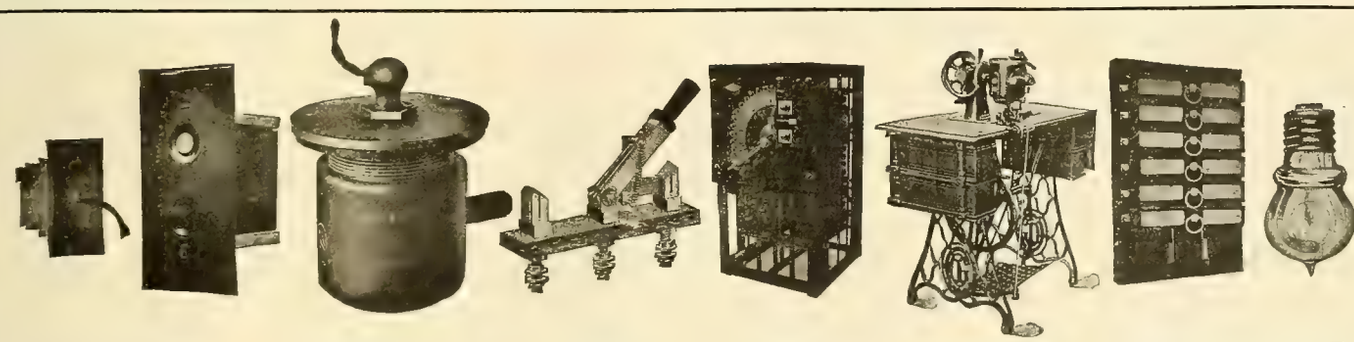
TRADE **G. I.** MARK

STANDS FOR ELECTRICAL AND MECHANICAL PERFECTION.

Bulletins, Blueprints, Photographs, Estimates, Etc., Mailed Upon Application.

GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK, N. Y.

220 Devonshire St., Boston, Mass.
48 West Jackson Blvd., Chicago, Ill.
638 Century Bldg., St. Louis, Mo.
1732 Champa St., Denver, Colo.
510 New England Bldg., Cleveland, Ohio.
319 Hayward Bldg., San Francisco, Cal.
57 Perin Bldg., Cincinnati, Ohio.
115-117 Cannon St., London, E. C. Eng.



BULLETIN No. 54 | BULLETIN No. 94 | BULLETIN No. 50 | BULLETIN No. 240 | BULLETIN No. 65 | BULLETIN No. 51 | BULLETIN No. 190

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)

R. W. LYLE, President and Manager B. S. BARNARD, Vice-President and Secretary.

Standard Vitrified Conduit Company

VITRIFIED SALT GLAZED UNDERGROUND

CONDUITS AND INSULATORS

General Office, 39 and 41 Cortlandt Street = = = = New York

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.
Vought-Berger Company.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Babbitt Metal and Solder.
Gr. Western Sm. and Refg. Co.

Batteries and Jars.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Roche, Wm.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Rauscher, John.
Spies Electric Company.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Buffalo Forge Co.
Sturtevant Co., B. F.

Boiler Cleaners.
Mechanical BoilerCleaner Co.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
N. Y. Safety Steam Power Co.
Whitehead Company, W. W.

Books, Electrical.
Audel & Company, Theo.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
Barron & Co., Jas. S.
Chase-Shawmut Company.
Western Electric Co.

Cables. (See Insulated Wires.)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Western Elect. Supply Co.

Castings.
Christensen Engineering Co.
Smith Co., S. Morgan.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Badt & Co., F. B.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound.
Allen Co., L. B.
McLennan & Co., K.

Conduit and Conduits.
Camp Company, H. B.
Central Electric Co.
Electric Appliance Co.
National Conduit & Cable Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Western Elect. Supply Co.

Conduit Rods.
Barron & Co., Jas. S.

Construction & Repairs.
Chicago Edison Co.
Parsell & Weed.
Spies Electric Company.
Western Electric Co.

Contractors and Electric Light Plants.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Correspondence Schools.
American School of Corresp.
Electrical Engineer Inst.
Int. Correspond. Schools.

Cross-Arm Braces, Etc.
Anderson & Sons, W. H.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Central Manufacturing Co.
Standard Pole & Tie Co.
Western Elect. Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Edison Co.
Cutter Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Marshall-Sanders Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Cuts.
Franklin Eng. & Electro. Co.

Dynamos and Motors.
Central Electric Co.
Christensen Engineering Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
Parsell & Weed.
Schureman & Hayden.
Sprague Electric Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Company.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electric Signs.
Federal Electric Company.

Electrical and Mechanical Engineers.
Brown & Leasure.
Humphrey, Henry H.
Kohler Brothers.
Mayer Engineering Co.
Sargent & Lundy.
Schott, W. H.

Electrical Instruments.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Lowell Model Co.
Marinette Iron Wks. Mfg. Co.
Parsell & Weed.

Engines, Steam.
Allis-Chalmers Company.
Buffalo Forge Co.
N. Y. Safety Steam Power Co.
Sturtevant Co., B. F.
Whitehead Machinery Co.

Fan Outfits.
Buffalo Forge Co.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Extinguishers.
Monarch Fire Appliance Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co

Flashers.
Reynolds Electric Company.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Buffalo Forge Co.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Western Electric Company.
Western Elect. Supply Co.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Central Electric Co.
Chicago Edison Co.
Commercial Elec. Supply Co.
Electric Appliance Co.
Fisher Electric Company.
General Electric Co.
Manhattan Elec. Supply Co.
Vought-Berger Co.
Western Electric Co.
Western Elect. Supply Co.

Globes and Electrical Glassware.
Century Glass Co.
Phœnix Glass Co.
Western Elect. Supply Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating and Ventilating Apparatus.
Buffalo Forge Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance.
Hartford Steam Boiler Inspection & Insurance Co.

Insulators and Insulating Materials.
Akron Smoking Pipe Co.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Hemingray Glass Co.
Indiana Rub. & Ins. Wire Co.
Kartavert Mfg. Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Varnish Works.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cbl. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co.
Roebling's Sons Co. J. A.
Simplex Electrical Co.
Standard Underground C. Co.
Western Elec. Supply Co.
Western Electric Company.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamp Guards.
Wagor Mfg. Co., P. R.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Central Electric Co.
Ft. Wayne Elec. Wks., Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Nernst Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Central Electric Co.
Chicago Edison Co.
Edison Decorative & Miniature Lamp Dept
Electric Appliance Co.
General Electric Co.
General Inc. Arc Light Co.
General Inc. Lamp Co.
Nernst Lamp Co.
Phelps Company.
Rooney-Westbury El. Lmp. Co.
Sawyer-Man Elec. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Inc., Adjusters.
Inc. El. Lt. Manipulator Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Nernst.
Commercial Elec. Supply Co.
Nernst Lamp Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Climbers.
Anderson & Sons, W. H.
Klein & Son, Mathias.

Magnet Wires.
(See Insulated Wires.)

Manufacturers' Agent.
Stanley, Arthur F.

Mechanical Draft.
Sturtevant Co., B. F.

Meters.
Diamond Meter Co.
Duncan Electric Mfg. Co.
Ft. Wayne Elec. Wks., Inc.
General Inc. Arc Light Co.
Westinghouse El. & Mfg. Co.

Mica.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors).

Name Plates.
Murdock Parlor Grate Co.

Nippers and Pliers.
Klein & Son, Mathias.

Packing.
Besly & Co., Chas. H.

Patent Attorneys.
Johnston, Thomas J.
Rice, Cyrus W.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm. Co., Ltd.

Platinum Bought and Sold.
American Platinum Works.
Baker & Company.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Fowler, John H.
Fulmer Lumber Co., D. M.
Huebel Company, C. J.
Lindsley Bros. Co.
Maltby Lumber Co.
Morse Cedar Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Vreeland, B. F.
Whitmore, A. E.
Worcester Co., C. H.

Polish (Metal).
Hoffman, Geo. W.

Porcelain.
Akron Smoking Pipe Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Pulleys.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Rail Bonds.
American Steel & Wire Co.
Badt & Co., F. B.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West. Sm. and Refining Co.

Reflectors and Shades.
American Refl. & Lighting Co.
Faries Manufacturing Co
Western Electric Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Schureman & Hayden.

Rheostats.
Badt & Co., F. B.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Second-Hand Mach'y.
Gregory Electric Co.
Illinois Electrical Mfg. Co.
Ill. Maintenance Co.
Matthews & Bro., W. N.
Rose Electric Company.
Schoonmaker Co., A. G.
Schureman & Hayden.
Station Equipment Co.
Stewart Electric Co., John A.
Thompson, Son & Co.
Walsh's Sons & Co.
Whitehead Machinery Co.
Wickes Bros.

Slate.
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Sockets & Receptacles.
Paiste Co., H. T.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Western Electric Co.
Western Elec. Supply Co.

Speed Indicators.
Besly & Co., Chas. H.
Weston Electrical Inst. Co.

Springs.
American Steel & Wire Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.

Switchboards (Slate and Marble).
Bonville, Edward.
Maley, Martin.
McNamara Brothers.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tele. & Elec. Co.
Chicago Pay Station Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Metropolitan Tel. & Elec. Co.
Moon Mfg. Co., The.
Sterling Electric Co.
Stromberg-Carlson Tel. M. Co.
U. S. Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.

Tools.
Anderson & Sons, W. H.
Klein & Son, Mathias.
Western Electric Co.

Transformers.
Central Electric Company.
Christensen Engineering Co
Crocker-Wheeler Company.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Standard Electric Company,
Vindex Electric Company.
Wagner Electric Mfg. Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines, Water Wheels.
Leffel & Co., Jas.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Varnishes.
Standard Varnish Works.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Water Wheel Governors.
Replogle Governor Works.

Wires, Copper.
American Electrical Works.
American Steel & Wire Co.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground C. Co
Western Electric Company.

Wire, Bare.
American Steel & Wire Co
Besly & Co., Chas. H.
Central Electric Co.
Chicago Insulated Wire Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Standard Underground C. Co.
Western Electric Co.
Western Electrical Sup. Co.

For Alphabetical Index of Advertisements See Page 3.

THE H. B. CAMP CO.

MANUFACTURERS OF

"Camp" Standard Vitrified Clay Conduits for Underground Wires.

Installers of Complete Underground Conduit Systems.

SALES OFFICES

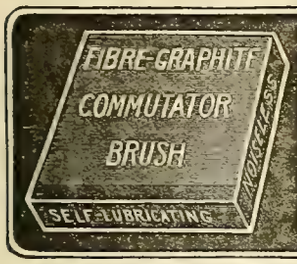
Room 85 Hartford Building, Chicago. 170 Broadway, New York.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.



There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

WE CAN PLEASE YOU
IN THE LINE OF
ELECTRICAL GLASSWARE

AND ARE PREPARED TO FURNISH YOU WITH GLOBES OR SHADES FOR ALL TYPES OF LAMPS.

OPEN AND ENCLOSED, OUTER AND INNER ARC GLOBES AND SHADES.

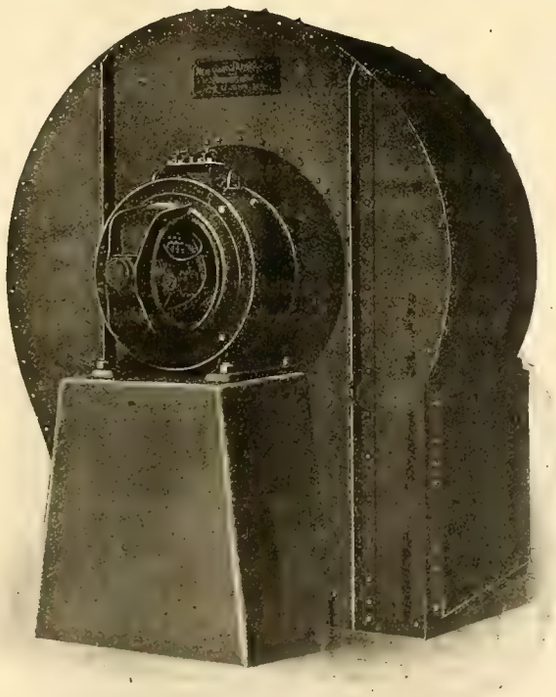
WRITE FOR CATALOGUE.

THE CENTURY GLASS CO., BELLAIRE, OHIO.

Motor Driven Exhaust Fan and Blower Equipments

For Ventilation and Heating Purposes.

All Styles and Sizes.



Adapted for Use in Hotels, Restaurants, Theatres, Laundries, etc.

Fully Described in Bulletin No. 3020.

Chicago
Saint Louis

Western Electric Company

New York
Philadelphia

United States Patents for Weston Electrical Measuring Instruments Sustained.

In the final hearing in a suit in equity, after submission of full proofs and arguments on both sides, Judge Coxe, of the United States Circuit Court, Southern District of New York, holds that the KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, has infringed certain patents of the WESTON ELECTRICAL INSTRUMENT COMPANY by its manufacture and sale of certain electrical measuring instruments, and awards a decree for perpetual injunction and for an accounting of the profits and damages.

The purpose of this notice is to call the attention of dealers and users of electrical measuring instruments sharply to the fact, that these patents of the Weston Electrical Instrument Company have been sustained after long and expensive litigation; and that the rights of the Weston Electrical Instrument Company will be enforced against ALL who aid and abet the infringement by dealing in or by using Keystone or other instruments embodying the features covered by these broad patents.

Other suits are now being pressed to a hearing against the Keystone Company and their agents, the Cutter Co., and also against other makers. All who deal in or use instruments infringing these basic patents do so at their peril.

Copies of the opinion, which is a broad and sweeping one, may be had upon request to the undersigned. Pertinent excerpts therefrom follow:

"Many of the perplexities which usually beset patent causes are entirely absent here. We are enabled to "start with several fundamental propositions which cannot be successfully disputed.

"FIRST: Mr. Weston was the first to make a successful commercial voltmeter for measuring alternating "currents.

"SECOND: The device of the patent is small, simple, compact, easily operated and requires no preliminary "adjustment. It can be operated at any angle by an unskilled workmen, and will measure direct as well as "alternating currents.

"THIRD: Strictly speaking, there is no prior art. There were no instruments entitled to be considered "as anticipations. . . . .

"FOURTH: The invention is not disclosed in any prior patent or publication.

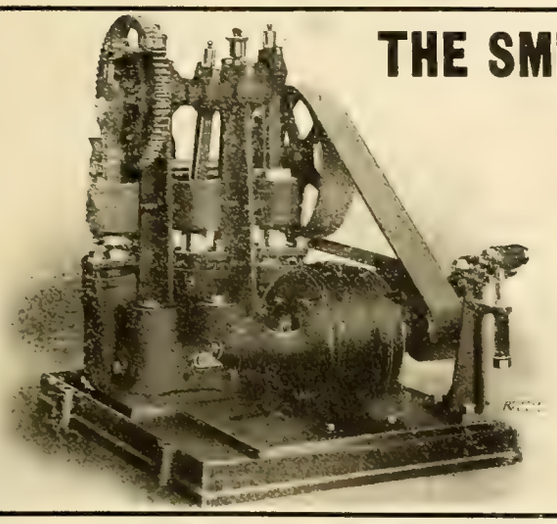
"FIFTH: Infringement is clear. The defendants have copied the patented instrument even in its minute "details. . . . . .

"Few patents that come before the courts are entitled to more liberal treatment. This is a case where, upon "the undisputed testimony, the inventor has accomplished something which has been of unquestioned benefit "to the electrical world.

"THE COMPLAINANT IS ENTITLED TO THE USUAL DECREE FOR AN INJUNCTION "AND AN ACCOUNTING."

Weston Electrical Instrument Co.

Waverly Park, = = Newark, N. J., U. S. A.



THE SMITH-VAILE ELECTRIC TRIPLEX PUMPS

afford an excellent means for pumping water for House service, Hydraulic Elevator service Factories and Mills desiring an independent water supply, also for Mine Work and : : : :

WATER WORKS SUPPLY.

Can be located wherever electric current is available, and require little or no attention after once installed. We make steam and power : : : : : : : : : : : : : : : : : :

PUMPING MACHINERY FOR ALL PURPOSES.

Jet and Surface CONDENSERS, Feed Water Heaters and Victor Turbine Water Wheels

THE STILWELL-BIERCE & SMITH-VAILE CO.,

DAYTON, OHIO, U. S. A.

New York: 141 Broadway. Chicago: 311 Dearborn St. Boston: 73 Oliver St.
Philadelphia: 612 Arch St. Cleveland: 1116 New England Bldg. Baltimore: 1107 Continental Trust Bldg.
New Orleans: 304 Hennen Bldg.

Sales Agents: FREDERIC NELL, 97 Queen Victoria St., London, Eng. E. F. AUSTIN, Smith Blk., Pittsburg.

McNAMARA BROS.
ELECTRIC SWITCHBOARDS,
SLATE AND MARBLE.
Write for Catalogue B. Fair Haven, Vt.

HELP
Secured quickly through Western Electrician "Help Wanted" ads.

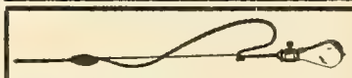
FISHER ELECTRIC CO.
TOLEDO, O
ELECTRIC SUPPLIES AND CONSTRUCTION.
WE CARRY A FULL LINE.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

STERLING EXTRA INSULATING VARNISH.
Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.
THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A.
THE STERLING VARNISH CO., 26 Colmore Row, Birmingham, England.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

MARTIN MALEY,
MANUFACTURER OF ALL KINDS OF
VERMONT SLATE
FOR ELECTRICAL USE.
Switchboards A Specialty.
FAIR HAVEN, VERMONT.



MORSE AUTOMATIC LAMP ADJUSTER
For Mills, Factories and Offices
Incandescent Electric Light Manipulator Company,
116 Bedford Street, Boston, Mass.

GASOLINE MOTORS

—FOR—
BICYCLES, VEHICLES, LAUNCHES.
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

GENERAL ELECTRIC COMPANY'S

TYPE "H" TRANSFORMERS—CORE TYPE.

Type "H" Transformers for high potentials, and of the largest sizes, are not only provided with ducts for circulation of cooling oil between the secondary winding and the core, but also between the secondary and primary windings, thus securing perfect insulation between primary and secondary and a low uniform temperature rise.

PRINCIPAL OFFICE: Schenectady, N. Y.

CHICAGO OFFICE, Monadnock Block. Sales Offices in all Large Cities.

RENEWALS

December is an important month for the renewal of subscriptions. If your subscription is expiring this month, or even if it is expiring in January, it is to your interest to send in your renewal now so that the subscription may be extended on our books in plenty of time to prevent your missing any copies.

To make a Christmas gift of the WESTERN ELECTRICIAN send us the name and address of the person to whom you wish to give the subscription, with the annual subscription price of $3, and the paper will be sent regularly for 52 weeks.

With January 1st will begin the thirty-second volume of the WESTERN ELECTRICIAN, and during 1903 it will complete its sixteenth and the first half of its seventeenth year, the paper having been founded July 2, 1887, and continued under the present management for this entire period. We offer the past as a guaranty of the future, and in addition pledge the best efforts of an experienced and competent staff to the constant improvement of the paper.

The WESTERN ELECTRICIAN is published for the purpose of assisting everyone interested in the art. It is a general electrical and scientific paper, and gives to its readers all the latest news and keeps them thoroughly informed of everything that is going on in all the different departments of the electrical and allied fields. Its technical and scientific articles cover all the latest inventions and improvements and keep the reader thoroughly informed of all that is new in the art. Its special articles, written by the most prominent authorities, as well as its general articles, are of the highest order, and no interested person can afford to be without the paper.

SUBSCRIPTION PRICE PER YEAR

Of Fifty-two Numbers

IN THE

United States	**$3.00**
Foreign Countries	**5.00**

SAMPLE COPY FREE.

Electrician Publishing Company, SUITE 510, MARQUETTE BUILDING, CHICAGO, U. S. A.

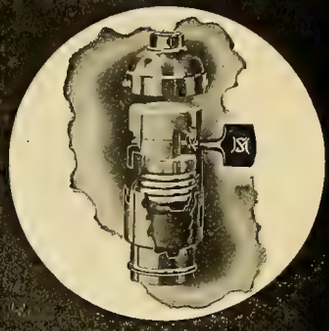
SOCKET ECONOMY

We invite the attention of Contractors using sockets to the economy of the M make. The linings, while easily removable with the fingers for re-finishing shells, never drop out. An economy of the wireman's time while connecting.

The binding screws are also so conveniently arranged and so nicely fitted that one contractor using large numbers reports a saving of from three to five dollars a thousand in connecting, owing chiefly to the perfection of these details, and the easy assembling of the caps and shells.

The mechanism is made by automatic machinery — which spells uniformity.

We are making a push button switch a little better than any heretofore offered. We make all flush and push plates to the standard size as authorized by the National Electrical Contractors' Association. Samples of switch upon request.



M.-S. KEY SOCKET.

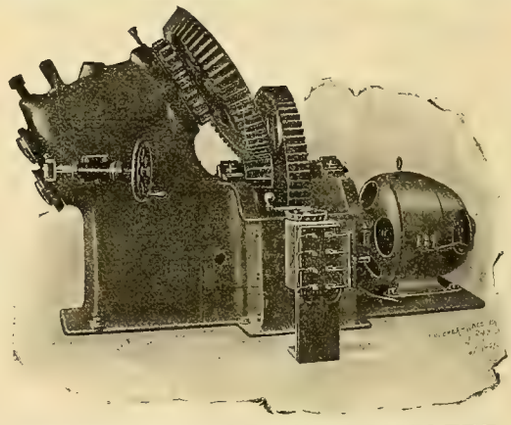
MARSHALL-SANDERS COMPANY.

301 CONGRESS ST., - - - - - BOSTON, MASS.

MILLS BUILDING, SAN FRANCISCO. STIMSON BLDG. LOS ANGELES.
NEW YORK BLOCK, SEATTLE, WASH. MONADNOCK BLDG., CHICAGO.

ALL Live men read the **WESTERN ELECTRICIAN** Each Week. Do You?

CROCKER-WHEELER COMPANY AMPERE N J U S A



THE SUCCESS OF OUR COMPLETE MACHINE SHOP EQUIPMENTS HAS PROVEN THE SUPERIORITY OF OUR SYSTEM OF ELECTRIC DRIVE.

TRANSFORMERS.

THE VINDEX ELECTRIC COMPANY — AURORA, ILL.

The "Electra" Carbons are the recognized standard all the world over.

HIGHEST GRADE NUERNBERG CARBONS
FOR ENCLOSED LONG BURNING ARC LAMPS
FOR DIRECT CURRENT
FOR ALTERNATING CURRENT
ARC LAMPS.

ELECTRA CARBONS

ELECTRA TRADE MARK

UNEQUALED IN
QUALITY AND EFFICIENCY.
PRODUCE EXCELLENT, UNIFORM,
STEADY AND BRILLIANT LIGHT.

HUGO REISINGER | 11 BROADWAY, NEW YORK.

There are no Carbons better than the "Electra" and none "just as good."

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. | BOSTON: 7 Otis St. | SAN FRANCISCO: 33 Second St.

Only workmen of experience and proven ability are engaged in manufacturing our goods. When you buy, you get the best that money can buy and no trouble follows your bargain.

C & H RHEOSTATS AND ELECTRIC CONTROLLING DEVICES

invite your investigation. Write to us for any desired information.

THE CUTLER-HAMMER MFG. CO.

AGENTS: Sturtevant Engineering Co. Ltd., London, Eng.
Edge & Edge, Sidney, Australia.
Kilbourne & Clark Co., Seattle, Wash.

MAIN OFFICES AND FACTORY--MILWAUKEE
BRANCH OFFICES--NEW YORK & CHICAGO

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation. Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

NOW READY!!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1903.

ARRANGED IN BOOK FORM, POCKET SIZE.

10 Cents per Copy. Send for It.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

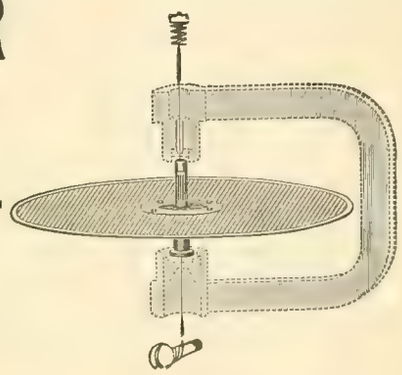
FLOTATION IN AIR

OF THE MOVING PARTS OF
STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT
IS ACCOMPLISHED BY

MAGNETIC SUSPENSION.

NO WEAR. NO LOST REVENUE.
NO FRICTION. ALL CURRENT USED RECORDED.

SEND FOR DESCRIPTION AND BOOK FULL OF GOOD INFORMATION
"ABOUT METERS."



STANLEY INSTRUMENT CO.,
GREAT BARRINGTON, MASS., U. S. A.

PACIFIC COAST AGENTS:
JOHN MARTIN & CO., San Francisco, Cal. | Los Angeles, Cal. | Seattle, Wash.

Non-Flickering

Light of the non-flickering type comes from a perfect lamp in perfect order. The A-B Lamps don't flicker because there is nothing to get out of order.

BULLETINS UPON REQUEST.

ELECTRIC APPLIANCE COMPANY,
92 & 94 W. VAN BUREN ST., CHICAGO.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.,
218 Water St., New York. 117 Lake St., Chicago.

ARC LAMPS

ARC LAMPS

39 Cortlandt St.

THE SHORTEST DAYS

of the year are made bright and profitable to all who use Toerring Arc Lamps.
The largest, the most progressive, the most successful mills, factories, stores and stations use them. Can you afford to pay twice as much as they for carbons, etc.? Write for Bulletin No. 4.

19th & Allegheny Ave.

NEW YORK CITY. C. J. TOERRING CO. PHILADELPHIA.

ARE YOU IN NEED OF

MINIATURE OR
CANDELABRA LAMPS

IN A HURRY?

IF SO send to us. Quality Guaranteed.

CATALOGUE ON REQUEST.

THE ROONEY-WESTBURY
ELECTRIC LAMP CO.,
154 E. 23rd St.,
NEW YORK CITY.

VOLT-AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
38-40 Cortlandt St., NEW YORK, N. Y.

CHAS. L. BROWN. E. E. LEASURE.

BROWN & LEASURE,
Electrical Contractors,
312 Fisher Building,
Telephone Harrison 3698. CHICAGO

Long Distance Phone Central 2448.

W. H. SCHOTT,
ENGINEER AND CONTRACTOR,
Specialties: Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 Marquette Building, CHICAGO.

KOHLER BROTHERS,
CONTRACTING ELECTRICAL ENGINEERS.
LIGHTING POWER RAILWAYS
1804-1806-1808-1810-1812 Fisher Building.
CHICAGO.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Manufacturers, 909, 100 Washington St., Chicago.

BEARDSLEE CHANDELIER MFG CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

THE "P-K" ROSETTE

needs no description, it is so well known for its *exclusive superior points.*

Just specify "P-K"

H. T. PAISTE CO.,
Chicago - Philadelphia - New York

Electric Heating Apparatus.
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.
CHICAGO, Monadnock Block.

HENRY H. HUMPHREY,
CONSULTING ENGINEER
CENTRAL LIGHTING STATIONS,
ELECTRIC POWER TRANSMISSION.
Suite 1305, Chemical Bldg., St. Louis.

NAME PLATES
FOR MACHINERY.
We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.
No Plate Too Large or Too Small.

MURDOCK PARLOR GRATE CO.,
161 Boylston St., Boston, Mass, U. S. A.

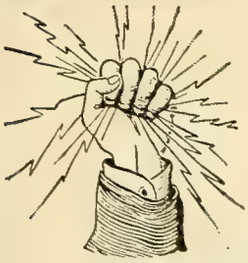
THE NATIONAL CONDUIT & CABLE CO.

Manufacturers of BARE COPPER WIRE AND CABLE, PAPER INSULATED CABLES, FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER.
CEMENT LINED PIPE FOR CONDUITS.
Executive Offices, Times Building, NEW YORK, N. Y.

FRANK N. PHILLIPS, President. C. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, JR., Sec

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE "MAYER" DROP.
WRITE FOR PRICES.
THE MAYER ENGINEERING CO.
Monadnock Block, Chicago, Ill.

Six Years with General Electric Company.

THOMAS J. JOHNSTON,
Counsellor at Law,
No. 66 Broadway, - NEW YORK CITY.
Patent Causes. Patent Soliciting.

DODGE SUBSTITUTES (?) FOR THE ALLEN SOLDERING STICK MAKES SOLDER FLOW

WE PROTECT YOU

BY THIS on a pink Label { Beware of Imitations. L. B. Allen. None Genuine without Signature.

You Protect Yourself.

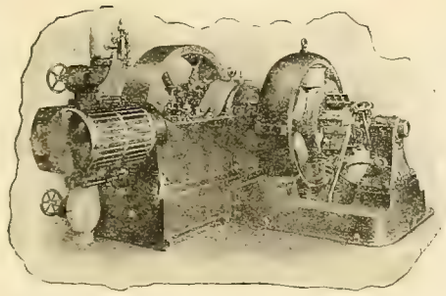
EVER SPILL YOUR CHOCOLATE?
Full Size ALLEN Stick Free for Trial.

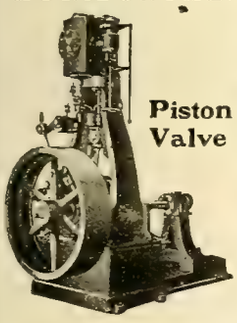
L. B. ALLEN CO., Inc. Sole Manufacturers, 1334 Columbia Ave. CHICAGO.

ENGINES

VERTICAL OR HORIZONTAL.

AUTOMATIC.





Piston Valve

For Direct Connected or Belted Service. Heavy Duty. High Speed. High Pressure. Units from 6 to 200 H.-P.

DUPLICATE PARTS ALWAYS ON HAND.

N. Y. SAFETY STEAM POWER CO.
60 South Canal Street, - CHICAGO, ILL.
New York. Philadelphia. San Francisco. Boston.

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents,
1211 Ashland Block, CHICAGO.
Bank References. Branch Office Washington, D.C.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

FOR HIGH GRADE
INSULATING VARNISHES
ADDRESS
STANDARD VARNISH WORKS
CHICAGO NEW YORK LONDON

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

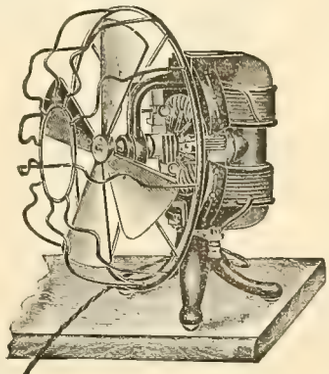
Phillips Insulated Wire Co.,

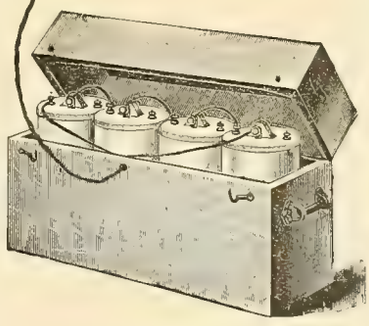
Office and Factory: PAWTUCKET, R. I.

EDISON

BATTERY FAN OUTFITS
...WITH...
EDISON PRIMARY CELLS

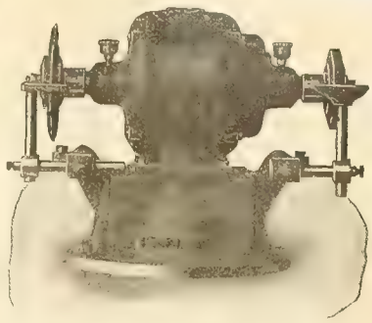
Are the only efficient battery fan outfits on the market. Invaluable for the sick room.





Write for Catalogue No. 4.

EDISON MFG. CO.,
FACTORY, Orange, New Jersey, U. S. A.
NEW YORK OFFICE, 83 Chambers Street.
CHICAGO OFFICE, 144 Wabash Avenue.



WATSON

MOTOR BENCH GRINDER.

A PORTABLE DUST-PROOF ELECTRIC GRINDER. A BENCH TOOL WHICH EVERY MACHINE SHOP IN THE COUNTRY SHOULD BE EQUIPPED WITH. A TIME SAVER AND A MONEY MAKER YOU CANNOT AFFORD TO BE WITHOUT. ASK WHY? BUILT FOR 110 AND 220 VOLTS.

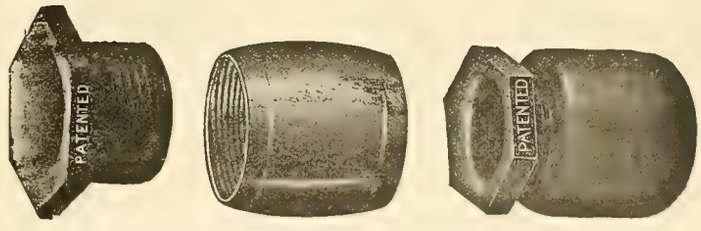
THE MECHANICAL APPLIANCE COMPANY,
MILWAUKEE.
Ask for Bulletin No. 55.

TO CONTRACTORS

USE THE

CHASE NIPPLE COMBINATION

IN YOUR JUNCTION AND OUTLET BOXES.



IT SAVES IN { COST, LABOR OF INSTALLING, ECONOMY OF SPACE IN BOX.

It Makes Rigid Connection Between Box and Conduit. No Other Combination Leaves so Much Working Space in the Box.—This is of Great Importance in Switch Boxes.

IN USE EVERYWHERE.

CHASE-SHAWMUT CO.
(SOLE MANUFACTURERS.)
BOSTON, MASS.

THOS. G. GRIER CO., 128 W. JACKSON BLVD., CHICAGO, ILL.
WESTERN REPRESENTATIVE.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

Agents wanted for our Electrical Specialties.

J. JONES & SON,
64 Cortlandt St., New York City.

MOTORS WANTED.

500-VOLT MOTORS, FROM TWO TO FIFTEEN HORSEPOWER.

ROSE ELECTRIC CO., ST. LOUIS.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

FOR SALE.—AMMETERS.

Old style Edison and U. S. Pattern.

$2 & $3 Each Old Material and Machinery Purchased.

WALSH'S SONS & CO. 261 Washington St. Newark, N.J.

For Sale, Automatic Engines

20x36x36 inch McIntosh & Seymour, four valve.
24x33 inch Buckeye.
22x33 inch Buckeye, style B.
20x42 inch Putman, four valve.
20x20 inch Green, center crank.
17½x18 inch Buckeye.
17x30 inch Buckeye, style B.
16x20 inch Jackson & Church.
16x16 inch Green, center crank.
15½x15 inch Armington & Sims, center crank.
15x14 inch Ideal, center crank.
13½x18½x15 inch A. & S., cross compound.
13x18¼x15 inch Phoenix, tandem compound.
14½x15 inch Armington & Sims, automatic.
14x36 inch Rollins, four valve.

Send for complete monthly stock list.

WICKES BROS., Saginaw, Mich.
45th St and A. V. R. R., Pittsburg, Pa.
95-97 Liberty St., New York City.
1214 Marquette Bldg., Chicago, Ill.

SECOND-HAND

Dynamos and Motors.

We invite correspondence with those wishing to buy or sell.

SCHUREMAN & HAYDEN,
140 S. Clinton St., Chicago.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE.

Alternators 125-133 cycles, 1,100 volts.
1—400 K. W. Westinghouse, with exciter.
1—200 K. W. Stanley inductor, with exciter.
2—200 K. W. Wood (3 bearings), with exciter.
1—150 K. W. Slattery (3 bearings). Big bargain.
2—150 K. W. General Electric monocyclic.
2—120 K. W. Westinghouse.
1—120 K. W. General Electric type A. S. 120.
12—120 K. W. General Electric type A. 120.
2— 90 K. W. General Electric type A. S. 90.
1 - 90 K. W. Westinghouse.
4— 75 K. W. Wood.
6— 60 K. W. General Electric A. 60.
2— 60 K. W. Westinghouse.

Large stock of direct-current machines.

Send for monthly bargain sheet with complete list and net prices of machines. All apparatus fully guaranteed.

IT'S UP TO YOU.

We pay highest market prices for

SCRAP COPPER, BRASS AND PLATINUM, ALSO Incandescent Lamp Bases, Etc.

WRITE US.

We Manufacture Copper Hard Babbitt

the best on earth for electrical work. Wire Solder, Pig Lead, Ingot Copper, Spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING AND REFINING CO., CHICAGO.

Wanted Central Station Managers

And Users of Machinery

TO CORRESPOND WITH US.

We have an exceptionally good proposition for those desiring to exchange their equipment for something larger more improved or more modern.

We have the following Quick Shipment Bargains:—
1—20x18½ Harrisburg Ideal Engine.
1—16x16 Erie Ball Engine.
1—15x15 " " "
1—13x12 " City "
1—150 H. P. McIntosh & Seymour Engine.
400 K. W. in T. H. and G. E. Transformers.

We also have a full line of Central Station Apparatus, Power Generators, Boilers, Engines and Pumps

A. G. SCHONMAKER CO.,
126 Liberty St., New York City, U. S. A.

60-K. W. EDISON, 500-VOLT.

For Sale, four 60-K. W. Edison Generators, 500 Volts, F. O. B. Cars, Hamilton, Ohio. Each $450

ROSE ELECTRIC CO., ST. LOUIS.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.

$3.00 per year, in advance

Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

The Best of Everything

THE NORTH-WESTERN LINE

THE through train service of the Chicago & North-Western Railway from Chicago to Omaha, Denver and the Pacific Coast on the west, the Black Hills and Dakotas to the northwest and to Milwaukee, Madison, St. Paul, Minneapolis and Duluth on the north, is as nearly perfect as modern and skillful management can make it.

The Overland Limited, a magnificent electric-lighted train, less than three days Chicago to San Francisco, daily.

The Colorado Special, only two nights to Denver from the Atlantic seaboard. Solid train Chicago to Denver.

The North-Western Limited, an electric lighted daily train between Chicago, St. Paul and Minneapolis.

H. R. McCULLOUGH, 3d Vice-President. W. B. KNISKERN, Gen'l Pass'r and Tkt. Agt. CHICAGO, ILL.

ENGINES.

3-18x30x16 Westinghouse.
2-15x24x18 Armington & Sims
2-15x23x17 Mc I. & Seymour.
1-16x27x16 Westinghouse.
2-13x22x13 Westinghouse.
2-11x19x11 Westinghouse.
1-8x14½x10½ Mc I. & Seymour
1-15x15 Erie Ball.
2-13x12 Armington & Sims.
1-11x16 Straightline.
1-9x9 New York Safety.
3-7½x7 Westinghouse.

BOILERS.

4-375 H. P. National watertube, 150 lbs. pressure.
3-276 Abendroth & Root, 150 lbs. pressure.
1-100 H. P. Babcock & Wilcox, watertube, 150 lbs. pressure.
1-80 H. P. Heine watertube, 150 lbs. pressure.
2-66x15 Phoenix Iron Works, H. T., 100 lbs. pressure.
2-48x14 Bigelow Iron Works, H. T., 100 lbs. pressure.

DIRECT CONNECTED SETS.

1-100 K. W. G. E. 250 volts, d. c. McIntosh & Seymour.
1-80 K. W. Jenny, 115 volts, d. c. Russell 4-valve engine.
2-75 K.W. G. E. 110 volts, d. c. Ames tandem engines.
1-50 K. W. Western Electric 110 volts, d. c. Ball & Wood engine
1-50 K. W. Walker 110 volts d. c. Russell engine (new).
1-43 K. W. Westinghouse 110 volts, d. c. Russell engine.
1-30 K. W. C. & C. 110 volts, d. c. Atlas engine.
1-5 K. W. Perritt 110 volts, d. c. double Sturtevant engine.
1 4 K. W. Northern Electric, 110 volts, d.c., vert. eng. (new)
1-3 K. W. Northern Electric 110 volts, d. c. vertical eng. (new)

RY. GENERATORS.

2-500 K. W. Gen'l E., M. P.
2-150 K. W. Westinghouse M. P.
1-120 K. W. C. & C. M. P.
2-100 K. W. C. & C. M. P.

ALTERNATORS.

1-150 K. W. Stanley, 2 phase, 125 cycle.
2-120 K. W. Westinghouse, s. phase, 125 cycle.
2-75 K. W. Fort Wayne, s. phase, 125 cycle.
1-60 K. W. Stanley, 2 phase, 50 cycle.
2-60 K. W. Stanley 2 p. 125 c.
4-60 K. W. G. E., s. p. 125 c.
1-35 K. W. Westinghouse, 60 cycle.
110 and 220 and 500 volt Motors. Dynamos, Arc Lamps, Transformers.

THOMPSON, SON & CO., 114, 116, 118 Liberty Street, NEW YORK.

THE BEST **VERMONT SLATE** FOR Electrical Purposes.

It Pays to Get the Best from

EDWARD BONVILLE

P. O. Lock Box 24, FAIR HAVEN, VERMONT.

Manufacturer of all kinds of **Slates for Electrical Purposes**

All Sizes of Slate Switchboards.

Best Black Enameled and Marbleized Finishes in Vermont.

ENGINES.

34x60 International Power Corliss.
26x48 Dickson Corliss.
22x42 Hamilton Corliss.
20x48 Wheelock Corliss.
20x48 Harris Corliss.
18x42 Hamilton Corliss.
12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Atlas Heavy Duty Automatic.
13x18 Frost Center Crank Automatic.
11½x 14 Taylor-Beck Automatic.
32-in., 24-in., 22-in. Double Leather Belts.

BOILERS.

Ten 72x18 Horizontal Tubular, 125 pounds pressure.
One Geary Water Tube Boiler. 175 H. P. for 150 pounds pressure, almost new.
Two 150 Babcock & Wilcox Water Tube Boilers. 135 pounds pressure.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 6x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
200 H. P. Baragwanath Heater.
150 H. P. Kroeschell Heater.
500 H. P. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps, Full line Marsh Pumps, new.

WHITEHEAD MACHINERY COMPANY, DAVENPORT, IA.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE.

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

60-CYCLE ALTERNATORS.

150 K. W. Fort Wayne wood alternator, either 1,100 or 2,200 volts. W. A. L. type, compound wound, complete with exciter and instruments.
2—150 K. W. three-phase Stanley alternators, 2,750 or 5,500 volts.
2—200 K. W. two-phase Stanley alternators, 2,750 or 5,500 volts.
1—120 K. W. General Electric. A. S. type 1,100 or 2,200 volts, December delivery.
2—120 K. W. General Electric, 133-cycle, 1,100-volt, alternators.
1—175 K. W. Edison, bi-polar, railway generators.
3—100 K. W. Edison, bi polar, 140-volt generators.
1—45 K. W. Edison, bi-polar, 140-volt generator.
1 -30 K. W. Westinghouse, 110-volt, direct connected unit with engine.
1—72x16 tubular boiler, 100 pounds, Hartford.

CORLISS ENGINES.

500 H. P. Corliss Engine, 16 and 30x48 Cross compound condensing Cooper-Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37-inch face. As good as new. Immediate delivery.

375 H. P. 16x42 twin Cooper condensing Corliss, with Cooper condenser.
High speed automatics, from 250 H. P. down.
Write us for stock list of station equipments and accessories.

STATION EQUIPMENT COMPANY, 204 Dearborn Street, CHICAGO.

110-VOLT GENERATORS.

2—1,100-light, 65 K. W. Jenny.
2—1.100-light, 60 K. W. Thompson-Ryan, 10 pole.
1—1,000-light, 60 K. W. Siemen & Halske.
1—1,000-light, 50 K. W., T. & H.

133-CYCLE ALTERNATORS.

1—120 K. W. Slattery, 1,100 volt.
1—100 K. W. Slattery, 1,100 volt.
1—100 K. W. Westinghouse, 1,100 volt.
1—70 K. W., T. & H., 1.100 volt.
1—60 K. W. General Electric, 1,100 volt.
1—50 K. W., T. & H., 1,100 volt.

ILLINOIS MAINTENANCE COMPANY, 1625 Marquette Bldg. CHICAGO.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of all Kinds. Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

WE BUY OR SELL

Generators and Motors — Engines and Boilers

Recognized a great factor in electrical problems for twenty years.

ARMATURE FIELDS REWOUND.
We make a specialty of Drop Forged Commutator Segments.

FOR SALE.

GENERATORS—500 Volts.

6—Edison, No. 20, 60 K. W., each.....$ 400
6—T. H. D—62, each..... 500
6—Edison, No. 60, 175 K. W..... 1,200
1—General Electric, 100 K. W., 6 pole... 1,400
2—General Electric, 100 K. W., 4 pole... 1,200
1—Westinghouse, 175 K. W..... 2,000
1—General Electric, 250 K. W..... 2,250
4—T. H., 270 K. W., arranged to be driven with a single pulley clutch coupling on either side of pulley, per pair..... 5,000
2—T. H., 500 K. W., each..... 4,550
1—35 K. W. Westinghouse, with exciter and switchboard instruments, 1,100 volts..... 300
1—60 K. W. Westinghouse, without exciter and switchboard instruments, 1,100 volts..... 300
2—100 K. W. G. E. mono-cyclic, with exciter and switchboards complete, 1,100 volts, each..... 1,200
2—180 K. W. Stanley, 1,100 and 2,200 volts, with exciter and switchboard instruments, each..... 1,500

GENERATOR—220 Volts.

1—200 K. W. Triumph, 6 pole (new).....$2,400

GENERATOR—110 Volts.

2—210 K. W., G. E. design, 14 pole, for direct connection, speed, 120 R. P. M., each..... $2,250

ARC LIGHT GENERATORS.

10—No. 10, 100-light, 9.6 amperes, Brush Arc Dynamos with oil regulators, practically new, each.....$ 900
1—750 K. W. Westinghouse 60-cycle, 2-phase, 2,200 volt generator, belted to one 24 and 48x60 cross-compound condensing Cooper Corliss engine, complete.....25,000

MOTORS.

200—New 25 H. P. motors, complete with pinion gear and gear cases, each..... $250

CONTROLLERS.

100—"K" Controllers, each..... $60
25—K-2 Controllers, each..... 70

ENGINES.

1—Tandem Compound Ball, 8 and 13x12..$ 800
2—Tandem Compound Ball, 9 and 16x12 each.....$1,000
4—Russell Automatic, 15x20, each..... 700
2—Porter-Allen, 16x20, each..... 1,000
1—11 and 17x14 Cross-Compound Ideal.. 1,400
2—21x18 Armington & Sims, each..... 1,500
1—Porter-Allen, 21x36..... 1,500
1—Porter-Allen, 28x42..... 4,000
1—Hamilton-Corliss, 14x42..... 1,500
1—St. Louis Corliss, 30x54..... 5,000
1—Pennsylvania Iron Works Corliss, 28x60..... 4,500
2—Lane & Bodley, 24x60, designed for Rolling Mill work, for the pair..... 8,500
1—20x48 Wheelock..... 2,250
1—Double Wheelock, 20x48..... 4,000
1—Wheelock, 20x42..... 2,000
2—Armington & Sims, 13x12..... 400
1—Taylor-Beck, 12x14..... 300
4—Houston, Stanwood & Gamble, Cross-Compound, 16 and 22x22..... 1,250
6—Cooper Cross-Compound, Non-Condensing, 36 and 60x60, new, never having been shipped from factory..23,000
5—Tandem Compound Ball, 12 and 20x16 1,500
3—Skinner engines, 17x18, with air compressing cylinders attached, each... 750

BOILERS.

4—72 inches x 16 feet tubular boilers, with 72 4-inch tubes, each.....$ 450
4—66 inches x 18 feet, with 66 4-inch tubes, each..... 450
3—66 inches x 14 feet, with 66 4-inch tubes..... 350
10—72 inches x 18 feet, with 66 4-inch tubes, each..... 450
2—Sterling water tubes, each 350 H. P., per H. P..... 5
2—Hazelton 500 H. P., per H. P..... 1
2—Clark, 150 H. P. water tube boilers, per H. P..... 6

TRANSFORMERS.

72 K. W. assorted sizes, type G, per light. 30c.

FERRIS WHEEL.

1—60-ft. Ferris wheel electrically driven, $1,000

SHOOT THE CHUTE.

1—Shoot the Chute, steel construction, 60 feet high and 300 feet long, complete with boats.....$5,000

WORK CAR.

Length over all 40 ft; length inside cab, 29 ft.; height over all, 12 ft. 2 in.; height of body, 8 ft. 10 in.; width of body inside, 7 ft. 6 in.; width of body outside, 9 ft.; width of large side door, 5 ft.; height of large side door, 5 ft. 8 in.; length wheel base, bolster to bolster, 21 ft.; trucks, latest type Jackson & Sharpe M. C. B.; axle, 4½ in.; wheels, 33 in., 2¾ in. th ead, ⅞ in. flange. Equipment, 4 Westinghouse No. 38 B geared to 35 miles per hour; two trolleys, double end control; Christensen air brake, double end. Gauge, standard 4 ft 8½ in. Motors inside hung. Car equipped with M. C. B. couplers for hauling standard freight cars. Car complete in every respect and as good as new; has been in use about four months hauling gravel only and embodies every modern improvement known. Price $6,000 f. o. b., Cincinnati.

JOHN A. STEWART ELECTRIC CO.

Offices: 430 Sycamore St. Factory and Warehouse: LUDLOW, KY.

CINCINNATI, OHIO.

BOOKS

Make your friend or yourself a Christmas present of an electrical book chosen from the following list which we recommend:

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Trevert's Electrical Measurements for Amateurs, cloth binding	1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Construction, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

Any of the above books sent prepaid on receipt of price. Write for free book catalogue.

ELECTRICIAN PUBLISHING CO.,

SUITE 510, MARQUETTE BLDG.,

CHICAGO.

EDWARDS AND CO

The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.

All springs made of Phosphor Bronze and so formed that there is least possible strain.

Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.

Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.

The hammer entirely concealed by gong and cannot be tampered with.

It is especially adapted for use on street cars, as, in addition to the advantages mentioned, it is dust, insect and moisture proof.

NEW YORK, N.Y.

The Pioneer Limited.

Famous Train of the World.

Chicago—St. Paul—Minneapolis

VIA

THE ST. PAUL ROAD.

(Chicago, Milwaukee & St. Paul Ry.)

Equipment and Service Unequaled.

Time tables, maps and information furnished on application to

F. A. MILLER, General Passenger Agent, Chicago, Ill.

....BINDERS....

FOR THE

Western Electrician

$1.00 EACH.

ELECTRICIAN PUB. CO.,

CHICAGO.

Copyright, 1902 by C. & A. R'y.

ART CALENDAR

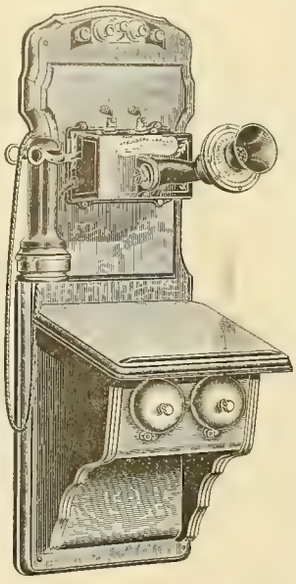
Four graceful poses from life; figures ten inches high, reproduced in colors. Highest example of lithographic art.

"THE ONLY WAY"

to own one of these beautiful calendars is to send twenty-five cents, with name of publication in which you read this advertisement, to GEO. J. CHARLTON, General Passenger Agent, Chicago & Alton Railway, 328 Monadnock Building, CHICAGO, ILL.

The best railway line between CHICAGO, ST. LOUIS, KANSAS CITY and PEORIA.

Stromberg-Carlson Telephones



embody superior points in design and construction. The prospective buyer will do well to remember the facts regarding same. The Stromberg-Carlson Telephone Mfg. Co. is the only manufacturer who has succeeded in keeping the same type of transmitter on the market for the past seven years, and their sales are to-day greater than nearly all the other makes combined. There is a reason for it. A trial will convince you why. Our guarantee is unquestionable.

Write us for prices and further information.

STROMBERG-CARLSON TELEPHONE MFG. CO.

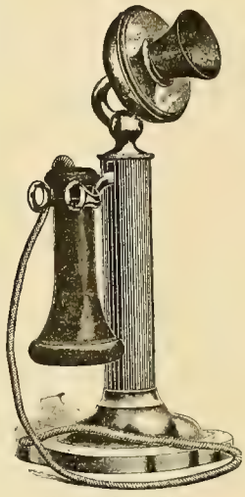
74 JACKSON BOULEVARD,

CHICAGO, ILLINOIS.

A DEFINITION

Sterling—Genuine; pure; of excellent quality.

WEBSTER.



No. 19. Desk Phone.

When you buy Silverware, you look for the "STERLING" mark.

Be equally wise in purchasing anything in the line of TELEPHONE APPARATUS and see that it has

"THE STERLING ELECTRIC COMPANY MARK"

STERLING ELECTRIC CO.,

LAFAYETTE, IND.

LEICH FOUR-PARTY LINE SELECTIVE SIGNALING SYSTEM

CONDENSERS TO STOP THE BATTERY FLOW.
NO SPRINGS OR RELAYS TO GET OUT OF ORDER.

METROPOLITAN TELEPHONE & ELECTRIC CO.,

610 WILSON AVE., CHICAGO, ILL.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H. Hyde and J. A. McManman, edited by Prof. C. H. Haskins.

EIGHTH EDITION. 48 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

KOKOMO TELEPHONES

Always Up-to-Date.

WE MANUFACTURE

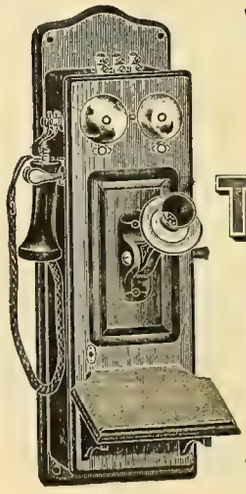
SWITCHBOARDS, TELEPHONES

AND EVERYTHING FOR COMPLETE EXCHANGE.

Write for Catalog and Prices.

KOKOMO TELEPHONE AND ELECTRIC MFG. CO.,

KOKOMO, IND.



WE ALSO MAKE

FIRST-CLASS

BRIDGING AND SERIES

TELEPHONES

COMBINING

QUALITY AND SIMPLICITY.

WRITE US AND WE WILL TELL YOU ALL ABOUT IT.

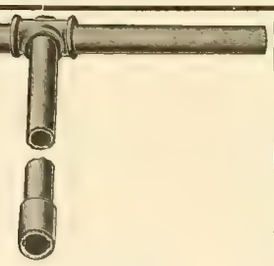
THE U. S. ELECTRIC MFG. CO., - Butler, Pa.

STOMBAUCH GUY ANCHORS HCUABMOTS GUY

The holding power of the 5 and 6 inch anchors when placed 4 feet in ground is as follows:

6-inch-9,600 lbs.
5-inch-8,000 lbs.
These weights were found for sandy soil.

3½, 5 and 6 inch.



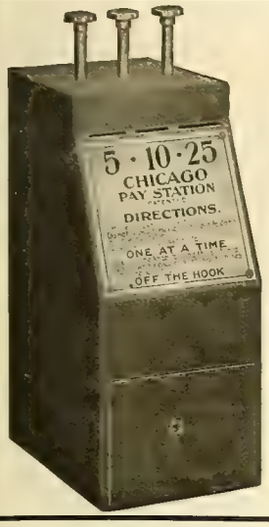
THIS IS THE WRENCH
that must be used to install the
3½, 5 and 6 inch anchors.

W. N. MATTHEWS & BRO.,
DISTRIBUTERS,
603 Carleton Bldg., - - ST. LOUIS.

The holding power of the 8, 10 and 12 in. anchors when placed 5 ft. in ground is as follows:

12-inch-30,000 lbs.
10-inch-25,000 lbs.
8-inch-20,000 lbs.

8, 10 and 12 inch.



Where are you going my pretty maid?
Going to use a **CHICAGO PAY STATION**
Sir, she said.

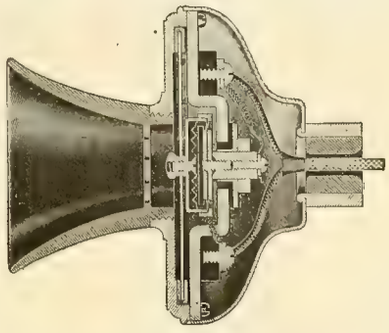
WHY? Telephone managers have discovered a source of revenue and the public (like the "pretty maid") enjoys patronizing an

UP-TO-DATE SERVICE.

Write for Full Particulars TO-DAY.

Chicago Pay Station Co.,
130 La Salle Ave., Chicago, Ill.

INTERNATIONAL TRANSMITTER



PATENT ALLOWED.

STANDS UNEQUALLED IN
Workmanship, Efficiency and Durability.

It is Clear, Distinct and Powerful.

IMPOSSIBLE
to become packed or deadened.

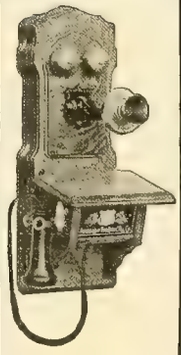
We manufacture a full line of public exchange central energy and generator call Telephones and multiple and trunking switchboards. Correspondence solicited.

INTERNATIONAL TELEPHONE MFG. CO.,
HARRISON AND CLINTON STREETS, - - - CHICAGO, U. S. A.

Talk With Us About Magneto Telephones

If you need Telephones and want the MAGNETO, the very best thing you can do is to consult with us. And then our common Battery Telephones—but they are famous the world over. Whatever you want in telephones, if it is the best you are looking for, write us. Every movable contact in the Kellogg Telephone is pure platinum.

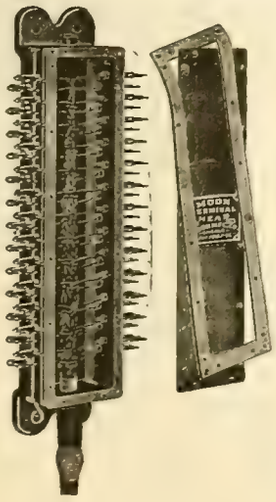
Kellogg Switchboard and Supply Company
Green and Congress Sts., CHICAGO.
NEW YORK. CLEVELAND. PHILADELPHIA.



LET US SEND OUR CATALOGUE AND TALK PRICES

It requires Capital, Electrical Knowledge and Good Mechanics, as well as Patience, to make a SUCCESSFUL TELEPHONE.

AMERICAN
CENTRAL ENERGY **TELEPHONES** GENERATOR CALL
ARE A SUCCESS
AMERICAN ELECTRIC TELEPHONE CO.
39 JACKSON BLVD., CHICAGO



THE MOON TERMINAL HEAD FOR TELEPHONE CABLES,

AFFORDS COMPLETE PROTECTION.

THIS STATEMENT IS SUSTAINED BY ITS RECORD.

250,000 Line Wires Protected. No Recorded Loss From Moisture or High Potential Currents.

We desire to figure with you on the Cable Protection you will require. The reputation of this apparatus should secure your careful consideration. We furnish the Moon Fuse Pole Terminal with fuses and Metal Outer Case or Storm Box complete; or Terminals either with or without Fuse protection, as required, for the Exchange end of the Cable. They are simple in construction, easy to install and most economical to maintain.
We are pleased to answer any questions regarding this equipment, and to furnish you with catalogue and price list.

MOON MFG. CO., 43-49 SO. CANAL STREET, CHICAGO.

POWER INCREASED

AND BOILERS PROTECTED
BY USING
Dearborn Vegetable Boiler Compounds.
MADE TO SUIT THE WATER AS PER ANALYSIS.

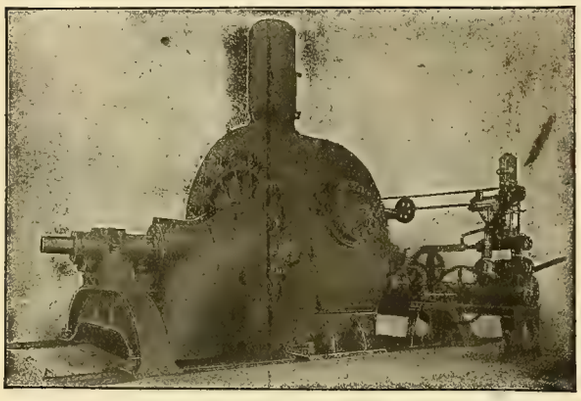
DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

M. KLEIN & SON.
LINE BUILDERS' TOOLS.
Our Tool Book tells about them. It is of interest to all linemen. Get a copy now, FREE.
Headquarters for Linemen's Tools.
MATHIAS KLEIN & SONS, 87-89 W. Van Buren St., CHICAGO, ILL.

CARBONS and lamp filaments baked in Dixon's No. 1365 Graphite do not lose their carbon. Furnished in any degree of fineness. Ask for booklet 125.
JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

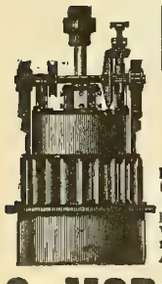
Send list of requirements for quotations to
W. H. ANDERSON & SONS,
ST. AUBIN AVE., DETROIT,
Manufacturers Tools and Iron Work for Telephone and Railway Construction.
IT'LL PAY YOU WELL.

GARRIGUS MECHANICAL BOILER CLEANER
THE ONLY KNOWN METHOD OF KEEPING BOILERS CLEAN AND FREE OF SCALE.
INSTALLED OUR EXPENSE ON 60 DAYS TRIAL
MECHANICAL BOILER CLEANER CO.
W. R. MASON MANAGER 413 WESTERN UNION BUILDING. CHICAGO.



SAMSON TURBINE
UNEXCELLED FOR DRIVING
ELECTRICAL MACHINERY.
Special Features:
HIGH SPEED, STEADY MOTION, HIGH EFFICIENCY AT ALL GATEAGES, GREAT POWER and STRENGTH.
We build these Turbines in all Sizes and Styles, on Upright or Horizontal Shafts, single or in pairs, belted or direct connected.
WRITE DEPT. "D" FOR CATALOG.
JAMES LEFFEL & CO.,
SPRINGFIELD, O., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.
THOROUGH INSPECTIONS
AND
Insurance against Loss or Damage to Property and Loss of Life and Injury to Persons caused by
STEAM BOILER EXPLOSIONS.
J. M. ALLEN, President,
WM. B. FRANKLIN, Vice-President,
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary,
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Asst. Secretary.



M'CORMICK TURBINE.
On Vertical or Horizontal Shaft.
Especially Adapted for Electrical Work.
Gives a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.
Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.
S. MORGAN SMITH CO., York, Pa.

NEW CATALOGUE ELEVATING = CONVEYING MACHINERY
NOW READY SEND FOR COPY
THE JEFFREY MFG. CO. COLUMBUS, O. U.S.A.

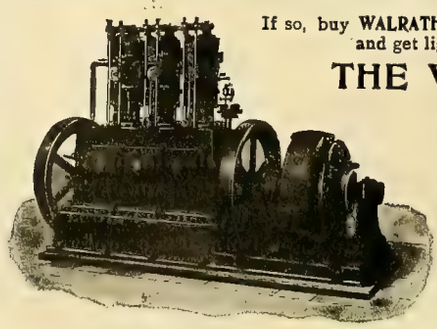
A LONG-FELT WANT.
THE HANDY ELECTRICAL DICTIONARY
BY W. L. WEBER, M. E.
225 PAGES, SIZE 2½ x 6 INCHES.
Price: { Cloth Binding, - - - - 25c.
Flexible Leather Binding, 50c.
This is a practical book in a convenient vest pocket size; alike suitable for workman, student or anyone employed or interested in the electrical science. It contains clear, concise definitions of every used electrical term or phrase and is sold at a price within the reach of all.
Promptly Mailed on Receipt of Price.
ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
The only complete and practical work of its kind on the market.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago

TO THE GREAT NORTHWEST
The Wisconsin Central Ry. will take you there in proper shape. Daily trains at convenient hours leave Chicago from Central Station, 12th St. and Park Row (Lake Front), for St. Paul, Minneapolis, Ashland, Duluth and the Northwest. Pullman Sleepers are attached, and meals in dining cars are served a la carte. Nearest ticket agent can give you further information.
JAS. C. POND,
Gen'l Pass. Agent,
Milwaukee, Wis.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE. PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

ARE YOU LOOKING FOR MONEY?
If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct connected generator. Simple, Economical and Reliable. Send for Catalogue W.
MARINETTE IRON WORKS MFG. CO.,
MARINETTE, WIS.
AGENCIES—
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
Mackay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

CEDAR POLES

LINDSLEY BROTHERS COMPANY, WHOLESALE PRODUCERS 536 TRIBUNE BLDG. CHICAGO.

PORTLAND, OREGON & SPOKANE, WASH. 50-FOOT TO 80 FOOT POLES OUR SPECIALTY. MAIN YARDS, MENOMINEE, MICH.

STILL HARPING ON PRICES.

MALTBY LUMBER CO., Bay City, Mich.

"THE POLE AND TIE MEN"

CEDAR AND CHESTNUT POLES

Cedar Ties, Posts, Shingles, Etc.

Get Our Prices Before You Buy Elsewhere.

THE MORSE CEDAR COMPANY - Saginaw, Mich.

Cedar Poles.

Pittsburg and Lake Superior Iron Co.

Producers and Wholesalers. Escanaba, Mich.

BUY YOUR POLES FROM FIRST HANDS—THE PRODUCER.

D. M. FULMER LUMBER CO., Florence, Wis.

WHITE CEDAR POLES. HALL L. BROOKS, TOMAHAWK, WIS.

Prompt Shipments from Large Stock.

EMPTY SHELLS.

Compared with Juniper Poles, the Northern Cedar Poles are Empty Shells.

Better Investigate. Write for More Information.

THE STANDARD POLE & TIE COMPANY,

44 Broad Street, New York City.

WILMINGTON, N. C. BROOKSVILLE, FLA.

CEDAR POLES STREET RY. TIES PERRIZO-SOWS DAGGETT MICH.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.

Eleven Pole Yards in Michigan.

Wholesale Producers for 20 years.

John H. Fowler Cedar Poles Posts Shingles & Ties Fisher Bldg. Chicago

IDAHO, WISCONSIN, MICHIGAN . . . . . CEDAR POLES FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT, TROLLEY.

POSTS, POLES, TIES AND EVERYTHING IN WHITE CEDAR

YARDS IN IDAHO AND AT WASHBURN, PLUMMER AND BRULE, WISCONSIN.

JOHN. H. FOWLER GENERAL OFFICE: 1705 FISHER BLDG., CHICAGO. Branch Offices: Washburn, Wisconsin, and Spokane, Washington. FOWLER-JACOBS CO.

Fowler-Jacobs Ties Posts Poles Piling Company

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

C. J. HUEBEL CO.

Producers and Wholesalers of

White Cedar Poles

Main Yard and Office at MENOMINEE, MICH.

Branch Yards—Nathan, Mich.; Stager, Mich., and Pembine, Wis.

We have a good assortment of Poles on hand, and can execute orders promptly. Write us for Prices.

CEDAR POLES OF ALL LENGTHS AND SIZES . . . .

SPECIAL PRICES UPON APPLICATION.

PROMPT SHIPMENT A SPECIALTY.

A. E. WHITMORE, 230-31-32 Lumber Exchange, Minneapolis, Minn.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand

WESTERN CEDAR POLES—Low Prices.

Stocks: Idaho—Montana. Address B. F. VREELAND, Denver, Colo. (Main Office.)

CEDAR POLES

IT WILL PAY YOU

To get our Prices on 25-foot 6's by return mail. We can Save You Money on other Lengths as well.

KELLOGG SWITCHBOARD AND SUPPLY CO., 229 So. GREEN ST., CHICAGO, ILL.

BRANCH OFFICES: Keystone Telephone Building, Philadelphia, Pa. Electric Building, Cleveland, Ohio. 346 Broadway, New York.

CEDAR POLES.

From 16 Feet to 70 Feet.

SPECIAL PRICES ON SMALL POLES.

C. H. WORCESTER CO.,

MARINETTE, WIS.

Producers and Wholesalers of White Cedar Products.

Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES

THE VALENTINE-CLARK CO.,

— 234 LA SALLE ST, CHICAGO.

YARDS: PINCONNING, MICH. — GREEN BAY, WIS. — NEW LONDON, WIS.

Nernst Lamps

Operative on all Alternating Current Circuits

This illustration was reproduced from a photograph of a Men's Furnishing Goods Store, taken while illuminated by two 6-Glower Nernst Lamps

The Light is the same as Daylight
It shows the True Color of Fabrics
Cost 50 per cent less to operate than Incandescents

Ask your nearest supply dealer, or write for illustrated booklet No. 6.

Nernst Lamp Co.

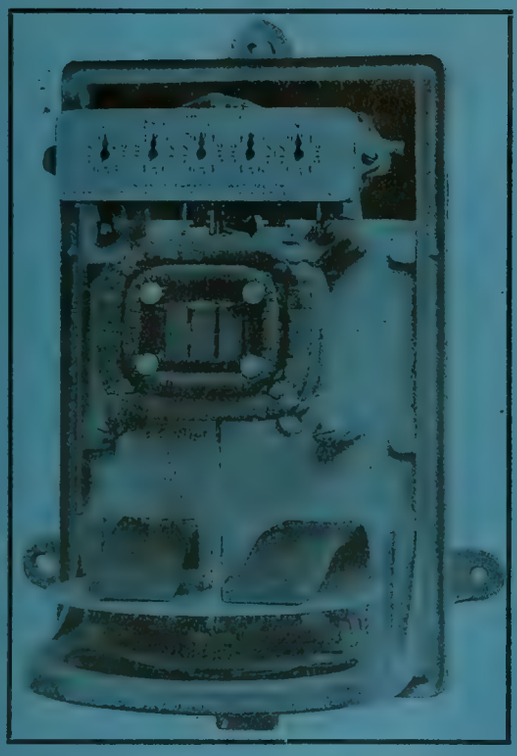
General Offices: Pittsburgh, Pa.

SALES OFFICES: New York, 120 Broadway; Boston, 131 State St.; Philadelphia, 710 Girard Trust Bldg.

DUNCAN
Integrating Wattmeter

FOR DIRECT AND ALTERNATING CURRENTS.

BUILT STRICTLY IN ACCORDANCE WITH PRESENT DAY REQUIREMENTS.



JUST THE METER
FOR
DIRECT CURRENT LIGHTING
AND
POWER CIRCUITS

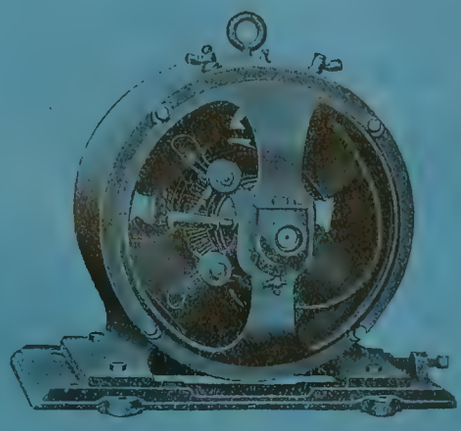
WRITE FOR PRICES

DUNCAN ELECTRIC MFG. CO.
MANUFACTURERS OF ELECTRICITY METERS
LAFAYETTE, IND.

AGENTS:
Goltz Engineering Co., 1504 Monadnock Bldg., Chicago.
C. H. Norwood, 1503 Fisher Bldg., Chicago.
Safety Electric Mfg. Co., 303 Magazine St., New Orleans.

Direct Current Motors

TYPE E



For all purposes where direct current is available these motors may be used. They are invertible and enclosible, reliable and economical. Standard in 1 to 30 H. P. sizes, at 115, 230 and 500 volts, any speed.

SEND FOR BULLETIN 1036.

Fort Wayne Electric Works

Main Office and Factory,
FORT WAYNE, - IND.

112

...Stamp

...single ...exhibition ...number of pat... ...search for mak... ...inventions per... ...and design worked ...Send for ...

...WELL & WEED,
...Street, New York

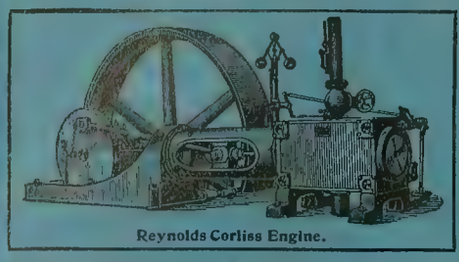
PROTECTION.

A GOOD INVESTMENT.

A Lamp Guard firmly fastened to socket protects completely.

THE P. R. WAGOR MFG. CO.,
SPRINGFIELD, MASS.

ALLIS-CHALMERS CO.,
CHICAGO, U. S. A.



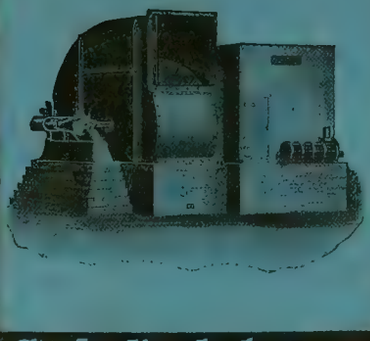
Reynolds Corliss Engine.

Sole Builders of
REYNOLDS CORLISS ENGINES
For All Power Purposes

SPECIAL ENGINES FOR ELECTRIC LIGHT and STREET RAILWAY PURPOSES.
RIEDLER PUMPS AND AIR COMPRESSORS.

CHARLES H. BESLY & CO.
FINE TOOLS & SUPPLIES FOR METAL WORKERS
10 & 12 N. CANAL ST.
CHICAGO ILL. U.S.A.
SEND FOR 300 PAGE ILL CATALOGUE

STURTEVANT SYSTEM OF HEATING & VENTILATION



Centralized plant.
No scattered steam piping.
Utilizes exhaust steam.
Send for Catalogue No. 84

B. F. STURTEVANT CO. BOSTON,
NEW YORK · PHILADELPHIA · CHICAGO · LONDON ·

HAZARD MANUFACTURING CO.
HIGH-GRADE RUBBER-COVERED, WEATHERPROOF WIRES AND CABLES
MAGNET, OFFICE, ANNUNCIATOR WIRE.
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 1201-2 Marquette Bldg.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

BARE COPPER WIRE.
RUBBER COVERED WIRE.
WEATHERPROOF WIRE.
MAGNET WIRE. LAMP CORD.

POWER CABLES.
TELEPHONE CABLES. OFFICE WIRE.

JOHN A. ROEBLING'S SONS CO.
NEW YORK. CHICAGO. TRENTON, N. J. CLEVELAND. SAN FRANCISCO.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Exhibitions

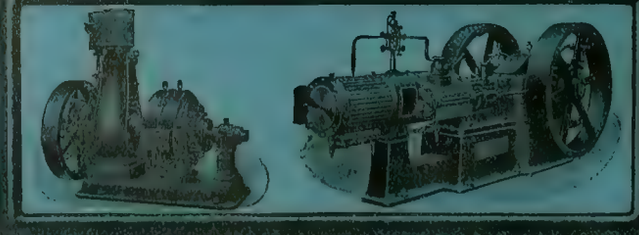
TRADE MARK.

Special Prize Gold Medal at Atlanta, 1895.

...ARE FOR SALE IN EVERY LEADING HARDWARE ... IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY
PHILADELPHIA, PA.

BUFFALO FORGE COMPANY ENGINES
FOR ELECTRIC LIGHT AND POWER SERVICE
VERTICAL HORIZONTAL
SEE NEW CATALOGUE



BUFFALO FORGE COMPANY
BUFFALO, N.Y.
CHICAGO PITTSBURG